Radiation Oncology
PET-CT Response Evaluation Following Radiation Therapy—Established and Emerging Applications

All Day Location: RO Community, Learning Center

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TEACHING POINTS
1. To understand the rationale for using PET-CT to assess treatment response in radiation oncology
2. To illustrate established applications of FDG PET-CT in assessment of efficacy of radical radiotherapy, chemo-radiotherapy and radionuclide therapy
3. To highlight emerging PET-CT applications in response assessment following radiation treatment

TABLE OF CONTENTS/OUTLINE
Outline
1. Rationale for PET-CT response assessment in radiation oncology
2. Current uses of FDG PET-CT in treatment response following radiation therapy: head and neck cancer; oesophago-gastric carcinoma; rectal carcinoma; brain tumors
3. Emerging applications of FDG PET-CT: cervical carcinoma; lung carcinoma; HPB tumours particularly pancreatic carcinoma and liver metastases (post selective internal radiotherapy treatment)
4. Potential applications of non-FDG PET-CT: neuro-oncology; prostatic malignancy; neuroendocrine malignancy
5. Limitations of PET-CT

The major teaching points are:

a) Radiation therapy is associated with a significant risk of disease recurrence.
b) PET-CT provides accurate non-invasive surrogate biomarkers of tumor response to therapy.
c) FDG PET-CT has a role in treatment response assessment following radiotherapy in a variety of tumor types and can help guide patient management.
d) Novel tracers show promise in a range of applications.
Recurrent Lipoblastoma: Intensity Modulated Radiotherapy or Surgery?

Participants
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TEACHING POINTS
1. Lipoblastomas are rare benign tumors seen in infants and young children. Complete resection achieves optimal results, but recurrence is possible. 2. Recurrent growths can be treated with radiotherapy in surgically inaccessible sites/in cases which would lead to mutilating surgery.

TABLE OF CONTENTS/OUTLINE
17 year boy presented with swelling on left side face extending to peri-orbital region and proptosis with no diminution in vision. He was operated twice, in 2000 and May 2012 by wide local excision. Histopathology had reported lipoblastoma. One week after surgery the swelling recurred. Imaging MRI reported T1 hypointense/isointense/T2 hyperintense lobulated lesion involving left masseter muscle, 4.7x2.2x6.9 cm insinuating ramus of mandible and pterygoid muscles. Similar lesion was seen at infra-orbital region involving eyelids, inner and outer canthus infiltrating intraorbitally encasing eyeball, extraocular muscles and retrobulbar fat, extending to orbital apex encasing left optic nerve. It extended to temporal fossa, temporalis muscle eroding zygoma and greater wing of sphenoid measuring 7.8x3.1x4.8 cm. Treatment We treated patient with Intensity Modulated Radiotherapy, 6 coplanar beam, 24 segments to 50 Gy/25 fractions, 2 Gy/day keeping organs at risk below tolerance. Seven months post radiotherapy he was clinically stable with no diminution of vision.
**Teaching Points**

After revising this exhibit, the learner will be able to:

1. Follow a practical workflow for imaging cutaneous melanoma.
2. Identify the most suitable imaging techniques for the initial assessment of early and advanced disease of cutaneous melanoma.
3. Utilize the recommendations from the international updated guidelines to develop their own protocol for imaging cutaneous melanoma within their own institutions.

**Table of Contents/Outline**

I. Introduction
   a. American Journal Cancer Committee Staging for Cutaneous Melanoma
      i. Initial Assessment
      ii. Follow-up
II. Retrospective Study Methods and Materials
   Results
   Discussion
   Conclusions
III. Suggested Protocol for Imaging Tests in the diagnosis and follow-up of Cutaneous Melanoma
IV. Cases
Differentiation of Skull Base Lesions After Radiotherapy for Nasopharyngeal Carcinoma: A Comparative Study of MR Imaging and Pathology

Participants
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TEACHING POINTS
The main MRI features of skull base recurrence of NPC are as follows: a slightly more intense signal than muscle on T2WI, an asymmetrically homogeneous appearance, isolated bone involvement, bone destruction that originates from the exterior, and peri-space fat haziness. While a moderately intense signal on plain T1WI and obvious enhancement were visible, T2WI intensity is the key to differentiate high activity lesions from recurrences. Skull base masses with obvious high signal intensity on T2WI are suggestive of noncancerous lesions rather than recurrence. Early and accurate diagnosis of skull base lesions and differentiation of recurrence from noncancerous lesions can guide the selection of therapeutic strategies for nasopharyngeal carcinoma patients who have received radiotherapy.

TABLE OF CONTENTS/OUTLINE
Purpose; Methods; Results; Conclusions.
Fundamental Study of Beam Attenuation Correction Due to the 6-axis Corresponding Carbon Fiber Couchtop (CFC) for Linac

All Day Location: RO Community, Learning Center

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TEACHING POINTS
The purpose of this exhibit is: 1. Evaluation of beam attenuation for each gantry angle. 2. Evaluation of the consistency of the measured value and calculated value in treatment planning system (TPS). 3. Carrying out the optimization of the electron density of the CFC.

TABLE OF CONTENTS/OUTLINE
Difference of dose distribution due to the presence or absence of CFC. Beam attenuation of each gantry angle. Comparison of the TPS and the measured value for absorption. Comparison between the measured value and the correction value for absorption.
Clinical study
Prostatic Carcinoma Treated with Focal Brachytherapy: Multiparametric Magnetic Resonance (MR) Imaging Evaluation

All Day Location: RO Community, Learning Center

Participants
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TEACHING POINTS
To illustrate multiparametric MR imaging effectiveness in the early evaluation of post-implant dosimetry in patients treated with Focal Brachytherapy. To report the spectrum of multiparametric MR findings of prostate gland treated with Focal Brachytherapy. To show the evolution, as time passed, of the signal intensities of prostate treated with Focal Brachytherapy.

TABLE OF CONTENTS/OUTLINE
1) Focal Brachytherapy of the prostate: technical aspects
2) Multiparametric MR imaging techniques
3) Anatomic and functional MR patterns of prostate gland after Focal Brachytherapy: a) size b) morphology c) contrast enhancement d) diffusion e) spectroscopy f) radiation therapy seeds MRI evaluation g) periprostatic changes after treatment
4) Post-implant dosimetry, performed on fused transverse T1w and T2w MR images, using dedicated image fusion software.
Prostatic Carcinoma Treated with Brachytherapy: Multiparametric Magnetic Resonance (MR) Recurrence Patterns

All Day Location: RO Community, Learning Center

Participants
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TEACHING POINTS

To report the spectrum of multiparametric MR findings of prostate gland treated with temporary and permanent Brachytherapy. To review the most frequent recurrence patterns after Brachytherapy. To evaluate the most effective MR imaging examination techniques in the evaluation of patients treated with Brachytherapy.

TABLE OF CONTENTS/OUTLINE

1) Brachytherapy of the prostate: technical aspects
2) MR imaging techniques
3) MR patterns of prostate gland after Brachytherapy
   a) size
   b) morphology
   c) contrast enhancement
   d) periprostatic changes after treatment
   e) radiation therapy seeds MRI evaluation
4) MR most frequent recurrence patterns. Morphologic MR evaluation showed reduction in size of the gland and diffuse reduction of signal intensity on T2w images due to parenchimal fibrosis and atrophy. Dynamic ce MR evaluation showed reduction of the vascularization of the gland. Radiation therapy seeds were seen as small foci of focal signal intensity void. The most important parameter in the evaluation of recurrences was the presence of nodular patterns of enhancement on dynamic MR study in the prostate parenchima. MR can be an effective imaging technique in the follow-up of prostate tumors treated with Brachytherapy, in particular in the evaluation of patients with clinical or biochemical suspect of recurrence.
Perineural Invasion in Head and Neck Malignancies: A Practical Approach to Identification, Contouring and Radiation Treatment

All Day Location: RO Community, Learning Center

Participants
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TEACHING POINTS
Perineural invasion (PNI) is not an uncommon manifestation of malignancies in the head and neck region. Identification can be challenging, requiring multi-modality imaging and detailed physical examination. For Radiation Oncologists, defining the extent of PNI and the involved nerves is of critical importance in defining treatment volumes. In addition, contouring at risk volumes on CT (for treatment planning) requires expert knowledge of skull base bony anatomy. However, there is a paucity of literature to guide Radiation Oncologists regarding this topic. The purpose of this exhibit is to 1) review cranial nerve (CN) and skull base bony anatomy in the head and neck, 2) demonstrate a practical approach to identifying and tracking/contouring CN (focusing on CN V and VII) and 3) present a case based review of cases of PNI, including CN contours and radiation treatment planning approaches for CN targets in the vicinity of the skull base.

TABLE OF CONTENTS/OUTLINE
Overview of CN pathways and skull base anatomy Practical approaches for identifying, tracking and contouring CN CN V and its branches CN VII Interconnections between CN V and CN VII 3. Case based review of PNI cases Clinical/radiological correlation Contouring/defining at risk volumes Radiation treatment planning Post-treatment imaging 4. Post quiz
Purpose/Objective(s): In this study, our purpose was to compare the difference of overall survival (OS) between squamous (SCC) and non-squamous cell (non-SCC) non-small cell lung cancer patients, with consideration of other clinical factors.

Materials/Methods: Study population included patients treated from 2002 to 2014 in our center and with data recorded in the Tumor Registry. Age, gender, race, marital status, insurance status, tumor location, clinical stage, pathology, alcohol and smoking history, and treatments were tested for their significances. All alive patients had to be followed for at least 12 months to enter this study. Kaplan-Meier analysis and Cox proportional hazards model were used to determine differences in overall survival (OS). All tests were two-sided and p = 0.05 was considered to be significant. Results: A total of 1116 consecutive patients were eligible in which SCC and non-SCC patients accounted for 31.7% and 68.3%. Patients with stage I, II, III and IV for SCC and non-SCC were 20.3%, 8.6%, 33.1%, 38.0% and 16.9%, 6.0%, 23.9%, 53.2%, respectively. In multivariate analysis, age, gender, stage, chemotherapy and surgery were significantly correlated with OS. Median OS was not significantly different between SCC and non-SCC (9.6 vs 8.5 months, HR = 0.99, 95% CI: 0.87-1.15, p = 0.992). There was no significant difference in OS between SCC and non-SCC patients stratified by age, gender and race. For stage I patients, non-SCC had longer OS than SCC patients (49.5 vs 38.1 months, p = 0.013), while no significant difference was observed in patients with stage II, III and IV. Patients treated with chemotherapy had significantly better median OS than those who didn’t receive chemotherapy: SCC (15.9 vs 6.9 months, HR = 0.63, 95% CI: 0.48-0.81, p Conclusion: No significant difference of OS were found between SCC and non-SCC patients in this study. While surgery and chemotherapy improve OS in both SCC and non-SCC groups, radiotherapy extended OS only significantly for advanced stage non-SCC patients.
Evaluation of Tumor Volume and Target Volume Definition Based on Diffusion-weighted MRI in Radiotherapy of non-Small Cell Lung Cancer

Sunday, Nov. 29 11:15AM - 11:25AM Location: S104A

Participants
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PURPOSE
The purpose of this study was to evaluate DWI of the thorax in determination of tumor volume and assessment of target volume for radiation therapy planning of non-small cell lung cancer (NSCLC) in comparison to a FDG-PET-CT based approach.

METHOD AND MATERIALS
13 pts with NSCLC and indication for primary radio-(chemo)therapy were prospectively evaluated with both MRI and PET-CT. 13 primary tumors with UICC stages I (4 pts.), II (1 pt.), IIIA (3 pts.) and IIIB (5 pts.) were evaluated. For MRI a respiratory gated T2-weighted sequence in axial orientation and non-gated DWI (b=0, 800, 1400 and ADC map) were acquired on a 1.5 T scanner (Siemens, Magnetom® Aera). FDG PET-CT was performed as part of the routine staging. Both MR and PET-CT images were coregistered on a radiation treatment planning system (Philips, Pinnacle3®). For the FDG-PET-CT data a semiautomatik contouring of the gross tumor volume (GTV) of the primary tumor based on a "source-to-background"-Algorithm was applied. For DWI and the T2w sequences a visual definition of the GTV was performed. Beside a statistical comparison of the GTV an evaluation of the target volume based on the "Hausdorff-Distance" (HD) and the "Dice Similarity Coefficient" was performed.

RESULTS
The median values (+ range) of the GTV for PET-CT and MRI (DWI and T2w imaging) did not differ significantly (PET-CT 69 ml (3 - 229 ml), DWI 71 ml (4 - 361 ml), T2w 65 ml (5 - 350 ml). The measured tumor volumes with all three techniques showed a highly significant correlation (PET/CT vs. DWI: r=0.97; PET/CT vs. T2w imaging: r=0.89; DWI vs. T2 imaging: r=0.92; p <0.0001). However in 9 out of 13 cases DWI showed a larger volume as compared with the FDG-PET data (mean difference 29.8% ± 19.5%). Comparing PET-CT and DWI a good agreement regarding the spatial target volume was found (HD: 2.5 ± 1.1 mm; DC 0.65 ± 0.08), which showed a tendency of decreased agreement with increasing tumor volumes.

CONCLUSION
FDG-PET-CT and MR based GTV definition overall shows a good agreement, especially regarding the spatial-topographic tumor localization. Tumor volumes may differ considerably in a particular case and further studies have to evaluate the added value of DWI in radiotherapy planning.

CLINICAL RELEVANCE/APPLICATION
Based on our initial findings DWI in radiation therapy planning can give important additional information and should be evaluated in larger scale studies.

The Impact of Respiratory Movement on Local Recurrence in Patients with Stage I Non-Small Cell Lung Cancer in the Treatment of Intensity Modulated SBRT

Sunday, Nov. 29 11:25AM - 11:35AM Location: S104A

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ABSTRACT
Purpose/Objective(s): Phase II study of intensity-modulated stereotactic body radiotherapy (SBRT) using compensated filter for patients with stage I NSCLC was conducted. In this study, an internal target volume (ITV) was set to compensate for respiratory uncertainty under restriction of respiratory movement. The purpose of this study was to evaluate outcomes and prognostic factors when patients with stage I NSCLC were treated using this method.
Materials/Methods: This study was approved by our facility’s ethical board. All patients provided written informed consent. Eligible criteria included the following: 1. patients who were unsuitable for surgery, 2. cytologically or histologically proven NSCLC, a tumor highly suspected of having NSCLC due to high accumulation in positron emission tomography or tumor growth rates of 25% compared to a previous image, 3. a clinical stage of T1-2N0M0 according to the 7th UICC TNM classification. To restrict the respiratory movement, the abdomen was pressed by a custom-made plastic immobilization belt. While wearing this device, a planning CT was taken during the inspiratory and expiratory phases, and the uncertainty under restriction of respiratory movement. The purpose of this study was to evaluate outcomes and prognostic factors when patients with stage I NSCLC was treated using this method.

METHOD AND MATERIALS
Forty-three patients with a total of 45 tumors at stage I NSCLC who underwent SBRT were entered into this study at Tokyo Medical University between March 2012 and March 2014. The median age of patients was 80 years (range, 49-90), and the male/female ratio was 28/15. Of the 45 tumors, 29 were T1, 16 were T2. Eighteen tumors were located in the upper lobe, 6 in the middle lobe and lingual segment, and 21 in the lower lobe. Regarding histological type, 12 tumors was identified as adenocarcinoma, 9 as squamous cell carcinoma, 8 as non-small-cell carcinoma and 16 were unidentified. During follow-up (median 15 months), actuarial local progression-free rates at 1-year and 2-years were 92.3% (95% confidence interval [CI] 78.0 to 97.5%) and 87.2% (95% CI, 67.5 to 95.3%), respectively. The actuarial local progression-free survival rate in patients with an ITV 30 ml larger than their GTV was significantly lower than those with a difference of 30 ml or less (p=0.029). Tumor histology, tumor location and minimum dose of ITV had no significant effect on local progression-free survival.
rate by univariate analysis. By multivariate analysis, an ITV minus GTV volume larger than 30 ml (hazard ratio = 11.2, p = 0.04) was a statistically significant indicator of poor local progression-free survival rates. Minimum dose of ITV and tumor location were not significant. Conclusion: A large volume of ITV minus GTV was a negative prognostic factor for local progression in SBRT, which suggested that in instance of high respiratory movement, special technique of respiratory gating or tumor-tracking may be necessary.

SSA22-06 Comparison of Dose Distributions Calculated with Different Dose Calculation Algorithms in Pulmonary Lung Lesions in Order to Analyze the Influence of Different Algorithms on the Dose Prescription

Sunday, Nov. 29 11:35AM - 11:45AM Location: S104A

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Purpose
To introduce more accurate algorithms like Monte Carlo (MC) into the clinical routine, an adjustment of the currently used EPL or PB dose prescription is required. The goal of this study was to find the dose prescription adjustment when switching from PB to MC in iPlan and from EPL to MC in MultiPlan, respectively. For that reason dose distributions calculated with the different algorithms were analyzed for patients with malignant pulmonary lung lesions with different tumor size and location.

Method and Materials
For 124 lung lesions, treated between 2010 and 2014 at the Novalis TX (Varian Medical Systems) and at the CyberKnife (Accuray), dose distributions were initially calculated with PB and retrospectively re-calculated with MC in iPlan. In the same way, dose distributions were initially calculated with EPL and retrospectively re-calculated with MC in Multiplan. We compared the PB with the MC dose distribution within iPlan as well as the EPL with the MC dose distribution within MultiPlan. The following parameter were compared: minimum dose to 99% (D99), 95% (D95) and Dmean of the different target volumes (GTV, CTV, ITV, PTV), prescription isodose volume (PIV), the heterogeneity index (HI) and Dmean as well as Dmax to the organs at risk (OARs). Based on changes in D99, D95 and mean PTV dose, the prescription dose was converted from PB to MC and from EPL to MC, respectively.

Results
So far, 64/124 lesions were evaluated (PB n=52, EPL n=12). The D99 and D95 to the PTVs were reduced when using MC in comparison to PB and EPL. Reduction was larger for peripheral tumors than for central tumors (up to 25% vs. 5%). Maximum in reduction was seen in small peripheral lesions, i.e. the PIV can be reduced up to 95% (PB volume 8.36ccm vs. MC volume 0.37ccm). Based on D95, for small peripheral lesions the PB prescription of 5x12Gy has to be reduced to 5x9.5Gy for MC. The mean and maximum dose to OARs decreased when using MC in comparison to EPL or PB.

Conclusion
Our preliminary results confirm that the dose prescription has to be adjusted when switching from PB or EPL to MC. Furthermore we found, that the adjustment is different when switching from PB to MC in iPlan in comparison to switching from EPL to MC in MultiPlan.

Clinical Relevance/Application
Future trials will show, if the more accurate dose calculation by MC might increase the probability of tumor control and/or might lower the toxicity.

SSA22-07 Dynamic Contrast-enhanced Perfusion Area-Detector CT Assessed by different Mathematical Models vs. FDG-PET/CT: Capability for Therapeutic Outcome Prediction in Non-Small Cell Lung Cancer Patients with Chemoradiotherapy

Sunday, Nov. 29 11:45AM - 11:55AM Location: S104A

Participants
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Purpose
To directly compare the capability for therapeutic outcome prediction between dynamic first-pass contrast-enhanced (CE-) perfusion area-detector CT (ADCT) assessed by different mathematical methods and FDG-PET/CT in non-small cell lung cancer (NSCLC) patients treated with chemoradiotherapy.
RESULTS
Area under the curves (Azu) of TTPDMS (Az=0.81), TPSDMS (Az=0.85) and SUVmax (Az=0.84) had significantly larger than that of TTPDMS (Az=0.69, p<0.05). On disease free interval and overall survival assessments, responders had significantly longer disease free interval and overall survival than non-responders on TPSDMS (disease free: p=0.002, overall: p=0.001), TPSMS (disease free: p=0.0004, overall: p=0.03) and DV (disease free: p=0.03, overall: p=0.04).

CONCLUSION
Dynamic first-pass CE-perfusion ADCT provide a few good predictors, and have better potential than PET/CT for therapeutic outcome prediction in NSCLC patients treated with chemoradiotherapy.

CLINICAL RELEVANCE/APPLICATION
Dynamic first-pass CE-perfusion ADCT provide a few good predictors, and have better potential than PET/CT for therapeutic outcome prediction in NSCLC patients treated with chemoradiotherapy.

A Retrospective Evaluation of Stereotactic Body Radiation Therapy for Pulmonary Oligometastases in a Multicenter Study

Participants
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ABSTRACT
Purpose/Objective(s): Oligometastases was divided into sync-oligometastases and oligo-recurrence, the difference being that the
The primary site of oligometastases was uncontrolled (sync-oligometastases) or controlled (oligo-recurrence). The purpose of this study was to evaluate treatment outcomes after stereotactic body radiotherapy (SBRT) for pulmonary oligometastases.

Materials/Methods: A total of 96 patients (65 males and 31 females) who received SBRT for pulmonary oligometastases between January 2004 and April 2014 at 4 high-volume institutions in Japan were enrolled in this retrospective study. The primary sites were the colorectum (n=25), lung (n=24), head and neck (n=8), and others (n=39). Ten cases were sync-oligometastases, 79 cases were oligo-recurrences and 7 cases were unclassified oligometastases. The median disease-free interval (DFI) between initial therapy and SBRT was 24 months (range, 0-246 months). The median prescribed BED was 105.6 Gy (range, 75-134.4 Gy). Overall survival (OS), local control rate (LCR) and relapse-free survival rate (RFS) were calculated using Kaplan-Meier curves, and the log-rank test was used to compare the curves. Multivariate analysis for RFS was performed using a Cox proportional hazards model. Statistical significance was set at p = 0.05.

Results: The median follow-up periods were 21 months (range, 1-119 months) for all patients. The 3-year OS, LCR and RFS rates were 52%, 75% and 25%, respectively. Radiation pneumonitis of grade 3 was found in 2 patients and gastrointestinal toxicity of grade 4 was found in 1 patient. No grade 5 toxicity occurred. The 3-year RFS for sync-oligometastases was 0% and that for oligo-recurrence was 28% (Figure, p = 0.001). Conclusion: In SBRT for pulmonary oligometastases, control of the primary site is a significant prognostic factor for RFS.
The Use of Radiation Therapy in Patients with Clear Cell Adenocarcinoma of the Uterus: A Study of 1,470 Women

PURPOSE
To characterize the temporal trends and survival benefits of radiation therapy (RT) in clear cell adenocarcinoma (CCC) of the uterus.

METHOD AND MATERIALS
Patients with a diagnosis of uterine CCC were selected from the SEER database from 2001 - 2011. Temporal trends and patterns were measured using Chi-square analysis. Kaplan-Meier survival analysis and multivariate Cox proportional hazards models were used to measure disease-specific survival.

RESULTS
1,470 patients with CCC were identified with a median age at diagnosis of 69 years. There was no trend in the absolute number of CCC cases per year. RT was used in 600 patients (41%), of which 296 (49%) had external beam irradiation (EBRT), 131 (22%) brachytherapy (BT), and 143 (24%) combinations of EBRT and BT (COMB). 386 patients (26%) did not undergo lymphadenectomy, while 76 (5%) had 1 to 3 regional lymph nodes (LNs) removed, and 727 (50%) had 4 or more regional LNs removed. The 5-year survival of all patients was 52% and in patients receiving EBRT, BT, and COMB rates were 51%, 72%, and 53% respectively. In multivariate Cox regression adjusted for age, stage, grade, lymphadenectomy, and race, increased survival was associated with any RT (HR 0.78, p=0.008) and in patients who had 1-2 or 4+ LNs removed (HR 0.69, p=0.027 and HR 0.49, p<0.001). Decreased survival was associated with older age (HR 1.04, p<0.001), stage III (HR 1.46, p<0.001), grade II (HR 3.44, p=0.014), grade III (HR 3.48, p=0.014), and black race (HR 1.35, p=0.008). In radiation therapy subtype analysis, BT was associated with improved survival (HR 0.57, p=0.006). Over the 10 year study period, there was no significant trend in the % of patients receiving RT, however, among patients who did receive RT, the fraction receiving BT increased significantly (p<0.001) from 12% to 32%, EBRT decreased significantly from 54% to 44% (p=0.025), and COMB decreased significantly from 28% to 16% (p=0.007).

CONCLUSION
Uterine CCC is a relatively rare malignancy with roughly 50% survival. RT use remained fairly constant from 2001-2011, but employment of BT increased relative to EBRT and COMB. BT use is associated with improved survival even after adjusting for confounders.

CLINICAL RELEVANCE/APPLICATION
This study suggests that BT is associated with improved survival in uterine CCC patients after adjusting for multiple confounders, though it is limited by lack of chemotherapy data.

Squamous Cell Carcinoma (SCC) Increases the Risk for Local Recurrence in Non-Small Cell Lung Cancer (NSCLC) Treated With Stereotactic Body Radiation Therapy (SBRT)

PURPOSE
To characterize the temporal trends and survival benefits of radiation therapy (RT) in clear cell adenocarcinoma (CCC) of the uterus.

METHOD AND MATERIALS
Patients with a diagnosis of uterine CCC were selected from the SEER database from 2001 - 2011. Temporal trends and patterns were measured using Chi-square analysis. Kaplan-Meier survival analysis and multivariate Cox proportional hazards models were used to measure disease-specific survival.

RESULTS
1,470 patients with CCC were identified with a median age at diagnosis of 69 years. There was no trend in the absolute number of CCC cases per year. RT was used in 600 patients (41%), of which 296 (49%) had external beam irradiation (EBRT), 131 (22%) brachytherapy (BT), and 143 (24%) combinations of EBRT and BT (COMB). 386 patients (26%) did not undergo lymphadenectomy, while 76 (5%) had 1 to 3 regional lymph nodes (LNs) removed, and 727 (50%) had 4 or more regional LNs removed. The 5-year survival of all patients was 52% and in patients receiving EBRT, BT, and COMB rates were 51%, 72%, and 53% respectively. In multivariate Cox regression adjusted for age, stage, grade, lymphadenectomy, and race, increased survival was associated with any RT (HR 0.78, p=0.008) and in patients who had 1-2 or 4+ LNs removed (HR 0.69, p=0.027 and HR 0.49, p<0.001). Decreased survival was associated with older age (HR 1.04, p<0.001), stage III (HR 1.46, p<0.001), grade II (HR 3.44, p=0.014), grade III (HR 3.48, p=0.014), and black race (HR 1.35, p=0.008). In radiation therapy subtype analysis, BT was associated with improved survival (HR 0.57, p=0.006). Over the 10 year study period, there was no significant trend in the % of patients receiving RT, however, among patients who did receive RT, the fraction receiving BT increased significantly (p<0.001) from 12% to 32%, EBRT decreased significantly from 54% to 44% (p=0.025), and COMB decreased significantly from 28% to 16% (p=0.007).

CONCLUSION
Uterine CCC is a relatively rare malignancy with roughly 50% survival. RT use remained fairly constant from 2001-2011, but employment of BT increased relative to EBRT and COMB. BT use is associated with improved survival even after adjusting for confounders.

CLINICAL RELEVANCE/APPLICATION
This study suggests that BT is associated with improved survival in uterine CCC patients after adjusting for multiple confounders, though it is limited by lack of chemotherapy data.

Squamous Cell Carcinoma (SCC) Increases the Risk for Local Recurrence in Non-Small Cell Lung Cancer (NSCLC) Treated With Stereotactic Body Radiation Therapy (SBRT)

PURPOSE
To characterize the temporal trends and survival benefits of radiation therapy (RT) in clear cell adenocarcinoma (CCC) of the uterus.

METHOD AND MATERIALS
Patients with a diagnosis of uterine CCC were selected from the SEER database from 2001 - 2011. Temporal trends and patterns were measured using Chi-square analysis. Kaplan-Meier survival analysis and multivariate Cox proportional hazards models were used to measure disease-specific survival.

RESULTS
1,470 patients with CCC were identified with a median age at diagnosis of 69 years. There was no trend in the absolute number of CCC cases per year. RT was used in 600 patients (41%), of which 296 (49%) had external beam irradiation (EBRT), 131 (22%) brachytherapy (BT), and 143 (24%) combinations of EBRT and BT (COMB). 386 patients (26%) did not undergo lymphadenectomy, while 76 (5%) had 1 to 3 regional lymph nodes (LNs) removed, and 727 (50%) had 4 or more regional LNs removed. The 5-year survival of all patients was 52% and in patients receiving EBRT, BT, and COMB rates were 51%, 72%, and 53% respectively. In multivariate Cox regression adjusted for age, stage, grade, lymphadenectomy, and race, increased survival was associated with any RT (HR 0.78, p=0.008) and in patients who had 1-2 or 4+ LNs removed (HR 0.69, p=0.027 and HR 0.49, p<0.001). Decreased survival was associated with older age (HR 1.04, p<0.001), stage III (HR 1.46, p<0.001), grade II (HR 3.44, p=0.014), grade III (HR 3.48, p=0.014), and black race (HR 1.35, p=0.008). In radiation therapy subtype analysis, BT was associated with improved survival (HR 0.57, p=0.006). Over the 10 year study period, there was no significant trend in the % of patients receiving RT, however, among patients who did receive RT, the fraction receiving BT increased significantly (p<0.001) from 12% to 32%, EBRT decreased significantly from 54% to 44% (p=0.025), and COMB decreased significantly from 28% to 16% (p=0.007).

CONCLUSION
Uterine CCC is a relatively rare malignancy with roughly 50% survival. RT use remained fairly constant from 2001-2011, but employment of BT increased relative to EBRT and COMB. BT use is associated with improved survival even after adjusting for confounders.

CLINICAL RELEVANCE/APPLICATION
This study suggests that BT is associated with improved survival in uterine CCC patients after adjusting for multiple confounders, though it is limited by lack of chemotherapy data.
PET scans and/or pathology. 30 patients with a PET scan at least 24 months post SBRT were selected as the control group. All patients were planned using BrainlabTM and treatment delivered using five to seven 6MV photon beams delivering 50 Gy in 5 consecutive fractions on a Novalis Tx machine assisted with CBCT, 6D robotic alignment, and respiratory gating. Collected parameters included age, gender, histopathology, and biomarkers. Results: In the locally recurrent group, 5 of 6 cases were diagnosed as squamous cell carcinoma with none TTF-1 positive, while 25 of 30 locally controlled cases were identified as adenocarcinoma (ACA), as shown in the following table.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cases</th>
<th>Gender (M:F)</th>
<th>Age (mean)</th>
<th>SCC</th>
<th>ACA</th>
<th>TTF-1 (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Recurrent</td>
<td>6</td>
<td>4:2</td>
<td>80.0</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Locally Controlled</td>
<td>30</td>
<td>28:2</td>
<td>78.8</td>
<td>0</td>
<td>25</td>
<td>23.3%</td>
</tr>
</tbody>
</table>

*p-value* = 0.057

Conclusions: SCC appears to have a strong correlation to local recurrence in this our study using 50Gy in 5 fractions. The following factors predicted local recurrence in our study: 1. Squamous cell histology: 1/6 of recurrences vs 1/30 of locally controlled. 2. TTF-1 negative: all recurrences were TTF-1 negative vs 23.3% of the locally controlled. This is a pilot study looking at our confirmed local recurrences. We plan to expand our analysis to include tumor size and other histologic factors, location (motion), image acquisition and other dosimetric factors.
Radiation Oncology Sunday Poster Discussions

Sunday, Nov. 29 1:00PM - 1:30PM Location: RO Community, Learning Center

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Nina A. Mayr, MD, Seattle, WA (Moderator) Nothing to Disclose
John C. Grecula, MD, Columbus, OH (Moderator) Research Grant, Teva Pharmaceutical Industries Ltd; Research Grant, Soligenix, Inc;
Interventional Oncology Series: Percutaneous Management of Renal Tumors: Updates and Ongoing Controversies in 2015

Sunday, Nov. 29 1:30PM - 6:00PM Location: S405AB

**LEARNING OBJECTIVES**

1) To review management options for small renal masses as well as indications for each.  
2) To review the data supporting the energy based thermal ablation modalities for ablation of renal masses.  
3) To describe the role and limitations of biopsy of renal masses.  
4) To review the management of benign solid renal masses.  
5) To describe the evidence for ablation of T1b renal masses.

**Purpose**

To investigate survival outcomes in patients with stage 1a renal cell carcinoma (RCC) undergoing open or laparoscopic partial nephrectomy (PN) vs. percutaneous cryoablation (CRA) or radiofrequency ablation (RFA) in a large-scale population study.

**Method and Materials**

The most recently updated SEER-Medicare linked database was queried for patients with T1aNOM0 RCC (≤4cm, ICD-O-3 C64.9).
The most recently updated SEER-Medicare linked database was queried for patients with T1aN0M0 RCC (≤4cm, ICD-O-3 C64.9) diagnosed between 2000 and 2011 and followed to 2012. Patients who underwent therapy were selected from Medicare via CPT carrier claim codes (percutaneous RFA 50592; percutaneous CRA 50593; open PN 50240; laparoscopic PN 50543). Mean overall survival (OS) from therapy was compared between patients who underwent percutaneous ablation vs. partial nephrectomy, with subgroup survival analysis of individual therapies. Kaplan-Meier estimation and Cox proportional hazard models were used for survival analyses and to assess independent prognostic factors for OS.

RESULTS

A total of 5,983 T1a RCC patients underwent percutaneous ablation or PN within the study period, median age 72.0 yrs, 61.0% male. Of these, 3150 received open PN, 1785 received laparoscopic PN, 419 received CRA and 629 received RFA. Of these, 47.9% of patients undergoing PN were >72 yrs, vs. 67.1% of patients in the ablation group. Mean age of patients receiving ablation was significantly higher than that of the PN group, 80.1 vs. 70.6 yrs, p<0.001. Other factors including gender, ethnicity, mean index tumor size and tumor grade were not significantly different between comparison groups. Patients who underwent PN had significantly higher mean OS compared to the ablation group, 128.7 vs. 75.5 months, p<.001. On Cox regression analysis, younger age was the only independent prognostic factor for survival, HR 0.91 (0.87-0.93, p<0.001).

CONCLUSION

In T1aN0M0 RCC, patients undergoing ablation were significantly older compared to PN patients. Age was found to be an independent prognostic factor for survival from treatment.

CLINICAL RELEVANCE/APPLICATION

In T1aN0M0 RCC, age was found to be an independent prognostic factor for survival from treatment and may impact choice of therapy.

VSIO11-06 Ablation for Renal Cell Carcinoma: Radiofrequency, Cryoblation, or Microwave?

Participants

LEARNING OBJECTIVES

View learning objectives under main course title.

VSIO11-07 Small Renal Mass (T1a): The Case for RFA in 2015

Sunday, Nov. 29 2:40PM - 3:00PM Location: S405AB

Participants

Debra A. Gervais, MD, Chestnut Hill, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Debra A. Gervais, MD - 2012 Honored Educator

VSIO11-08 US-guided Percutaneous Radiofrequency Ablation of Renal Cell Carcinoma: Experience from Treating 120 Renal Masses Over 7 Years

Sunday, Nov. 29 3:00PM - 3:10PM Location: S405AB

Participants

Adriana C. Montealegre Angarita, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Xavier Serres Creixams, PhD, Barcelona, Spain (Presenter) Nothing to Disclose
Enrique Trilla, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Milton R. Villa III, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Juan Halaburda Berri, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Esteban Ramirez Rinto, MD, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose
Xavier G. Azogue JR, Barcelona, Spain (Abstract Co-Author) Nothing to Disclose

PURPOSE

Evaluate the efficacy and safety of ultrasound (US) guided percutaneous radiofrequency ablation (RFA) for small renal masses. Describe the complications of RFA guided by US. Evaluate the technique in their initial ablative capacity and rate of tumor recurrence at one year minimum follow up. Illustrate postablation findings of residual or recurrent renal tumor by using Contrast-enhanced US (CEUS). Evaluate the effect of renal function in patients undergoing RFA guided by US

METHOD AND MATERIALS

Over a 7 year 105 patients with 120 renal masses (tumor size averaged 2.7 cm) were reviewed treated with US-guided percutaneous RFA. Biopsy was performed at the same moment of the procedure from 2009. Cool-tip RFA system was percutaneously inserted under ultrasound guidance. RF was emitted at 100-120 W for 12 minutes to attain temperatures sufficient to ensure tumor kill. The treatment response and technical success were defined by absence of contrast enhancement within the tumor on contrast enhanced CT and CEUS. The patients were followed up with CEUS and computed tomography at 3.6 months and every 6 months thereafter. Multivariate analysis was performed to determine variables associated with procedural outcome.

RESULTS
Follow-up ranged from 24 months to 84 months. The initial treatment success rate was 95.8%. Five of the remaining tumors were successfully re-treated. Four tumors had recurrence (defined as the occurrence of contrast enhancing tumor 12 months after complete ablation) three of whom required a second ablation and one nephrectomy. The overall technical success rate was 99%. Complications were seven self-limited included hematomas subcapsular or perirenal. In all 104 (99%) patients have preservation of renal function, only one patient developed significant renal function deterioration associated with perirenal hematoma. There were no bowel complications despite the fact that 6 of the tumors were within 1 cm of bowel. Protective strategies progressed from reliance on electrode positioning to hydro dissection.

CONCLUSION

Our experience to date suggests that US-guided RFA of small renal tumors is a safe and effective, minimally invasive technique in selected patients.

CLINICAL RELEVANCE/APPLICATION

US-guided RFA of renal tumors can provide benefits compared to other techniques: Intraprocedural monitoring affords visualization of the forming hot ball, helps detect proximity to surrounding structures and does not use ionizing radiation.

VSI101-09 Small Renal Mass (T1a): The Case for Cryoablation

Sunday, Nov. 29 3:10PM - 3:30PM Location: S405AB

Participants

Peter J. Littrup, MD, Providence, RI (Presenter) Founder, Cryomedix, LLC; Research Grant, Gall Medical Ltd; Research Grant, Endo Health Solutions Inc; Consultant, Delphinus Medical Technologies, Inc

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

Cryoablation of smaller renal cancers (i.e., T1a, or <4 cm) is an outpatient treatment that is safe, effective and flexibility for nearly any renal location. Major cryoablation benefits include its excellent visualization of ablation zone extent, low procedure pain and flexible protection of tumor ablation sites near calyces, bowel and ureter. CT-guidance is the cryoablation guidance modality of choice due to circumferential visualization of low density ice and ready availability. US-guidance can augment renal cryoablation, especially for smaller visible masses and/or placement of interstitial metallic markers during biopsy for selected cases requiring better eventual CT localization. MR-guidance has little clinical benefit or cost-efficacy. For safety, cases will be considered for avoidance of direct calyceal puncture, selection of hydrodissection or balloon interposition for bowel protection, and protection of the uretero-pelvic junction by stent placement. Imaging outcomes of complications and their avoidance will be shown. For optimal efficacy, tumor size in relation to number and size of cryoprobes emphasize the "1-2 Rule" of at least 1 cryoprobe per cm of tumor diameter and no further than 1 cm from tumor margin, as well as cryoprobe spacing of <2 cm. Thorough extent of visible cryoablation margins beyond all apparent tumor margins produces very low local recurrence rates for tumors in nearly any renal location, resulting in excellent cost-efficacy by minimizing the need for re-treatments.

VSI101-10 Adjunctive Techniques to Improve Image-Guided Percutaneous Cryoablation of Renal Masses in Difficult Anatomic Locations: Quantifying Procedural Success and Long-term Outcomes

Sunday, Nov. 29 3:30PM - 3:40PM Location: S405AB

Participants

Ahmed Fadi, MD, Mineola, NY (Presenter) Nothing to Disclose
Andrew Ho, Bayside, NY (Abstract Co-Author) Nothing to Disclose
Samia Sayegh, DO, Mineola, NY (Abstract Co-Author) Nothing to Disclose
April Griffith, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Siavash Behbahani, MD, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Jason C. Hoffmann, MD, Mineola, NY (Abstract Co-Author) Consultant, Merit Medical Systems, Inc; Speakers Bureau, Merit Medical Systems, Inc

PURPOSE

When performing renal mass cryoablation in difficult anatomic locations, adjunctive techniques such as retrograde pyeloperfusion, hydrodissection, and angioplasty balloon interposition can improve safety and technical success rates. Prior studies have reported the technical success of these techniques, but correlation with longer-term outcomes has not been reported in this specific patient population. This study quantifies the success of these techniques, and correlates with long-term cross-sectional imaging outcomes.

METHOD AND MATERIALS

Retrospective analysis of percutaneous renal mass cryoablation was performed from September 2011 through October 2014 at a single, tertiary care institution. Cases using adjunctive techniques were analyzed. The diagnostic cross-sectional imaging, procedural images and report, and follow-up multi-phasic cross-sectional imaging were reviewed by one radiology resident and one interventional radiology attending. The type of adjunctive technique used, reason for such utilization, and procedural outcome of the technique were recorded. Specifically, in cases of hydrodissection or balloon angioplasty interposition, measurements of the displacement distance were made. Minor and major complications were recorded, per Society of Interventional Radiology criteria. Longer-term outcomes were evaluated by review of follow-up cross-sectional imaging.

RESULTS

Out of 53 cryoablations during the study period, 9 utilized adjunctive techniques, including hydrodissection (n=8), retrograde pyeloperfusion (n=1), and angioplasty balloon interposition (n=1). Median greatest tumor dimension was 1.9 cm (range 1.3-3.5 cm). Prior to adjunctive technique, median tumor proximity to closest organ was 0.4 cm (range 0.1-1.3 cm). After technique was used, median distance to closest organ was 2.8 cm (range 0.3-3.3 cm). One hydrodissection was unsuccessful, thus angioplasty balloon interposition was then performed. All cases had appropriate ablation zones and protection of adjacent critical structures. No minor or major complications were reported. No patients had evidence of residual or recurrent tumor on follow-up imaging, ranging from 3 to 30 months.
CONCLUSION
Adjunctive techniques to allow cryoablation of renal masses in difficult anatomic locations have excellent technical success rates and long-term outcomes.

CLINICAL RELEVANCE/APPLICATION
Improving outcomes of difficult renal mass cryoablations.

VSIO11-11 Small Renal Mass (T1a): The Case for Microwave
Sunday, Nov. 29 3:40PM - 4:00PM Location: S405AB

Participants
Fred T. Lee JR, MD, Madison, WI (Presenter) Stockholder, NeuWave Medical, Inc; Patent holder, NeuWave Medical, Inc; Board of Directors, NeuWave Medical, Inc; Patent holder, Medtronic, Inc; Inventor, Medtronic, Inc; Royalties, Medtronic, Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

VSIO11-12 Long-term Clinical Outcomes Following Radiofrequency and Microwave Ablation of Renal Cell Carcinoma at a Single Large VA Medical Center
Sunday, Nov. 29 4:00PM - 4:10PM Location: S405AB

Participants
Salim E. Abboud, MD, Cleveland, OH (Presenter) Nothing to Disclose
Tanay Y. Patel, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Stephanie Soriano, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Nannette Alvarado, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Preet S. Kang, MD, Pepper Pike, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
Earlier detection and a desire to preserve renal function and decrease surgical morbidity in the treatment renal cell carcinoma (RCC) has prompted increased use of percutaneous thermal ablation treatments such as radiofrequency ablation (RFA) and more recently microwave ablation (MWA). MWA has the potential to provide more complete ablation compared to RFA in part due to more uniform and higher intra-tumoral temperatures, but only a few small studies have examined the short- and long-term outcomes of MWA for RCC. This retrospective review assesses the experience and technical short- and long-term success rates of using RFA and MWA for RCC at a large VA medical center.

METHOD AND MATERIALS
Patient and tumor characteristics (tumor size, nearness to collecting system, anterior/posterior location, location relative to polar line, and endophytic/exophytic predominance) were tabulated using descriptive statistics. Group comparisons were performed by using univariate logistic regression analysis to determine factors impacting primary efficacy, secondary efficacy, and technique effectiveness. Kaplan-Meier local tumor progression-free survival following ablation was calculated.

RESULTS
71 patients with 78 renal lesions underwent ablation. Mean, primary, and secondary mean follow-up were 35.1, 33.5, and 31.3 months. Total, primary, and secondary technique effectiveness rates were 86%, 82%, and 4%, respectively. Primary efficacy and total technique effectiveness were associated with size, with p values of 0.02 and 0.001. There was no significant difference in survival curves between MWA and RFA treated patients. MWA and RFA groups were not significantly different in terms of age, BMI, or tumor size. Complications occurred in 11.5% of patients, none resulting in death. More than 90% patients were done as outpatients (sent home day of procedure) with moderate sedation. No cases used intubations or general anesthesia.

CONCLUSION
RFA and MWA both represent effective treatment modalities for RCC. Longer follow-up time and larger tumor size may be associated with the somewhat lower effectiveness rates; the comparable efficacy/complication rates compared to prior ablation studies demonstrate the feasibility of performing ablations on an outpatient basis.

CLINICAL RELEVANCE/APPLICATION
Image guided percutaneous ablation is an effective and cost-effective treatment modality for RCC in patients that are not surgical candidates.

VSIO11-13 To Biopsy or Not Biopsy the Small Renal Mass before Ablation? That Is The Question

Participants

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Characterization of small renal masses has proven challenging. However, with appropriate CT and MR protocols, the majority of these lesions can now be characterized pre procedurally, enabling a confident diagnosis. In this lecture, we will describe renal mass characterization protocols and describe the common imaging signatures of RCC subtypes and their common mimics including lipid poor AML and oncocytomas. This may eliminate need for preprocedural biopsy.

VSIO11-14 Biopsy or No Biopsy Before Ablation? Biopsy Every Renal Mass before Percutaneous Ablation
Biopsy or No Biopsy before Ablation? Don't Trouble Yourself or the Patient with the Renal Mass - Imaging Diagnosis Will Do Just as Well in 2015

Participants
William W. Mayo-Smith, MD, Boston, MA (Presenter) Author with royalties, Reed Elsevier; Author with royalties, Cambridge University Press

LEARNING OBJECTIVES
View learning objectives under main course title.

Thermal Ablation of a Confluent Lesion in the Porcine Kidney with Magnetic Resonance Guided High Intensity Focused Ultrasound (MR-HIFU)

Participants
Johanna M. van Breugel, MSc, Utrecht, Netherlands (Presenter) Nothing to Disclose
Martijn de Greef, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Joost W Wijlemans, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Gerald Schubert, PhD, Vantaa, Finland (Abstract Co-Author) Employee, Koninklijke Philips NV
Chris T. Moonen, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Maurice V. Bosch, MD, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose
Mario G Ries, PhD, Utrecht, Netherlands (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate if MR-HIFU can provide for a reliable confluent volumetric lesion in the renal cortex in a clinically relevant time-frame in a porcine study.

METHOD AND MATERIALS
Nine anesthetized pigs were placed on a clinical Philips Sonalleve MR-HIFU therapy system integrated with a 1.5T Achieva MRI. Both acoustic energy delivery and MR-thermometry were respiratory gated and active surface cooling was employed to prevent near-field damage. A honeycomb pattern of at least seven ablation cells (9-25s, 450W acoustic power, 4x4x10 mm3 per cell) were positioned in the cortex of the kidney. The therapeutic endpoint was evaluated by a non-perfused volume (NPV) measurement using DCE-MRI. Subsequently, the animal was euthanized and the extent of induced necrosis was examined using a cellular viability staining (NADH).

RESULTS
Confluent volumes on NPV-imaging (up ~3 mL) and NADH staining (up to ~4mL) were obtained and temperatures exceeding 60°C were reached in 6 pigs. I.e. heating of the false rib, poor respiratory correction, and a large incidence angle caused poor kidney heating in 3 pigs.

CONCLUSION
These first results indicate that current clinical MR-HIFU equipment might be suitable for non-invasive therapy of renal masses. Positioning of the sonication and the subject based on anatomical scans is very important, as well as adequate motion compensation. Future work will include a first clinical study on renal cell carcinomas.

CLINICAL RELEVANCE/APPLICATION
There is an increasing interest in non-invasive kidney sparing therapy for renal cancer, since ~1.6% of men and women will be diagnosed with kidney and renal pelvis cancer during their lifetime, in 25% of all abdominal imaging sessions a renal lesion is found, partial nephrectomy - standard care for tumors <4cm - has a 15% complication rate, and the population is aging and known with comorbidities and poor physical condition. Therefore, several patient studies investigated the feasibility of HIFU for the thermal ablation of renal masses. Mainly a hand-held extracorporeal ultrasound device with US B-mode imaging for guidance or a laparoscopic approach was used. Disadvantages are i.e. the lack of respiratory motion compensation, no real-time visualization of energy deposition, and the complexity of the probe positioning. Alternatively, feasibility of MR-HIFU interventions on the kidney with respect to motion compensated real-time thermometry and acoustic energy delivery was established, recently.

Outside the Box: Is Ablation Effective for Masses other than T1a RCC

Participants

LEARNING OBJECTIVES
View learning objectives under main course title.
**VSIO11-18 Percutantous Ablation for T1b Tumors**

Sunday, Nov. 29 5:20PM - 5:40PM Location: S405AB

Participants
Thomas D. Atwell, MD, Rochester, MN (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

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**VSIO11-19 Percutantous Ablation for Angiomyolipomas**

Sunday, Nov. 29 5:40PM - 6:00PM Location: S405AB

Participants
Fred T. Lee JR, MD, Madison, WI (Presenter) Stockholder, NeuWave Medical, Inc; Patent holder, NeuWave Medical, Inc; Board of Directors, NeuWave Medical, Inc; Patent holder, Medtronic, Inc; Inventor, Medtronic, Inc; Royalties, Medtronic, Inc

**LEARNING OBJECTIVES**

View learning objectives under main course title.
Participants
Simon S. Lo, MD, Cleveland, OH (Moderator) Research support, Elekta AB;

Sub-Events

RC120A  Fundamentals in Radiation Oncology Imaging of Head and Neck Cancer

Participants
Hilda E. Stambuk, MD, New York, NY (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Define key anatomy and understand pathways of tumor spread for head and neck cancers. 2) Identify radiographic features of the patterns of tumor involvement. 3) Understand the implications of radiographic imaging in treatment planning.

ABSTRACT
Radiographic imaging is integral to diagnosis, extent of disease assessment, treatment planning and post-treatment surveillance in patients with head and neck cancer. Since the overwhelming majority of cancers of the head and neck are squamous cell carcinoma, these tumors will be the primary focus of the lecture. In addition, choosing the appropriate imaging modality is of vital importance in effective evaluation and therefore the pros and cons of imaging modalities in particular subsites will be presented. The patterns of tumor spread depend on the site of origin of the tumor and will be discussed in detail for some of the common sites such as nasopharynx and oropharynx that are treated primarily with radiation. The implications of pathways of tumor involvement including perineural spread on treatment planning will be emphasized. This lecture will provide radiation oncologists a basic understanding of the role of imaging and will highlight pearls and pitfalls that can influence management.

RC120B  Fundamentals in Radiation Oncology Imaging of Thoracic Malignancies

Participants
Matthew M. Harkenrider, MD, Maywood, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To review the normal imaging changes after precision radiotherapy for lung cancer. 2) To discuss methods of distinguishing recurrence vs. fibrosis after stereotactic radiotherapy. 3) To highlight difficult imaging cases in assessing response after radiotherapy.

ABSTRACT

RC120C  Fundamentals in Radiation Oncology Imaging of Skull Base Tumors

Participants
Jason Rockhill, MD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identifying imaging techniques to help delineate target volumes for skull based tumors. 2) Discuss the challenges of determining target volumes for skull based tumors in the resected and non-resected patient. 3) Review key features to follow by imaging of skull based tumors after radiation therapy.

RC120D  Imaging and RT QA in Cancer Clinical Trials: The Advanced Technology Consortium (ATC), the Quality Assurance Review Center (QARC), and the Imaging and Radiation Oncology Core (IROC)

Participants
Thomas J. Fitzgerald, MD, Worcester, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe diagnostic imaging and radiation therapy utilization in clinical trials. 2) Describe the role of quality assurance in imaging and radiation therapy in clinical trials. 3) Describe future QA strategies in the National Clinical Trials Network (NCTN).
MRI: Imaging for Treatment Planning

Sunday, Nov. 29 2:00PM - 3:30PM Location: E353A

AM A P R A Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Eric Paulson, Milwaukee, WI (Moderator) Nothing to Disclose

ABSTRACT

LEARNING OBJECTIVES
1) Understand the advantages of MRI simulation for anatomical delineation in both external beam radiation therapy and brachytherapy. 2) Understand the differences between images obtained during MRI simulation versus diagnostic MRI. 3) Understand the current solutions to address technical challenges of using MRI for anatomical delineation in Radiation Oncology.

ABSTRACT

MRI is rapidly emerging as a primary imaging modality in Radiation Oncology, fueled by innovations in MRI-guided treatment delivery, MRI simulation systems, and the role of MRI in individualizing and adapting radiation therapy. This course will discuss the advantages and technical challenges of using MRI for anatomical definition in radiation treatment planning. Current solutions to tailor MRI to the unique demands of Radiation Oncology will be explored. Clinical examples illustrating the use of MRI for anatomical delineation in both external beam radiation therapy and brachytherapy will be presented.

RC122A MRI for Anatomical Definition

Participants
Eric Paulson, Milwaukee, WI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Get an overview of the most relevant functional MRI modalities are available. 2) Understand how they can be used to improve target definition. 3) Understand their limitations and specific concerns for use in radiation oncology.

ABSTRACT

In addition to anatomical imaging, MRI affords a range of functional techniques. Diffusion-weighted MRI images the restriction of water mobility in tissue, thus probing microanatomy. This is used to identify tumors and monitor response to treatment. Dynamic contrast-enhanced MRI shows the tracer kinetics of contrast agents and reflects the characteristics of the microvasculature, such as flow and permeability. These and other techniques can be used to improve target definition, and to characterize tumor tissue for radiotherapy dose painting.
BOOST: Gynecology-Oncology Anatomy - Radiologic Evaluation of Pelvic Malignancies in the Era of Imaging Biomarkers (An Interactive Session)

Monday, Nov. 30 8:30AM - 10:00AM Location: S103AB

AMAPRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants
Saurabh Gupta, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Robert S. Hellman, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Paul M. Knechtges, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Mark D. Hohenwalter, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Beth A. Erickson, MD, Milwaukee, WI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Review uterine/cervical anatomy and current anatomic imaging methods for the evaluation of pelvic malignancy. 2) Review the current role of PET in the imaging of pelvic malignancy. 3) Discuss the growing role of imaging biomarkers (e.g. diffusion weighted imaging and perfusion imaging) in determining prognosis and treatment response for pelvic malignancies.
BOOST: Head and Neck-Oncology Anatomy (An Interactive Session)

Monday, Nov. 30 8:30AM - 10:00AM Location: S103CD

Participants

Sub-Events

MSRO24A Imaging of Larynx and Hypopharynx: Applied Anatomy

Participants
Suresh K. Mukherji, MD, Northville, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the normal anatomy of the larynx. 2) Discuss the spread patterns of the different primary sites of the larynx. 3) Explain the information that imaging provides that directly affects staging and management.

ABSTRACT
This session will demonstrate the value of laryngeal imaging. This talk will review the normal anatomy of the larynx. The talk will also discuss the spread patterns of the different primary sites of the larynx and illustrate the information that imaging provides that directly affects staging and management of laryngeal cancer.

MSRO24B Current Concepts and Controversies in Contouring for Treating Laryngeal Carcinoma

Participants
Sung Kim, MD, New Brunswick, NJ (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review anatomy of larynx as it relates to patterns of spread of squamous cell carcinoma. 2) Discuss how patterns of spread affects how to contour larynx for radiation therapy.

MSRO24C QandA

Participants

MSRO24D Imaging of the Oral Cavity and Oropharynx: Applied Anatomy

Participants
Suresh K. Mukherji, MD, Northville, MI (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Review the normal anatomy of the oral cavity and oropharynx. 2) Illustrate the normal spread patterns of the various subsites of the oral cavity and oropharynx. 3) Explain the information that imaging provides that directly affects staging and management.

ABSTRACT
Imaging plays a crucial role in evaluating the evaluating the primary site. The information provided on pre-treatment imaging directly affects the stage of the tumor and provides information regarding management and treatment that cannot be ascertained through physical exam or staging. This talk will review the normal anatomy and malignancies involving the oral cavity and oropharynx. The presentation will also provide information on technique and provide a “checklist” of information that should be included in the radiologist's report that will help determine treatment and management.

MSRO24E Current Concepts and Controversies in Contouring and Treatment of Oral Cavity/Oropharynx Carcinoma

Participants
Clifton D. Fuller, MD, PhD, Houston, TX, (cdfuller@mdanderson.org) (Presenter) In-kind support, General Electric Company; Research Grant, Elekta AB; ; ;

LEARNING OBJECTIVES
1) Review imaging anatomy of or pharynx as it relates to patterns of spread of squamous cell carcinoma. 2) Discuss oropharyngeal contouring patterns for radiation therapy. 3) Discuss treatment indications for surgery, radiotherapy, and chemoradiotherapy and the requisite contouring guidelines across oropharynx cancer staging.

MSRO24F QandA

Participants
**Imaging Evaluation of Post-Radiation Therapy Normal Tissue Effects**

Monday, Nov. 30 8:30AM - 10:00AM Location: S403A

**Participants**

Gregory Videtic, MD, FRCP, Cleveland, OH, (videtig@ccf.org) (Moderator) Nothing to Disclose

**Sub-Events**

**RC220A** Post-radiation Therapy Lung Imaging

**Participants**

Gregory Videtic, MD, FRCP, Cleveland, OH, (videtig@ccf.org) (Presenter) Nothing to Disclose

Michelle S. Ginsberg, MD, New York, NY (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review short term and long term changes following radiation therapy. Post SBRT changes will also be reviewed which can differ from more traditional conformal radiotherapy changes. 2) To distinguishing evolving post RT changes from recurrence which is critical in the follow up of these patients. Use of PET/CT in these cases will be discussed.

**ABSTRACT**

**RC220B** Post-radiation Therapy Pediatric Body Imaging

**Participants**

Ralph P. Ermoian, MD, Seattle, WA, (ralphpe@uw.edu) (Presenter) Nothing to Disclose

R. Paul Guillerman, MD, Houston, TX (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Attendees will be able to list at least one common late body imaging finding associated with radiation treatment for Ewing sarcoma, Hodgkin lymphoma, Wilms tumor and transplant conditioning with total body irradiation. 2) Attendees will be able describe the relationship between dose and target volume in discussing late imaging findings on the musculoskeletal, hepatic and gastrointestinal systems.

**ABSTRACT**

**RC220C** Post-radiation Therapy Liver Imaging

**Participants**

Michael I. Lock, MD, FRCP, London, ON, (michael.lock@lhsc.on.ca) (Presenter) Research Consultant, Accuray Incorporated; Speaker, AbbVie Inc

Ashkan A. Malayeri, MD, Bethesda, MD, (ashkan.malayeri@nih.gov) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Discuss the current literature on radiological liver changes induced by radiation. 2) Describe the incidence and long-term morphology/natural history of these changes. 3) Apply practical concepts that distinguish recurrence from normal changes in a growing subject area where evidence is just emerging.

**ABSTRACT**
RC222

**MRI: Imaging for Treatment Guidance and Verification**

Monday, Nov. 30 8:30AM - 10:00AM Location: S502AB

**Participants**
Rojano Kashani, Saint Louis, MO (Moderator) Investigator, Koninklijke Philips NV; Investigator, ViewRay, Inc

**Sub-Events**

**RC222A  In-room MRI for Treatment Guidance**

Participants
Rojano Kashani, Saint Louis, MO (Presenter) Investigator, Koninklijke Philips NV; Investigator, ViewRay, Inc

**LEARNING OBJECTIVES**
1) Understand the main concepts of MRI-guided radiation therapy. 2) Understand the advantages and limitations of MRI-guided radiotherapy systems currently in use or under development. 3) Understand the use of in-room MRI guidance for management of intra- and inter-fraction variations in anatomy.

**RC222B  Integrating MRI, the Clinician Perspective**

Participants
Cynthia Menard, MD, Montreal, QC, (cynthia.menard@umontreal.ca) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**
1) Understand the clinical benefits associated with the integration of MRI into Radiotherapy. 2) Describe the uncertainties and challenges that exist in MR for radiotherapy.
The ability to predict and reduce toxicities by applying a learning health system (LHS) model is thus an important goal. The quality of life (QOL) of irradiated head and neck cancer (HNC) patients is significantly limited by toxicities leading to weight loss. The purpose of this study was to determine the impact of patient and tumor characteristics on time-to-treatment (TTT) from diagnosis in HNC patients treated with curative intent radiation therapy (RT).

**Materials/Methods:** From August 2004 to May 2011, 131 non-metastatic and non-recurrent biopsy proven HNC patients completed definitive RT at an urban academic safety net hospital. Patient and tumor factors examined included: race/ethnicity (Black, White, Hispanic, Other), English proficiency (English proficient, EP, Limited English proficient, LEP), marital status (Married, Non-married), insurance coverage (Private/Medicare, Medicaid/Free care), age at diagnosis (years) (median, =50) and AJCC stage (stage I-III versus stage IV). TTT was calculated from date of biopsy to date of first treatment received (surgery, induction chemotherapy/IC, radiotherapy alone/RT or concurrent radiotherapy/CCRT). Analysis of Variance was performed using SAS version 9.1 to determine the drivers of TTT. Data were analyzed using a 0.05 level of significance. Results: The median TTT was 41 days (range 6-249 days). Surgery, IC, RT or CCRT was the first treatment received in 45 (34.4%), 22 (16.8%), 13 (9.9%) and 51 (38.9%) patients, respectively. TTT did not differ by first treatment received (time to surgery 48 days, time to IC 47 days, time to RT 40 days and time to CCRT 51 days), P=0.802. No statistically significant differences in TTT were noted for gender (P=0.637), race/ethnicity (P=0.996), marital status (P=0.737), insurance coverage (P=0.836), age at diagnosis (P=0.571), and AJCC stage (P=0.889). TTT among EP and LEP patients was 46 and 57 days, respectively (P=0.197). Conclusion: Limited English proficient patients had longer TTT compared to EP, although this result failed to reach statistical significance. Other patient and tumor factors were not found to be predictive of TTT.
aim of this study is to determine the predictors for weight loss based on the outcomes of similar patients previously treated with radiation therapy (RT) to develop a real-time clinical decision-support system.

**METHOD AND MATERIALS**

From a database of systematically captured prospective data elements, NCI-CTCAEv4.0 toxicity assessments and all aspects of RT planning, 326 HNC patients with longitudinal records from 2007 to 2014 were identified. The records consisted of 2,985 variables, including planned dose-volume histogram at 1% volume increments (2,020 variables), distance between planning target volume (PTV) and organs at risk, diagnostic ICD-9 code, QOL and toxicities during treatment. Weight loss of 5kg or more at 3 months post-RT was predicted by the Classification and Regression Trees algorithm. Two different prediction models at the time of RT planning and at the end of treatment were developed.

**RESULTS**

Weight loss predictors during treatment were 1) patient reported outcome of oral intake, 2) ICD-9 code, N stage, 3) nausea, esophagitis/pharyngitis, skin toxicity, pain intensity, 4) dose to larynx, parotid, cricopharyngeal muscle and 5) minimum distance between low dose PTV and larynx. The weight loss prediction at RT planning was also developed excluding assessment variables during treatment. The sensitivity of the model at treatment / RT planning was 0.988 / 0.860 and the positive predictive value (PPV) was 0.467 / 0.451 respectively.

**CONCLUSION**

The informatics framework combined with data mining tools can facilitate large-scale analysis predicting for weight loss and is encouraging for the development of a LHS model to reduce the risk of toxicities. The two prediction models at RT planning / treatment show the potential for a real-time decision-support based on the incremental data collection in each patient’s RT course. Given the importance of diagnostic modality, we believe that incorporation of imaging features is an important next step to improve PPV.

**CLINICAL RELEVANCE/APPLICATION**

The weight loss prediction model at RT planning / treatment can support decisions regarding treatment planning and toxicity management during treatment.

**MSRO25-04 Short Treatment Time and Excellent Treatment Outcome in Accelerated Hyperfractionated Radiation Therapy for T1 Glottic Cancer**

**Abstract Co-Author**

*Yoshida, MD, Izumo, Japan* (Abstract Co-Author) Nothing to Disclose  
*Kitagaki, MD, Izumo, Japan* (Abstract Co-Author) Nothing to Disclose  
*Inomata, MD, Osaka, Japan* (Abstract Co-Author) Nothing to Disclose  
*Taisuke Inomata, MD, Osaka, Japan* (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Accelerated hyperfractionated radiotherapy was performed as treatment for patients with T1 glottic cancer, and its utility was evaluated based on treatment outcomes and adverse effects.

Materials/Methods: Subjects were 58 men (median age, 70 years) who underwent radiotherapy at a University Hospital between January 2000 and November 2013. Tumor classification was Tis (6.9%) in 4 patients, T1a (65.5%) in 38, and T1b (27.6%) in 16. Histological examination revealed squamous cell carcinoma in the majority of cases (55 patients, 94.8%). Travel time from home to hospital was 2 h for 25 patients (43.1%). Laser vaporization was performed prior to radiotherapy in 38 patients (65.5%), and 19 patients (32.8%) received concurrent chemotherapy with an agent such as S-1. Patients were irradiated twice daily (morning and evening) using an irradiation container. Most patients received a dose of 1.5 Gy/fraction up to a total of 60 Gy.

Results: The median overall treatment time was 30 days (range, 26–45 days), with a median observation period of 59.6 months. After completion of radiotherapy, a complete response was observed in all patients. The overall 5-year and 7-year survival rates were 97.2% and 86.1%, respectively, and the 5-year and 7-year disease-free survival rates were 93.2% and 82.2%, respectively. The 5-year and 7-year local control rates were both 97.8%. Seven patients died either of other cancer (3/7) or disease (4/7), with no death due to glottic cancer or treatment-related causes. Although grade 3 pharyngeal mucositis was observed in 2 (3.4%) patients, there were no other grade 3 or higher acute adverse events. As late toxicity, grade 2 laryngeal edema and grade 1 laryngeal hemorrhage were observed in 1 patient each, but no serious events such as laryngeal necrosis or laryngeal stenosis were observed.

Conclusion: The outcome of accelerated hyperfractionated radiotherapy for T1 glottic cancer was excellent, and the adverse events were acceptable. The present treatment method will substantially reduce the treatment duration among patients who need to stay at nearby hotels while undergoing treatment at hospitals in rural areas.

**MSRO25-05 Are Contouring Time and Multimodality Imaging Prognostic Factors for Radiation Therapy of Head and Neck Cancer?**

**Participants**

*Michael W. Schmuecking, MD, Hamburg, Germany* (Presenter) Nothing to Disclose  
*O Elicin, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Bernd Klaeser, MD, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Alan Dal Pra, MD, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Beat Bojaxhiu, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Natalie D. Klass, MD, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Roland Bigler, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Yannick Eller, MD, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*Marco Malthaner, PhD, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose  
*S Funkhauser, Bern, Switzerland* (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): The aim of this study is to determine the predictors for weight loss based on the outcomes of similar patients previously treated with radiation therapy (RT) to develop a real-time clinical decision-support system.
MSRO25-06 Lessons from a Standardized Program Using PET-CT to Avoid Neck Dissection after Primary Radiation Therapy for N2 Squamous Cell Carcinoma of the Oropharynx: Beware the Late Recurrence and Salvage Is Unlikely

Monday, Nov. 30 11:20AM - 11:30AM Location: S103CD

Participants
Kathryn E. Hitchcock, MD, PhD, Gainesville, FL (Presenter) Nothing to Disclose
Robert J. Amdur, MD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
William M. Mendenhall, MD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
John Werning, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
Walter E. Drane, MD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose
Anthony A. Mancuso, MD, Gainesville, FL (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To report the results of a standardized program using positron emission tomography (PET)-computed tomography (CT) approximately 12 weeks after primary radiotherapy to determine the need for a planned neck dissection in patients with radiographic N2 squamous cell carcinoma (SCC) of the oropharynx. Materials/Methods: Fifty consecutive patients with T1-4 and hemineck radiographic stage N2A-B SCC of the oropharynx for whom the only indication for planned neck dissection was a positive PET-CT performed ~12 weeks after completing primary treatment with radiotherapy. Endpoints to determine the value of 12-week PET-CT in identifying residual neck disease were pathologic status of planned neck dissection specimens and neck recurrence at any time during the follow-up period. Results: All patients at risk for neck recurrence at last follow-up had ≥1 year of follow-up after PET-CT (median, 2.0 years). Results of PET-CT to identify residual neck disease were as follows: Sensitivity and positive predictive value: 0% (zero true positive), Specificity: 89% (4 False Negatives), and negative predictive value: 91%. Potential neck recurrence from using this 12-week PET-CT program: 2% (Three of 4 neck recurrences would not have been prevented by surgical intervention). Conclusion: PET-CT approximately 12 weeks after radiotherapy for oropharyngeal cancer is an excellent way to identify patients who do not need neck dissection, but low-risk is not no-risk. Approximately half of neck recurrences present over 2 years after negative PET-CT and the chance of successful salvage is low. Accurate results for this kind of program will require long-term follow-up and support a policy of frequent neck imaging for years in patients with N2 oropharyngeal cancer who do not undergo neck dissection after primary treatment with radiotherapy.
to reduce hot and cold spots due to sharp surface irregularities and oblique incident angles. Radiation treatment of skin malignancies on the nose is challenging due to the irregular surface anatomy of the nose to which homogenous dose must be delivered. Materials/Methods: Superflab is a commonly used bolus material that is non-conformal for irregular surface contours of the nose making it difficult to reproducibly apply and maintain. Additionally, air gaps from non-conformal bolus will result in dose inhomogeneity. We present our experiences and outcomes using custom-made paraffin bolus to conform to the shape of the nose for the treatment of basal cell cancer (BCC) or squamous cell cancer (SCC). A mold of the patient’s nose was created and a negative impression made in a paraffin rectangle block. Minimum thickness was 1.5 cm laterally and 1 cm anterior-posteriorly. Thin coating of petroleum jelly was applied within bolus to reduce air gaps. Nine patients were treated to 60 Gy at 2 Gy per with parallel opposing 6x MV photon beams using three-dimensional conformal treatment planning. Six patients had BCC and three patients had SCC. Six patients had two or more distinct sites of disease. Results show that 100% prescription isodose line conforms to the planned target volume and dose to critical structures are well below tolerance limits. Daily kilovoltage orthogonal and weekly cone beam CT show close patient and wax bolus contact and reproducibility. Six thermoluminescent dosimetry (TLD) chips (LiF) were used to measure doses deposited and matched the planned dosimetry for each patient. TLD measurements showed a 2.6% average difference between planned dose and delivered dose. Results: Of the 9 patients treated with this method, maximum hot spot was 102.7% (101.1%-104%) for all 9 plans. Mean follow-up time was 25 months (10 – 58 months). Of the 9 treated, two patients developed new lesions on the nose over the past three years to assess its safety and efficacy in treating various RT toxicities. It is our hope that clinicians consider HBOT more often to treat life threatening complications of RT. Followup visits reported no telangiectasia and good cosmetic outcomes. Conclusion: This study demonstrates a practical approach to radiotherapy of the nose which minimizes air gaps and daily setup variability, while achieving dose homogeneity with minimal hotspots.

**MSRO25-08 Superior Carotid Artery Sparing by Proton Radiation Therapy Compared to IMRT/VMAT for Reirradiation of Locally Recurrent Cancers of the Base of Tongue**

**Participants**
Upendra Parvathaneni, MBBS,FRANZCR, Seattle, WA (Presenter) Nothing to Disclose
Yolanda D. Tseng, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Quang Dang, Seattle, WA (Abstract Co-Author) Nothing to Disclose
George E. Laramore, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Kent McCune, CMD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jay J. Liao, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Salvage treatment options for isolated in-field local recurrences in the base of tongue (BOT) after previous radiotherapy (RT) are limited. Total glossectomy is extremely morbid and re irradiation (reRT) is often preferred in an attempt to preserve function. However, the close anatomical proximity of the carotid arteries to the BOT makes it difficult to avoid this structure with photon based conformal planning such as IMRT or VMAT. Adding radiation dose to a previously irradiated carotid artery may increase the risk of a carotid blow out, which is a fatal complication. Although a clear dose threshold for this complication has not been established, a treatment plan that delivers the least dose to the carotid would be preferred. We hypothesized that compared with photon based planning (IMRT/VMAT), proton radiotherapy (PRT) may decrease the dose to the carotids as there is no exit dose distal to the target, thereby limiting cumulative dose to surrounding organs at risk (OARs). We compared the dose to carotid arteries and other OARs with IMRT/VMAT versus PRT for two patients who had reRT for locally recurrent cancers of the tongue base. Materials/Methods: Comparative plans with photons using an IMRT or VMAT technique and PRT with uniform scanning or pencil beam scanning technique were generated for two patients on Eclipse and RayStation planning systems. Both patients had BOT recurrences that were located centrally within the high dose region of previous RT fields. They also received elective nodal RT for their initial BOT cancers and hence their carotid arteries were irradiated. The patients developed local recurrences after one and 3 years following initial RT. The BOT recurrences were treated to a dose of 66-72 Gy. Elective nodal RT was not given with reRT. Target cover and OAR doses, including dose to the carotid artery were evaluated by standard dose volume histograms. Results: In both patients, the proton plans spared the surrounding OARs including carotid arteries better than IMRT or VMAT photon plans. For patient 1, mean dose to both carotids was lower with protons (right, 3.0 vs 28.0 Gy; left, 4.8 vs 15.7 Gy). Dose to the spinal cord (max, 0 vs 14.9 Gy) was also lower with protons versus photons. Similarly, in patient 2, the proton plan had a lower mean dose to both carotids (right, 5.9 vs 15.9 Gy; left, 0.7 vs 8.1 Gy) and parotids (right, 1.6 vs 19.0 Gy; left, 0 vs 10.7 Gy). Both techniques provided adequate target coverage. Conclusion: Compared with conformal photon techniques such as IMRT/VMAT, proton radiotherapy reduces dose to previously irradiated carotid arteries and other surrounding OARs during treatment of recurrent cancers of the base of tongue. In the re irradiation setting, this advantage may translate to a reduced risk of a fatal carotid blow out. This case study suggests that proton therapy should be considered for reirradiation of locally recurrent tongue base cancers.

**MSRO25-09 Hyperbaric Oxygen Therapy for Radiation Induced Toxicity: A Retrospective Review from a Single-Institution**

**Participants**
Leah Katz, MD, MPH, New York, NY (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Adverse radiation (RT) side effects pose an important barrier to progress in the field of radiation oncology. While hyperbaric oxygen therapy (HBOT) is recognized as an effective treatment for RT side effects, in particular for osteoradionecrosis (ORN); many radiation oncologists fail to refer patients. We evaluated NYU’s HBOT experience over the past three years to assess its safety and efficacy in treating various RT toxicities. It is our hope that clinicians consider HBOT more often to treat life threatening complications of RT. Followup visits reported no telangiectasia and good cosmetic outcomes. Conclusion: This study demonstrates a practical approach to radiotherapy of the nose which minimizes air gaps and daily setup variability, while achieving dose homogeneity with minimal hotspots.
effects. Results: Each RT injury category was evaluated. Symptoms associated with RT soft tissue injury included chronic wound infection, vaginal bleeding/pain, rectal pain, dyspareunia, and perineal pain. 38% of patients had complete resolution of symptoms after HBOT alone, 31% underwent adjuvant flap closure with complete wound healing, and 31% experienced no wound healing. For radiation cystitis, 60% had complete symptom resolution within a one month period after HBOT. A single patient treated for a rectal bladder fistula enjoyed complete resolution of the fistula with cessation of rectal urine drainage within one month after HBOT. Patients with ORN of the mandible with BRONJ stage I experienced complete resolution of intraoral deficits. Patients with BRONJ stage 2 experienced complete resolution of infection after HBOT with adjuvant debridement. Patients with BRONJ stage 3 experienced complete fracture healing after HBO with adjuvant mandibulectomy. Conclusion: The NYU experience demonstrates both safety and efficacy in ameliorating symptoms and improving patient quality of life with various types of RT morbidity. Our data encourages early referral to HBOT in an effort to save patients time, medical costs, energy, and psychological stress associated with ineffective medical measures. This study encourages further research with longer follow-up to better define the benefit and durability of HBOT.
B. All patients were evaluated using the Childhood Hodgkin International Prognostic Score (CHIPS) class 0-4. The CHIPS score cm and the median cranio-caudal bulky disease was 13 cm. Eleven patients (65%) had high-risk disease (stages IIBX, IIIB, IVA, or (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (X). The median axial bulky disease was 9 15 years, 5 patients (29%), and 16-18 years, 9 patients (53%). Nine patients (53%) were male and 8 (47%) were female. Stage

Between 2010 and 2014, 17 patients ages 18 years and younger were treated with PT for HL and enrolled on a prospective institutional review board-approved outcomes tracking protocol. Age distribution was as follows: 6-8 years, 3 patients (18%); 12-15 years, 5 patients (29%), and 16-18 years, 9 patients (53%). Nine patients (53%) were male and 8 (47%) were female. Stage distribution was as follows: stage I, 0 patients; stage II, 4 patients (23%); stage III, 7 patients (41%); stage IV, 3 patients (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (X). The median axial bulky disease was 9 cm and the median cranio-caudal bulky disease was 13 cm. Eleven patients (65%) had high-risk disease (stages IIIB, IIIIB, IVA, or B). All patients were evaluated using the Childhood Hodgkin International Prognostic Score (CHIPS) class 0-4. The CHIPS score

Purpose/Objective(s): The Children's Oncology Group upcoming protocol, AHOD1331, for pediatric high-risk Hodgkin lymphoma (HL) allows the use of proton therapy (PT). PT reduces the radiation dose to organs at risk, which should translate into fewer long term side effects, yet minimal data exist on the use of PT in HL. The purpose of this study is to determine whether PT is an effective and safe treatment for pediatric HL. Herein, we present our institutional experience treating pediatric HL with PT.

Materials/Methods: Between 2010 and 2014, 17 patients ages 18 years and younger were treated with PT for HL and enrolled on a prospective institutional review board-approved outcomes tracking protocol. Age distribution was as follows: 6-8 years, 3 patients (18%); 12-15 years, 5 patients (29%), and 16-18 years, 9 patients (53%). Nine patients (53%) were male and 8 (47%) were female. Stage distribution was as follows: stage I, 0 patients; stage II, 4 patients (23%); stage III, 7 patients (41%); stage IV, 3 patients (18%); and relapsed, 3 patients (18%). Thirteen (76%) had bulky mediastinal disease (X). The median axial bulky disease was 9 cm and the median cranio-caudal bulky disease was 13 cm. Eleven patients (65%) had high-risk disease (stages IIIB, IIIIB, IVA, or B). All patients were evaluated using the Childhood Hodgkin International Prognostic Score (CHIPS) class 0-4. The CHIPS score
distribution consisted of 3 (18%) class 0, 4 (23%) class 1, 6 (35%) class 2, 3 (18%) class 3, and 1 (6%) class 4 patients. Total PT dose was a median of 21 Gy (RBE) (range, 15-36 Gy[RBE]), including 7 patients (41%) treated with a sequential boost. Of 14 de

do novo patients, we obtained 11 PET and 12 CT images after 2 or 3 cycles of chemotherapy (mid-point). Seven patients (64%) had a partial response (PR) and 3 (36%) had a complete response (CR) on PET. Nine (75%) had a PR and 3 (25%) had CR on CT. Two of 3 (67%) recurrent patients achieved a PR on CT and PET and 1 patient achieved a CR before stem cell transplantation. Median follow-up for the cohort was 24 months (range, 4-52 months).Results: The 2-year overall survival rate was 93% and the progression-free survival rate was 80%. Three high risk patients recurred: 1 with an isolated in-field cervical lymph node and 2 recurred both in field and out of field. All recurrences were discovered within 5 months from completing PT. One patient with stage IVB died of a recurrence 7 months after treatment. The 2 other patients had stage IIB and stage IVA disease, and both had mid-treatment PET-positive disease. No PT-related grade 3 or higher acute or late complications were observed according to CTCAEv4.Conclusion: Our results indicate that PT for pediatric HL is safe and effective in our generally unfavorable cohort of patients. In future studies, considerations will include increasing doses for patients with PET-positive disease at the midpoint of chemotherapy.

**SSC11-05**  
**Risk Factors and Patterns of Lymph Node Involvement in Gastric Large B Cell Lymphoma: Implications for Target Definition**

**Monday, Nov. 30 11:10AM - 11:20AM Location: S104A**

**Participants**

ximei zhong, Oak Brook, IL (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To identify the appropriate radiation field in primary gastric diffuse large B-cell lymphoma (PG-DLBCL).Materials/Methods: The clinical and pathological findings of 48 PG-DLBCL patients treated with total gastrectomy and D2 lymphadenectomy were retrospectively analyzed. In addition, factors associated with lymph node involvement were also analyzed. Results: There were 26 patients with stage I disease, 14 patients with stage II and 8 patients with stage III disease. Lymph node involvement was identified in 37.5% of the whole series. Primary location, as well as the depth of invasion was significantly associated with lymph node involvement. The rate was rather low when gastric antrum was involved whereas when the whole stomach was involved, the rate could be as high as nearly 70%. The rate increased with the depth of invasion into stomach. Tumors invading into mucosa and submucosa, serosa and adjacent organs had a lymph node involvement rate of 0, 55.6% and 70%, respectively. When tumor was limited to the deep muscularis, the involved lymph nodes were all peri gastric nodes. For tumors invading upon muscularis, the involved lymph nodes were regional nodes. With a median follow up of 35 months, eight patients had developed progressive disease or a relapse, however, none of the patients who underwent adjuvant radiotherapy had disease progression or relapse.Conclusion: The radiation field for patients with PG-DLBCL is largely dependent on the primary location and depth of invasion. Large series as well as longer follow up are needed to further demonstrate the appropriateness of radiation volumes for PG-DLBCL.

**SSC11-06**  
**Hypofractionated Radiation Therapy in the Evolving Paradigm of Treating Nasal-Type Extranodal Natural Killer/T-CELL Lymphoma**

**Monday, Nov. 30 11:20AM - 11:30AM Location: S104A**

**Participants**

Amandeep Taggar, Oak Brook, IL (Presenter) Nothing to Disclose  
Douglas Stewart, MD,FRCPC, Calgary, AB (Abstract Co-Author) Nothing to Disclose  
Theresa Trotter, Calgary, AB (Abstract Co-Author) Nothing to Disclose  
Alexander G. Bolough, MD, MSC, London, ON (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Extranodal natural killer/T-cell lymphoma (ENKTL) is a rare and lethal malignancy with no consensus on its optimal management. External beam radiation (RT) is often used in its treatment with dosages of 45-50 Gy in 1.8-2.0Gy fractions delivered over 5 weeks. At our institution, a RT dose of 30 Gy in 3 Gy fractions over 2 weeks was introduced in 2006. Adjuvant therapies and autologous stem cell transplant (ASCT) were later introduced. It was hypothesized that this hypofractionated regimen would offer similar outcomes to the standard regimen, while shortening the duration of RT, because patients were progressing while on or shortly after the 5-week regimen. We look to describe our results by reporting on disease/treatment characteristics and survival outcomes in a cohort of patients treated in the era of 45-50 Gy and then with 30 Gy.  

Materials/Methods: The clinical records of patients presenting with ENKTL at our tertiary institution between 1999 and 2013 were retrospectively reviewed. Demographics, vital statistics, tumour characteristics and treatment parameters were extracted from the medical records. Results were examined using SPSSv.22 for both the descriptive analysis and survival. Non-parametric approaches including the Mann-Whitney U test was used to compare differences in outcomes between both groups. Results: The records of n=19 with nasal-type ENKTL were identified. Median age was 58.7 years. Median follow-up was 10.8 months (range(R): 4.4-43.9 months). Stage at presentation: 14 - stage I/II, 2 - stage IV and 3 - stage unknown. The observed median survival was 10.8 months. 2 year overall survival was 36%. N=17 received RT; n=10 received 30Gy in 10 fractions, n=1 received 35 Gy in 20 fractions and n=6 received 45 Gy in 25 fractions (of which 2 patients did not complete due to disease progression, and received 41.4 Gy in 25 and 36 Gy in 18 fractions). Among those patients who died, median time to death (MTD) was 7.2 months (R:5.4-29.8 months) for patients receiving the 30 Gy regimen versus 1.5 months (R:0.4-6.9 months) for those receiving standard dose-fractionation (p=0.05). In total, 12 patients received chemotherapy and 4 out of 12 subsequently received ASCT. All patients who proceeded to ASCT were treated with hypofractionated regimen. All patients who treated with RT plus ASCT are alive at a median follow-up of 42.4 months. N=7 of those receiving adjuvant chemotherapy relapsed, of which 2 had “in-field” recurrences. Median time to relapse was 12.4 months (R:6.5-19.4m) from diagnosis and 8.9 months (R:5.4-16.8 m) from the date RT. Conclusion: Patients treated in the post 2006 era of our hypofractionated regimen with 30Gy/10 fractions had improved OS outcomes compared to traditional dose fractionations. There remains a role for dose escalation to minimize in-field recurrences and more effective systemic agents to further delay relapses.

**SSC11-07**  
**Prospective Absorbed Dose Based Combined Treatment Planning and Therapy Using 153Sm-EDTMP Radiopharmaceutical with External Beam Radiation Therapy in Metastatic Osteosarcoma Patients**

**Monday, Nov. 30 11:30AM - 11:40AM Location: S104A**

**Participants**

zhang, Oak Brook, IL (Presenter) Nothing to Disclose

**Abstract Co-Author**

Theresa Trotter, Calgary, AB (Abstract Co-Author) Nothing to Disclose

**Abstract Co-Author**

Alexander G. Bolough, MD, MSC, London, ON (Abstract Co-Author) Nothing to Disclose
ABSTRACT

Purpose/Objective(s): Metastatic osteosarcoma is a cancer of adolescents and young adults that has a very low survival rate. We present results and describe a methodology related to an ongoing trial designed to boost the radiation dose to lesions in cases where external beam radiation therapy (XRT) is limited by normal organ toxicity. We combine radiopharmaceutical therapy (RPT) using 153Sm-EDTMP, an FDA approved bone seeking calcium mimetic with XRT, and provide a treatment plan that incorporates the dose from both modalities.

Materials/Methods: Three patients have been treated thus far under this protocol. The patients first underwent stem cell harvesting, then received a 1 mCi/kg pre-therapeutic dose of 153Sm-EDTMP and were imaged at 4, 24 and 48 h p.i. The in-house RPT treatment planning system, 3D-RD, was used to establish the maximum safe administered activity based on normal tissues absorbed dose (AD) constraints derived from RPT and the projected XRT treatment plan. One week after the pre-dose, a therapeutic dose, determined from the pre-therapeutic dosimetry and ranging from 10 - 15 mCi/kg of 153Sm-EDTMP was administered, and the patients imaged at 4, 24 and 48 h p.i. The images were reconstructed with an iterative algorithm including count-rate saturation corrections. AD-maps and DVHs were generated using 3D-RD for the RPT part of the treatment. These were entered into the XRT treatment planning system, which was used to create a renewed combined RPT/XRT treatment plan that incorporated the real Sm-153 dose deposition.

Results: Results for three patients will be shown. As an example for a pelvic tumor in patient 2: the AD delivered to the tumor by RPT was 25.5 Gy. The XRT plan was created based on the RPT plan and another 51.3 Gy was delivered to the tumor by XRT, resulting in a total tumor AD of 76.8 Gy. The AD to adjacent spinal cord from the combined treatments was 30.9 Gy, lower than the maximum tolerable AD of 52 Gy; the threshold dose of 75 Gy would not have been possible with XRT alone.

Conclusion: The treatment planning protocol combining RPT and XRT for metastatic osteosarcoma in pediatric patients showed potential to treat a highly aggressive disease, while limiting the AD to normal organs to below potentially toxic thresholds.

SSC11-08 Evaluation of the Response to Intratumor Implantation of Nanoparticles Activated by External Beam Radiation Therapy in Sarcoma by DCE-US and MRI: Radiologic-Pathology Correlation

Monday, Nov. 30 11:40AM - 11:50AM Location: S104A

Participants
Samy Ammari, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Laurent Dercle, MD, Villejuif, France (Presenter) Nothing to Disclose
Thierry Debaere, Villejuif, France (Abstract Co-Author) Consultant, Terumo Corporation; Speaker, Terumo Corporation; Consultant, Guerbet SA; Speaker, Guerbet SA; Consultant, General Electric Company; Speaker, General Electric Company; Proctor, Galil Medical Ltd
Sylvie Bonvalot, MD, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Jean-Charles Soria, Villejuif, France (Abstract Co-Author) Nothing to Disclose
Nathalie B. Lassau, MD, PhD, Villejuif, France (Abstract Co-Author) Speaker, Toshiba Corporation; Speaker, Bracco Group; Speaker, Novartis AG; Speaker, Pfizer Inc; Speaker, F. Hoffmann-La Roche Ltd

PURPOSE

Nanoparticles activated by external beam radiation therapy (EBR) are new drugs tested in phase 1 trial in patients with soft tissue sarcoma of the extremity and trunk wall. Using current thresholds, there is a poor agreement between RECIST1.1 and the response to treatment. We aimed to determine the predictive value of biomarkers measured on MRI and Dynamic contrast-enhanced ultrasound (DCE-US).

METHOD AND MATERIALS

14 patients with a histological diagnosis of sarcoma received an injection of nanoparticles in a phase I study with NBTXR3. Once implanted in the tumor, they were activated by EBR (Day 2 until day 37). DCE-US and MRI (T1, T2, gadolinium) were performed at baseline and prior to the surgery (realized at 5 weeks). Biomarkers tested on MRI were: RECIST, WHO, Volumetric approach. Biomarkers tested on DCE-US were: Area Under Curve (AUC, quantitative) and DCE (Contrast enhancement in %, qualitative). A new biomarker: the percentage of tumor volume with increased T2-weighted signal (iT2%) or cystic on DCE-US was evaluated:

RESULTS

At baseline 14MRI and only 12 DCE-US were analyzed. The estimation of the tumor volume by US (r=.85) and MRI (r=.75) was significantly correlated with the pathology specimen. CV% was significantly correlated with the PVC (r=.57) and the percentage of necrosis (r=.65). RECIST and the relative variation of volume were correlated with the PVC: r=.63 and .57. The other biomarkers were not significantly correlated with the percentage of VC or of necrosis within the tumor volume.

CONCLUSION

The response to a treatment with nanoparticles activated by EBR lead to the apparition of a cystic portion within the overall tumor volume (CV%) that may be evaluated non-invasively by either MRI or US. and is a good predictor of the percentage of tumor necrosis and of viable cells. Changes in volume (US and MRI) are correlated with the PVC and it suggests that an adaptation of thresholds might be necessary.

CLINICAL RELEVANCE/APPLICATION

Nanoparticles activated by EBR are new drugs and RECIST1.1 is not a good predictor of the response to treatment. New biomarkers are needed.

SSC11-09 Outcomes of Adjuvant Radiation Therapy for Retroperitoneal Soft Tissue Sarcoma

Monday, Nov. 30 11:50AM - 12:00PM Location: S104A

Participants
Eric D. Miller, MD, PhD, Columbus, OH (Presenter) Nothing to Disclose
Nicole Andonian, Columbus, OH (Abstract Co-Author) Nothing to Disclose
PURPOSE
To evaluate outcomes of patients treated with adjuvant radiation therapy (RT) for retroperitoneal soft tissue sarcomas (RP STS) at our institution.

METHOD AND MATERIALS
The medical records of 34 consecutive patients with RP STS treated definitively between 1998-2013 were reviewed. Survival analyses were conducted using the Kaplan-Meier method and subsets of patients were compared using the log rank test.

RESULTS
Eighteen men and 16 women were included with a median age of 56 years (range 30-80). The most common histologies were liposarcoma (53%) and leiomyosarcoma (21%). The majority of patients had tumors >10 cm in size (53%). 26% of patients were stage III and 38% of patients were high grade. 21% of patients were treated for recurrent disease and 18% were treated for persistent disease after initial non-oncologic resection. All patients underwent resection and received RT as part of their treatment. 68% of patients had positive or close (<2 mm margins). 76% of patients completed external beam radiation therapy (EBRT). 62% of patients had RT delivered post-operatively with a median total dose of 45 Gy (range 39.5-54) and 38% of patients had pre-operative RT with a median total dose of 45 Gy (range 45-55). Intraoperative radiation therapy (IORT) was delivered in 82% of patients with 8 patients treated with IORT alone without EBRT. The median IORT dose was 12.5 Gy (range 10-15). At a median follow-up of 48 months (range 3-172), the 5-year LC, DFS, and OS rates were 62%, 50%, and 67%, respectively. 47% of patients ultimately failed with 35% failing locally, 15% failing distantly, and 3% failing both locally and distantly. RT timing delivered either pre- or post-operatively did not impact LC (p=0.68), DFS (p=0.65), or OS (p=0.46). Patients with recurrent disease had reduced LC (p<0.0001) and DFS (p<0.0001) but no effect on OS (p=0.46) was observed. There were no adverse effects on LC (p=0.01), DFS (p<0.001), or OS (p=0.02) in patients who were treated after initial non-oncologic resection as long as they received definitive treatment afterwards.

CONCLUSION
Patients with RP STS are most likely to fail locally. Based on our data, pre- vs. post-operative radiation and treatment following initial non-oncologic resection had no impact on outcomes. However, patients with recurrent disease were more likely to have a local or distant failure.

CLINICAL RELEVANCE/APPLICATION
Patients with RP STS fail locally with worse outcomes for recurrent disease.
**Radiation Oncology Monday Poster Discussions**

**Monday, Nov. 30 12:15PM - 12:45PM Location: RO Community, Learning Center**

**RO231-SD-MOA1**

**Co-registration of PSMA PET/CT and 3Tesla-MRI with Histopathological Slices in Primary Prostate Cancer**

Station #1

**Participants**
Beatriz E. Amendola, MD, Coral Gables, FL (*Moderator*)
Clifton D. Fuller, MD, PhD, Houston, TX (*Moderator*)

**Sub-Events**

**PURPOSE**

The aim of this study is to develop a methodology for the comparison of pathology specimens after prostatectomy with different images captured (PET/CT and 3Tesla-MRI) before surgery. Magnetic resonance imaging (MRI) is the standard of care in diagnosis of primary prostate cancer (PC). It can be used to accurately contour treatable intraprostatic tumor foci. A new radioactive-labelled tracers targeting prostate specific membrane antigen (PSMA) showed promising preclinical and clinical results in diagnosis of primary PC by positron-emission tomography (PET/CT). There is no direct comparison of PSMA-PET/CT and multiparametric MRI in the current literature.

**METHOD AND MATERIALS**

In our work we used in-vivo and ex-vivo imaging of the prostate. 10 preoperatively selected patients received both diagnostic modalities. After prostatectomy, the prostate was placed in a localizer and embedded in agarose. A postoperative CT-scan was performed and the prostate was cut into 4 mm slices, which have the same position and angle as the postoperative CT-slices. The pathology slices, postsurgery CT and presurgery imaging slices were co-registered in the MITK software. The postsurgery CT slices of the prostate were taken as the reference coordinate. Presurgery PET/CT and MRI imaging slices were reoriented on the postsurgery CT of the prostate fixed in the localizer using manual image fusion. Therefore, the presurgery imaging slices (PET/CT and MRI) corresponded with the postsurgery CT slices and consequently with histopathology. We evaluate if SUVmax of PSMA is located within histopathologically confirmed tumoral tissue. Furthermore we define Specificity and Sensitivity for both image modalities within the same population.

**RESULTS**

We present a new method of PSMA-PET/CT/3T-MRI-imaging/pathology co-registration in primary localized PC, which serves as a link between multimodal imaging in vivo and histopathological information in vitro. The results of this study could have a significant impact on the development of new radiation treatment strategies in primary PC.

**CONCLUSION**

Evaluation of MRI and PSMA PET imaging in comparison with histopathology within the same population has an impact for developing new standards in diagnosis of primary prostate cancer.

**CLINICAL RELEVANCE/APPLICATION**

Our presented data is of clinical relevance and has an impact for developing new standards in diagnosis of primary prostate cancer.

**RO213-SD-MOA2**

**The Clinical Value of DKI as An Early Predictor in Concurrent Chemo-radiotherapeutic Response of Advanced Nasopharyngeal Carcinoma**

Station #2

**Participants**
Yunbin Chen, MD, Fuzhou, China (*Presenter*)
Qiyuan Yue, Fuzhou, China (*Abstract Co-Author*)
Dechun Zheng, MS, Fuzhou, China (*Abstract Co-Author*)
Mingwei Zhang, Fuzhou, China (*Abstract Co-Author*)
Meng Liu, Fuzhou, China (*Abstract Co-Author*)
Ying N. Chen, PhD, Fuzhou, China (*Abstract Co-Author*)
Chunniao Hu, Fuzhou, China (*Abstract Co-Author*)
PURPOSE
To evaluate the clinical value of Diffusion Kurtosis Imaging (DKI) as an early predictor for concurrent chemo-radiotherapy (CCRT) treatment response in advanced nasopharyngeal carcinoma (NPC) patients.

METHOD AND MATERIALS
Thirty-seven newly diagnosed advanced NPC patients were enrolled during September 2013 and January 2015 and received three MRI scans using a 3.0T MRI scanner: at baseline (Pre-Tx), after 2 cycles neoadjuvant chemotherapy and before CCRT (Pre-CCRT), and on the sixth day of CCRT initiation (CCRT-6th) respectively. DKI parameters including corrected diffusion coefficient (D) and excess diffusion kurtosis coefficient (K) were obtained from dedicated software. Patients were divided into responder group (RG) and non-responder group (NRG) after CCRT according to the response evaluation criteria in solid tumors (RECIST). ΔD1 and ΔD1% represented the differences and percentage changes between D(CCRT-6th) and D (Pre-CCRT). ΔD2 and ΔD2% represented the differences and percentage changes between D(CCRT-6th) and D(Pre-Tx). Mann-Whitney U test, receiver operating characteristic (ROC) curve were applied in Statistical analyses.

RESULTS
The ΔD1 and the ΔD1% in RG were significantly larger than that in NRG (p=0.010, p=0.005). ROC analyses proved diagnostic accuracy of ΔD1 and ΔD1% to distinguish NRG from RG were 0.790 and 0.813 respectively, of which the sensitivity and the specificity were both 96.4% and 55.6%. No significant statistical differences could be found in ΔD2, ΔD2% and the rest values between RG and NRG (Table 1).

CONCLUSION
The change of D value of primary tumor within a week might be an effective and early predictor for predicting tumor response to CCRT in advanced NPC patients.

CLINICAL RELEVANCE/APPLICATION
DKI may help to identify proper candidates to undergo adaptive radiotherapy thus provide a reference of tumor radiosensitivity to optimize individual therapeutic strategies.

RO214-SD-MOA3
Nomograms for Individualized Conditional Survival Prediction in Locally Advanced Laryngeal Cancer Based on Weibull Parametric Hazards Modeling

PURPOSE
To formulate a survival prediction model relevant to patients with advanced laryngeal cancer at the time of diagnosis and to formulate a conditional survival prediction model that reflects a changing mortality hazard. To compare these two models and their predictions for a common survival time point, and to generate nomograms that can be implemented in the clinical setting to formulate individualized prognoses.

METHOD AND MATERIALS
Using an institution-specific database of 638 patients presenting with T3-T4 laryngeal cancer between 1983 and 2011, the influence of age, primary site, performance status, T and N classification, smoking status at diagnosis, and, when applicable, type of chemotherapy on 8 year overall survival (OS) from the time of diagnosis and 5 year survival conditional on 3 years of survival were determined using a Weibull parametric hazards model with a stepwise AIC reduction algorithm. The resulting models were converted into nomograms.

RESULTS
Five year OS was 56% (95% CI [CI] 52 - 60%), 8 year survival was 42% (CI 38 - 47%), and overall survival (OS) for an additional 5 years from the 3 year follow up time point was 62% (CI 56 - 67%). At diagnosis, non supraglottic site (hazard ratio [HR] 0.72, CI 0.55 - 0.94, p-value [p] = 0.017), presence of nodal disease (HR=1.98, CI=1.48 - 2.40, p<0.001), induction chemotherapy (HR=0.68, CI=0.47 - 0.98, p=0.039), age (HR=1.03, CI=1.02 - 1.04, p<0.001), and performance status (HR=1.42, CI=1.13 - 1.78, p=0.002) were significant predictors of OS on multivariate regression. At the 3 year time point, analysis of the 361 survivors represented the differences and percentage changes between D(CCRT-6th) and D (Pre-CCRT). ΔD2 and ΔD2% represented the differences and percentage changes between D(CCRT-6th) and D(Pre-Tx). Mann-Whitney U test, receiver operating characteristic (ROC) curve were applied in Statistical analyses.

CONCLUSION
The prognostic information available at the time of diagnosis does not reflect the changing hazards specific to locally advanced laryngeal cancer. Conditional survival can be used to determine a more accurate prognosis during predetermined follow up time points.
Conditional survival analysis adjusts for changing mortality hazards in advanced laryngeal cancer and can be implemented during discrete follow up time points for more accurate survival predictions.

A Comparison Between VMAT, IMRT and GAP Techniques on the Meduloblastoma Approach: Different Technologies Aiming Better Patient Care

Station #5

Participants
Daniel Przybysz, MD, RIO DE JANEIRO, Brazil (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To compare and analyze different types of treatment delivery (VMAT, IMRT and conventional 3D with GAP) to Meduloblastoma patients, intending to maximize disease's site proper dose without compromising noble structures that usually share boundaries with the tumor. Materials/Methods: 12 patients (age range 2-45 years old, mean 14 years) with biopsy proven diagnosis of Meduloblastoma were assigned to Radiation Therapy with three different treatment techniques (VMAT, IMRT and conventional 3D with GAP) and planned to be treated with 36 Gy @ 20 fractions. The following organs at risk (OAR) were delineated: optic chiasm, optic nerves, lens, retinas, jaw, kidneys and vertebrae. All OAR's doses were optimized on IMRT and VMAT to be as low as possible, respecting the Quantec tolerance doses guidelines. PTV was set to be an outer margin of 5mm from CTV. We here used Varian's planning system Eclipse to delineate and establish treatment properties, along with the linear accelerator Trilogy (equipped with MLC Millennium 120) to deliver treatment. 6 MV photon energy was the standard for all patients. Conventional 3D technique used two fields on the spinal cord area, separated by a 1cm gap and two cranial fields with angled collimator. Pencil Beam Convolution was the algorithm used. Sliding window technique was used for IMRT, where 3 fields were used on each superior and inferior site of the spinal cord. VMAT plans used a 359,8º arc. Collimator rotated to a 5º angle (355º).

Standard doses were set up to treat 98% of PTV volume with 100% of the prescribed dose. We also used a heterogeneity index for all cases. Results: Data showed that 3D conventional technique and VMAT had a lower mean monitor unity (MU), meeting the recent literature published. 3D technique showed the highest homogeneity index, bringing a higher dose gradient variation to our patient. Mean dose values were in general lower for the VMAT technique. IMRT showed to be the safest treatment on delivery high doses without damaging vertebrae, lungs and/or the heart. Although, no significant difference was observed among patient's breasts regarding doses delivered. Conclusion: High technology treatment options have shown to be significantly important on the matter of delivering the correct dose to tumor area, preserving with a considerable safe margin noble tissues. New and upcoming techniques such as VMAT and IMRT should be strongly recommended in order to treat Meduloblastoma, having in mind that this disease has a great incidence in children and young adults - where aiming for the right target could mean better quality of life, overall survival and less toxicities.

Megavoltage Radiation Therapy of Skin Malignancies of the Nose Using Custom Nasal Paraffin Bolus

Station #9

Participants
Randy Wei, MD, Orange, CA (Presenter) Nothing to Disclose
Juying Zhang, PhD, Long Beach, CA (Abstract Co-Author) Nothing to Disclose
Samar Azawi, MD, Long Beach, CA (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To treat surface malignancies, bolus materials are used to enhance the dose delivered at the surface and to reduce hot and cold spots due to sharp surface irregularities and oblique incident angles. Radiation treatment of skin malignancies on the nose is challenging due to the irregular surface anatomy of the nose to which homogenous dose must be delivered. Materials/Methods: Superflab is a commonly used bolus material that is non-conformal for irregular surface contours of the nose making it difficult to reproducibly apply and maintain. Additionally, air gaps from non-conformal bolus will result in dose inhomogeneity. We present our experiences and outcomes using custom-made paraffin bolus to conform to the shape of the nose for the treatment of basal cell cancer (BCC) or squamous cell cancer (SCC). A mold of the patient's nose was created and a negative impression was made in a paraffin rectangle block. Minimum thickness was 1.5 cm laterally and 1 cm anterior-posteriorly. Thin coating of petroleum jelly was applied within bolus to reduce air gaps. Nine patients were treated to 60 Gy at 2 Gy per with parallel opposing 6x MV photon beams using three-dimensional conformal treatment planning. Six patients had BCC and three patients had SCC. Six patients had two or more distinct sites of disease. Results show that 100% prescription isodose line conforms to the planned target volume and dose to critical structures are well below tolerance limits. Daily kilovoltage orthogonal and weekly cone beam CT show close patient and wax bolus contact and reproducibility. Six thermoluminescent dosimetry (TLD) chips (LiF) were used to measure doses deposited and matched the planned dosimetry for each patient. TLD measurements showed a 2.6% average difference between planned dose and delivered dose. Results: Of the 9 patients treated with this method, maximum hot spot was 102.7% (101.1%-104%) for all 9 plans. Mean follow-up time was 25 months (10 – 58 months). Of the 9 treated, two patients developed new lesions on the nose and one patient had recurrent disease at the columella. Acute side effects were erythema and congested nose. None of the patients developed RTOG Grade 3 skin toxicity immediately following radiation treatment. Followup visits reported no telangiectasia and good cosmetic outcomes. Conclusion: This study demonstrates a practical approach to radiotherapy of the nose which minimizes air gaps and daily setup variability, while achieving dose homogeneity with minimal hotspots.
**RO223-SD-MOB3**

**DCE-MRI for Anticipating the Curative Effect of Chemotherapy in Patients with Nasopharyngeal Carcinoma**

**Station #3**

**Participants**
Beatrice E. Amendola, MD, Coral Gables, FL (*Moderator*) Speakers Bureau, Varian Medical Systems, Inc
Clifton D. Fuller, MD, PhD, Houston, TX (*Moderator*) In-kind support, General Electric Company; Research Grant, Elekta AB; ;

**Sub-Events**

**PURPOSE**
To evaluate dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) for anticipating the curative effect of chemotherapy in patients with nasopharyngeal carcinoma nasopharyngeal carcinoma (NPC).

**METHOD AND MATERIALS**

Fifteen newly diagnosed NPC patients were selected during May 2014~Dec 2014. All these patients were underwent conventional MRI examination and DCE-MRI. The GE cinetool software was used to analyze the raw data and obtained Ktrans, kep, Ve values and parameter maps of tumor tissues and longus capitis. Tumor eliminating rate of these patients with NPC were calculated after chemotherapy. Student's t-test was used to evaluate the differences between tumor tissues and normal longus capitis. Pearson's correlation between Ktrans, kep, Ve values and tumor eliminating rate were performed. Student's t-test.

**RESULTS**
There were statistically Significant differences of Ktrans, kep, Ve values between NPC tumor tissues and normal longus capitis (P<0.001). The Ktrans value 95% CI of NPC tumor tissue was 0.1962 (minute-1)~0.4667 (minute-1), and normal longus capitis was 0.0419 (minute-1)~0.1280 (minute-1). There was negative correlation between Ktrans and VE value of NPC tumor tissues and Tumor eliminating rate and Pearson correlation coefficient was -0.870 and -0.647 (p<0.05).

**CONCLUSION**
GE cinetool software can obtain quantitative kinetic parameter (Ktrans, kep, Ve). DCE-MRI can be used as one of the evaluation means of nasopharyngeal carcinoma (NPC) after chemotherapy. The difference of kinetic parameter between NPC tumor tissues and normal longus capitis is mainly caused by the difference of microcirculation; The ktrans and VE value of NPC tumor tissue can be used to predict tumor eliminating rate after chemotherapy, so as to guide clinical personalized treatment options before chemotherapy.

**CLINICAL RELEVANCE/APPLICATION**
The ktrans and VE value of NPC tumor tissue can be used to predict tumor eliminating rate after chemotherapy, so as to guide clinical personalized treatment options before chemotherapy.

**ABSTRACT**

Purpose/Objective(s): To evaluate dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) for anticipating the curative effect of chemotherapy in patients with nasopharyngeal carcinoma nasopharyngeal carcinoma (NPC).

METHOD AND MATERIALS:
Fifteen newly diagnosed NPC patients were selected during May 2014~Dec 2014. All these patients were underwent conventional MRI examination and DCE-MRI. The GE cinetool software was used to analyze the raw data and obtained Ktrans, kep, Ve values and parameter maps of tumor tissues and longus capitis. Tumor eliminating rate of these patients with NPC were calculated after chemotherapy. Student's t-test was used to evaluate the differences between tumor tissues and normal longus capitis. Pearson's correlation between Ktrans, kep, Ve values and tumor eliminating rate were performed. Student's t-test.

RESULTS:
There were statistically Significant differences of Ktrans, kep, Ve values between NPC tumor tissues and normal longus capitis (P<0.001). The Ktrans value 95% CI of NPC tumor tissue was 0.1962 (minute-1)~0.4667 (minute-1), and normal longus capitis was 0.0419 (minute-1)~0.1280 (minute-1). There was negative correlation between Ktrans and VE value of NPC tumor tissues and Tumor eliminating rate and Pearson correlation coefficient was -0.870 and -0.647 (p<0.05).

CONCLUSION:
GE cinetool software can obtain quantitative kinetic parameter (Ktrans, kep, Ve). DCE-MRI can be used as one of the evaluation means of nasopharyngeal carcinoma (NPC) after chemotherapy. The difference of kinetic parameter between NPC tumor tissues and normal longus capitis is mainly caused by the difference of microcirculation; The ktrans and VE value of NPC tumor tissue can be used to predict tumor eliminating rate after chemotherapy, so as to guide clinical personalized treatment options before chemotherapy.

CLINICAL RELEVANCE/APPLICATION:
The ktrans and VE value of NPC tumor tissue can be used to predict tumor eliminating rate after chemotherapy, so as to guide clinical personalized treatment options before chemotherapy.

**RO224-SD-MOB4**

**Feasibility of Involved Nodal Radiation Therapy (INRT) in Chemotherapy Followed by Radiation Therapy for Stage I-II Diffuse Large B-Cell Lymphoma of Head and Neck**

**Station #4**

**Participants**
Saiji Ohga, MD, Fukuoka, Japan (*Presenter*) Nothing to Disclose
Katsumasa Nakamura, MD, PhD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshiyuki Shioyama, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Tomonari Sasaki, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Tadamasa Yoshitake, MD, Fukuoka City, Japan (*Abstract Co-Author*) Nothing to Disclose
Koari Asai, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Keiji Matsumoto, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroshi Honda, MD, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshihiro Yamaguchi, Fukuoka, Japan (*Abstract Co-Author*) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To evaluate the feasibility of involved nodal radiotherapy in combined treatment of CHOP or R-CHOP followed by radiotherapy for stage I-II diffuse large B-cell lymphoma (DLBCL) of head and neck.

Materials/Methods: From 1990 to 2014, 103 patients with stage I-II DLBCL in head and neck were treated with the combined treatment of CHOP or R-CHOP followed by radiotherapy. Patients' age ranged from 17 to 86 years (median: 63 years). Sixty-nine were male and thirty-four were female. Performance status (PS) was 0-1 in 99 patients and 2-3 in 4 patients. Initial clinical stage was I in 51 patients and II in 52 patients. Nine patients (8.7%) had B symptom. The cycles of chemotherapy was 1-8 (median: 3). Dose of 30-61 Gy (median: 40 Gy) was delivered using involved nodal field (INRT: 10), involved field (IFRT: 27) or extended field (EFRT: 66). Eight of 10 patients with INRT underwent R-CHOP.

Results: The duration of follow-up was 6 to 283 months (median: 64 months). Of all patients, 26
patients relapsed after treatment and 12 died of progression of lymphoma. Seven patients died of intercurrent disease. Twenty-six patients (25%), who included 6 with IFRT and 20 with EFRT, experienced relapse after treatment. Six relapsed patient with IFRT included 2 in-field and 4 out-of-field relapses. Twenty relapsed patients with EFRT included 5 in-field and 15 out-of-field relapses. No patients with INRT relapsed. Overall and progression-free survival (PFS) rates at 5 years were 81.5% and 72.3%, respectively. In univariate analysis PFS was not significantly associated with radiation field. In multivariate analysis chemotherapy and PS were predictive factors for PFS. Conclusion: In combined treatment of chemotherapy followed by radiotherapy for stage I-II DLBCL of head and neck, involved nodal radiotherapy was feasible.

**ABSTRACT**

Purpose/Objective(s): Patients with head and neck squamous cells carcinoma (HNSCC) are at a higher risk of second primary malignancies (SPMs), most commonly in head and neck (HN), lung, and esophagus, accounting for 30% of deaths in HNSCC cases. In this study, we aim to compare the survival across treatment types in HNSCC patients with a HN, lung, or esophagus SPM.

Materials/Methods: The MP-SIR session in Surveillance, Epidemiology, and End Results (SEER) database was used to list the cases in 9 registries from 1973 to 2011. Patients who died from the index tumor, developed a third malignancy, or had an un-staged SPM were excluded. Treatment types for HN SPMs were defined as: local surgery, open surgery, radiation, radiation + local surgery, and radiation + open surgery. 'Local surgery' and 'radiation + local surgery' groups were excluded from lung and esophagus SPMs because of atypical treatment patterns. The Kaplan-Meier method with log-rank test was used to compare survival from the diagnosis of SPMs. Cox proportional hazards regression models were used to adjust for age, gender, race, time since index tumor, and staging.

Results: In total, 3051 patients (1056 HN, 1730 lung, 265 esophagus SPMs) meeting the inclusion criteria were identified, with a median age for index and secondary tumor of 61yo and 69yo, respectively. The median time of developing a SPM was 70mo (range 2-424). For HN SPMs, patients who received 'radiation + local surgery' had the highest OS rate (2-yr survival 87.1% (71.6-94.5%), 5-yr survival 65.2% (43.2-80.4%)). At the same time, 'local surgery' showed the best OS among all stages (107mo, (67.4-146.6)), localized (109mo, (78.0-140.0)), and regional (43mo, (24.4-61.6)) SPMs. The hazard of death was lower in younger patients (p=0.0372) with both localized index (pConclusion: Local surgery with or without adjuvant radiation has significantly superior survival outcomes in localized and regional HN SPMs. In secondary lung cancer, surgery shows a definitely superior survival compared to other treatments. Our results warrant further study into treatment decision-making for patients with HNSCC SPMs.
LEARNING OBJECTIVES

1) To understand the role of molecular imaging in cancer therapy. 2) To understand the impact that new molecular imaging agents could have on drug development. 3) To understand the barriers facing the development of new molecular imaging agents.

ABSTRACT

Molecular Imaging is expanding in many new directions. Most research is being performed for PET and SPECT agents. However, optical and MRI agents are also being developed. Molecular Imaging can play a role in accelerating the development and approval of new cancer therapeutics by quantifying the impact drugs have in early Phase studies and by selecting the most appropriate patients for trials. Molecular Imaging agents can be useful in determining the utility and mechanism of actions of drugs that are already approved and may provide insights to oncologists regarding the best treatment combinations for individual patients. Molecular Imaging methods have already expanded our knowledge of cancer behavior and this will ultimately lead to new forms of the therapy that will one day cure this dreaded disease.

Sub-Events

MSMI23A Overview of MI in Oncology

Participants

Peter L. Choyke, MD, Rockville, MD, (pchoyke@nih.gov) (Moderator) Researcher, Koninklijke Philips NV Researcher, General Electric Company Researcher, Siemens AG Researcher, iCAD, Inc Researcher, Aspyrian Therapeutics, Inc Researcher, ImaginAB, Inc Researcher, Aura Biosciences, Inc

Umar Mahmood, MD, PhD, Charlestown, MA (Moderator) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;

LEARNING OBJECTIVES

1) To understand the broad spectrum of activities in molecular imaging including PET, SPECT, optical and MRI. 2) To understand the potential impact of Molecular Imaging on cancer treatment.

ABSTRACT

Molecular Imaging is expanding at a rapid rate. This overview will provide a panoramic view of the field of Molecular Imaging and major trends that are emerging among the different modalities, PET, SPECT, optical, ultrasound and MRI that constitute molecular imaging.

MSMI23B Hyperpolarized MRI of Prostate Cancer

Participants

Daniel B. Vigneron, PhD, San Francisco, CA (Presenter) Research Grant, General Electric Company

LEARNING OBJECTIVES

View learning objectives under main course title.

MSMI23C Radiogenomics

Participants

Michael D. Kuo, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To discuss the principles behind radgiogenomics and to highlight areas of clinical application and future development.

ABSTRACT

MSMI23D Somatostatin Receptor Imaging

Participants

Ronald C. Walker, MD, Nashville, TN, (ronald.walker@vanderbilt.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the advantages of 68Ga-somatostatin PET/CT over 111In-DTPA-octreotide imaging. 2) Detect patients likely to benefit...
1) Describe the advantages of $^{68}$Ga-somatostatin PET/CT over $^{111}$In-DTPA-octreotide imaging. 2) Detect patients likely to benefit from peptide receptor radiotherapy (PRRT).

ABSTRACT

$^{68}$Ga-labeled somatostatin analogs (DOTATATE, DOTATOC and DOTANOC) PET/CT imaging provides higher resolution scans than $^{111}$In-DTPA-octreotide with less radiation, comparable cost, and imaging completion within 2 hours vs. 2-3 days. $^{68}$Ga-somatostatin analogs have a higher impact on care than $^{111}$In-DTPA-octreotide, including superior ability to identify patients likely to benefit from PRRT. This activity will provide results from the literature and the author's experience to illustrate the advantages of $^{68}$Ga-based PET/CT imaging of neuroendocrine tumors.

Active Handout: Ronald Clark Walker


**MSMI23E  Multimodal MI in Oncology**

Participants

Umar Mahmood, MD, PhD, Charlestown, MA (Presenter) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;

LEARNING OBJECTIVES

1) To understand strengths of various imaging modalities for specific target/disease assessment.

ABSTRACT

Each imaging modality has a set of characteristics that helps define optimal use. These constraints include sensitivity, depth of imaging, integration time for signal, and radiation dose, among other factors. Understanding when each modality can be used and when combining the relative strengths of different modalities can be synergistic allows greater molecular information to be acquired.
LEARNING OBJECTIVES

1) To learn the indications for image-guided ablation and transcatheter-based therapies for patients with HCC. 2) To understand the potential limitations, pitfalls, side effects and toxicities associated with ablative and transcatheter therapies for patients with HCC. 3) To know the results, imaging responses and survival benefit of various ablative and transcatheter therapies. 4) To know the future ablative and transcatheter therapies and understand their potential. 5) To learn the various combination therapies available and undergoing clinical evaluation for HCC.

ABSTRACT

LEARNING OBJECTIVES

1) Recognize the increasing incidence of HCC in the Western Hemisphere. 2) Learn about scoring the cirrhosis and staging the cancer. 3) Identify sorafenib as the standard care treatment for advanced HCC.

PURPOSE

The new Hong Kong Liver Cancer (HKLC) staging offers 9-stage and 5-stage classification for survival and treatment allocation for hepatocellular carcinoma (HCC), thought to be superior to the Barcelona Clinic Liver Cancer (BCLC) staging. A known limitation of the HKLC staging is the need for validation in non-HBV patient cohort. The purpose of this study is to compare the 9-stage HKLC against BCLC staging in a North American cohort and then identify any needs for improvement.

METHOD AND MATERIALS

968 HCC patients at a single institution who underwent TACE were retrospectively reviewed. 890 had sufficiently complete record to calculate the 9-stage HKLC and BCLC stages. Overall survival (OS) from date of first TACE to death or last note date was recorded. The performances of the HKLC and BCLC systems were compared through homogeneity, survival discrimination, monotonicity of gradients, and reduction in error of survival prediction. The staging systems were evaluated through Kaplan-Meier
(KM) estimate, Cox model’s likelihood ratio (LHR), linear trend (LT), Harrell’s C, Akaike’s information criterion (AIC), and % error reduction in survival.

RESULTS
The HCC etiologies in this cohort included 132 (14.8%) hepatitis B, 427 (48.0%) hepatitis C, 254 (28.5%) alcoholic, 60 (7.8%) NASH, and 60 (6.7%) no identifiable cause (some patients with overlapping etiologies). Median OS in months for HKLC were I (62.6), IIa (35.8), IIb (24.3), IIIa (12.3), IIIb (10.9), IVa (11.0), IVb (4.3), Va (10.5), and Vb (2.7), notable for similarity in OS among a few stages. Median OS for BCLC were A (51.6), B (24.3), C (12.2), and D (4.3). The 9-stage HKLC performed better on all statistical measures. Better homogeneity was found for HKLC (LHR: 249) than BCLC (LHR: 119). Superior survival discrimination was shown for HKLC (C=0.72, AIC=6200) than BCLC (C=0.64, AIC=6320). Monotonicity was better in HKLC (LT: 261) than in BCLC (LT: 111). Reduction in error of prediction for HKLC was 15.9% while BCLC was 11.8%.

CONCLUSION
The 9-stage HKLC staging system outperformed the BCLC staging system as a prognostic classification system on overall statistical measures, but similarity in survival for stages IIIa/b, IVa, and Va should be further explored and addressed.

CLINICAL RELEVANCE/APPLICATION
The HKLC staging system may become the next HCC staging system of choice after addressing some of the identified issues and completing further validations.

VSIO21-03 TACE Techniques, Indications, and Results: Western Perspective

Monday, Nov. 30 2:00PM - 2:20PM Location: S406B

Participants
Jean-Francois H. Geschwind, MD, Westport, CT (Presenter) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

LEARNING OBJECTIVES
1) To understand the indications for TACE and describe the various technical issues and clinical results of TACE.

VSIO21-04 Does DEB-TACE Enhance the Local Effect of IRE? Imaging and Histopathological Evaluation in a Porcine Model

Monday, Nov. 30 2:20PM - 2:30PM Location: S406B

Participants
Peter Isfort, MD, Aachen, Germany (Presenter) Nothing to Disclose
Philip Rauen, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Hong-Sik Na, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Nobutake Ito, MD, Yokohama, Japan (Abstract Co-Author) Nothing to Disclose
Christoph Wilkmann, DIPLENG, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Bruners, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

PURPOSE
Irreversible electroporation (IRE) is associated with a hypervascular penumbra of vital temporarily damaged tissue due to reversible electroporation. Transarterial treatment of this penumbra could increase local efficacy of IRE. We conducted an in-vivo trial on swine to compare the ablation volumes of an IRE/DEB-TACE combination vs. IRE-only.

METHOD AND MATERIALS
Nine swine underwent IRE in one liver lobe and DEB-TACE immediately followed by IRE in a different liver lobe. For DEB-TACE, 100-300 µm beads (DC-Beads®) were loaded with 50mg doxorubicin. For IRE, the NanoKnife® was used with two IRE electrodes according to the vendor’s recommended protocol. After one day (n=3), three days (n=3) and seven days (n=3) animals were sacrificed, and ablation volumes were evaluated histopathologically. Imaging follow-up was performed using contrast-enhanced CT and MRI. Lesion volumes were measured one day (n=9), three days (n=6) and 7 days (n=3) after the procedure.

RESULTS
Mean histopathological ablation volume of IRE/DEB-TACE combination lesions after one, three and seven days were 15.7 ± 11.1 ml, 11.8 ± 9.3 ml and 4.2 ± 1.4 ml. Mean histopathological ablation volumes of IRE-only lesions after one, three and seven days were 7.2 ± 4.5 ml, 4.0 ± 1.0 ml and 1.7 ± 1.5 ml. In intra-individual comparison the ablation volumes of the IRE/DEB-TACE combination group were on average 199.6 %, 163.4% and 98.5% larger than IRE-only lesions after one, three and seven days.

CONCLUSION
Combination of IRE followed by DEB-TACE resulted in larger ablation volumes compared to IRE alone suggesting that local efficacy of IRE can be enhanced by post-IRE DEB-TACE.

CLINICAL RELEVANCE/APPLICATION
Results suggest that local efficacy of IRE can be enhanced when additional DEB-TACE is performed in the target liver segment after ablation.

VSIO21-05 TACE Techniques, Indications, and Results: Eastern Perspective

Monday, Nov. 30 2:30PM - 2:50PM Location: S406B

Participants
LEARNING OBJECTIVES

1) To describe the various techniques and approaches used in TACE treatment. 2) To understand the indications and results of TACE in the treatment of HCC. 3) To discuss differences and similarities between Eastern and Western approaches in TACE.

VSIO21-06 Anti-tumor Effects of TAE Administered in Combination with Sorafenib in a Rabbit VX2 Liver Tumor Model

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Participants

Yuki Tomozawa, MD, Otsu, Japan (Presenter) Nothing to Disclose
Norihisa Nitta, MD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Shinichi Ohta, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Shobu Watanabe, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Akinaga Sonoda, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Ayumi N. Seko, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Keiko Tsuchiya, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kiyohsi Murata, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

A number of studies have been reported that a combination of Sorafenib with TACE has been a more effective treatment than Sorafenib or TACE alone in addition to being tolerable. Using a VX2 liver tumor model, we investigated the most suitable timing parameters when using Sorafenib to enhance the anti-tumor effects of TAE.

METHOD AND MATERIALS

20 Japanese white rabbits were randomly assigned to four equal groups two weeks after of VX2 tumor transplantation to the liver. We then performed the combination treatment with Sorafenib and TAE on the four groups in the according ways; Group 1 (TAE prior to administration of Sorafenib), Group 2 (TAE on the second day after administration of Sorafenib), Group 3 (TAE on the fourth day after administration of Sorafenib) and Group 4 (TAE after the end of administrating Sorafenib). Sorafenib (40mg/day) was orally administrated for consecutive 7 days starting on the day two week after tumor implantation. The anti-tumor effects were assessed by comparing the pre- and post-treatment tumor volumes measured on a contrast-enhanced CT scans and by immuno-histochemical analysis of the number of intra-tumoral vessels two weeks after the treatment.

RESULTS

Among the four groups, the tumor growth rate tended to be lower in Group 1 and Group 2 than in Group 3 and Group 4. The difference between Group 1 and Group 3 was significant. The number of CD31-positive intra-tumor vessels in specimens tended to be higher in Group 3 than in the other groups, although there was no significant difference.

CONCLUSION

We suggest that the ideal time of TAE is prior to or early after commencement of administration Sorafenib.

CLINICAL RELEVANCE/APPLICATION

To date, limited data has focused on the timing parameters when Sorafenib is combined with TACE.

VSIO21-07 Y90 Radioembolization: What We Know, and What We Need to Know

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Participants

Raed Salem, MD, MBA, Chicago, IL (Presenter) Research Consultant, BTG International Ltd; Research Grant, BTG International Ltd;

LEARNING OBJECTIVES

1) To describe primary and metastatic liver tumors. 2) To discuss current gaps in knowledge and ongoing clinical studies.

VSIO21-08 Predicting the Hepato-pulmonary Shunt Fraction Using 3D Quantification of Tumor Enhancement on Contrast-enhanced CT Imaging in Patients with Hepatocellular Carcinoma before Y90 Radioembolization

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Participants

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Abstract Co-Author

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Shinichi Ohta, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Shobu Watanabe, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Akinaga Sonoda, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
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Keiko Tsuchiya, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kiyohsi Murata, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

A number of studies have been reported that a combination of Sorafenib with TACE has been a more effective treatment than Sorafenib or TACE alone in addition to being tolerable. Using a VX2 liver tumor model, we investigated the most suitable timing parameters when using Sorafenib to enhance the anti-tumor effects of TAE.

METHOD AND MATERIALS

20 Japanese white rabbits were randomly assigned to four equal groups two weeks after of VX2 tumor transplantation to the liver. We then performed the combination treatment with Sorafenib and TAE on the four groups in the according ways; Group 1 (TAE prior to administration of Sorafenib), Group 2 (TAE on the second day after administration of Sorafenib), Group 3 (TAE on the fourth day after administration of Sorafenib) and Group 4 (TAE after the end of administrating Sorafenib). Sorafenib (40mg/day) was orally administrated for consecutive 7 days starting on the day two week after tumor implantation. The anti-tumor effects were assessed by comparing the pre- and post-treatment tumor volumes measured on a contrast-enhanced CT scans and by immuno-histochemical analysis of the number of intra-tumoral vessels two weeks after the treatment.

RESULTS

Among the four groups, the tumor growth rate tended to be lower in Group 1 and Group 2 than in Group 3 and Group 4. The difference between Group 1 and Group 3 was significant. The number of CD31-positive intra-tumor vessels in specimens tended to be higher in Group 3 than in the other groups, although there was no significant difference.

CONCLUSION

We suggest that the ideal time of TAE is prior to or early after commencement of administration Sorafenib.

CLINICAL RELEVANCE/APPLICATION

To date, limited data has focused on the timing parameters when Sorafenib is combined with TACE.

Participants

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Abstract Co-Author

Norihisa Nitta, MD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Shinichi Ohta, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Shobu Watanabe, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Akinaga Sonoda, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Ayumi N. Seko, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Keiko Tsuchiya, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kiyohsi Murata, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

A number of studies have been reported that a combination of Sorafenib with TACE has been a more effective treatment than Sorafenib or TACE alone in addition to being tolerable. Using a VX2 liver tumor model, we investigated the most suitable timing parameters when using Sorafenib to enhance the anti-tumor effects of TAE.

METHOD AND MATERIALS

20 Japanese white rabbits were randomly assigned to four equal groups two weeks after of VX2 tumor transplantation to the liver. We then performed the combination treatment with Sorafenib and TAE on the four groups in the according ways; Group 1 (TAE prior to administration of Sorafenib), Group 2 (TAE on the second day after administration of Sorafenib), Group 3 (TAE on the fourth day after administration of Sorafenib) and Group 4 (TAE after the end of administrating Sorafenib). Sorafenib (40mg/day) was orally administrated for consecutive 7 days starting on the day two week after tumor implantation. The anti-tumor effects were assessed by comparing the pre- and post-treatment tumor volumes measured on a contrast-enhanced CT scans and by immuno-histochemical analysis of the number of intra-tumoral vessels two weeks after the treatment.

RESULTS

Among the four groups, the tumor growth rate tended to be lower in Group 1 and Group 2 than in Group 3 and Group 4. The difference between Group 1 and Group 3 was significant. The number of CD31-positive intra-tumor vessels in specimens tended to be higher in Group 3 than in the other groups, although there was no significant difference.

CONCLUSION

We suggest that the ideal time of TAE is prior to or early after commencement of administration Sorafenib.

CLINICAL RELEVANCE/APPLICATION

To date, limited data has focused on the timing parameters when Sorafenib is combined with TACE.

Participants

Yasuaki Arai, Tokyo, Japan (Presenter) Nothing to Disclose

Abstract Co-Author

Norihisa Nitta, MD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Shinichi Ohta, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Shobu Watanabe, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Akinaga Sonoda, MD, PhD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Ayumi N. Seko, Otsu, Japan (Abstract Co-Author) Nothing to Disclose
Keiko Tsuchiya, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Kiyohsi Murata, MD, Otsu, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

A number of studies have been reported that a combination of Sorafenib with TACE has been a more effective treatment than Sorafenib or TACE alone in addition to being tolerable. Using a VX2 liver tumor model, we investigated the most suitable timing parameters when using Sorafenib to enhance the anti-tumor effects of TAE.

METHOD AND MATERIALS

20 Japanese white rabbits were randomly assigned to four equal groups two weeks after of VX2 tumor transplantation to the liver. We then performed the combination treatment with Sorafenib and TAE on the four groups in the according ways; Group 1 (TAE prior to administration of Sorafenib), Group 2 (TAE on the second day after administration of Sorafenib), Group 3 (TAE on the fourth day after administration of Sorafenib) and Group 4 (TAE after the end of administrating Sorafenib). Sorafenib (40mg/day) was orally administrated for consecutive 7 days starting on the day two week after tumor implantation. The anti-tumor effects were assessed by comparing the pre- and post-treatment tumor volumes measured on a contrast-enhanced CT scans and by immuno-histochemical analysis of the number of intra-tumoral vessels two weeks after the treatment.

RESULTS

Among the four groups, the tumor growth rate tended to be lower in Group 1 and Group 2 than in Group 3 and Group 4. The difference between Group 1 and Group 3 was significant. The number of CD31-positive intra-tumor vessels in specimens tended to be higher in Group 3 than in the other groups, although there was no significant difference.

CONCLUSION

We suggest that the ideal time of TAE is prior to or early after commencement of administration Sorafenib.

CLINICAL RELEVANCE/APPLICATION

To date, limited data has focused on the timing parameters when Sorafenib is combined with TACE.
This study explored the ability of 3D quantitative CT image analysis to predict the hepato-pulmonary shunt fraction (HPSF) in patients with hepatocellular carcinoma (HCC) before Yttrium90 (Y90) radioembolization.

METHOD AND MATERIALS

This IRB-approved, retrospective analysis included a total of 26 patients with HCC, who underwent an evaluation study to calculate the HPSF from SPECT/CT after infusion of Tc-99m macroaggregated albumin into the proper hepatic artery. All patients underwent tri-phase contrast-enhanced CT imaging within six weeks before the evaluation study. A semi-automatic, segmentation-based 3D quantification of the total tumor volume (TTV) was used to calculate the enhancing tumor volume (ETV), measured in cm3 and as a relative ratio (%; TTV/ETV). TTV as well as ETV were correlated with the HPSF for each patient. Statistical analysis included the One-way ANOVA test and linear regression analysis to calculate the R2 values.

RESULTS

N=24 (92%) patients had preserved liver function (Child-Pugh A) and N=2 (8%) had Child-Pugh B. The mean HPSF was 13.5% (Range, 2.9-32.8; SD, 7.4) and the mean TTV was 569cm3 (Range, 18-2998; SD, 584). The mean absolute ETV was 120cm3 (Range, 7-431; SD, 116) and the mean relative ETV was 28% (Range, 6-60; SD, 19). A low correlation between TTV and the HPSF was observed (R2=0.29) and relative ETV (%) showed no correlation with the HPSF (R2<0.1). However, some correlation between the absolute ETV (cm3) and the HPSF was observed (R2=0.59). More importantly, patients with HPSF≤10% showed significantly lower mean ETVs as compared to patients with a HPSF≥10% (53cm3; Range, 7-96; SD, 21 vs. 187cm3, Range, 104-431; SD, 87, p<0.0001). No patient with HPSF≤10% exceeded the ETV of 100cm3. No statistically significant differences were observed for TTV and relative ETV (%).

CONCLUSION

The quantification of the absolute ETV (cm3) using semi-automatic 3D tools allows for an estimation of the HPSF in patients with HCC before Y90 radioembolization. TTV and relative ETV (%) did not appear as reliable predictors of the HPSF.

CLINICAL RELEVANCE/APPLICATION

These preliminary results may introduce absolute ETV (cm3) as a new imaging biomarker for HPSF, potentially allowing to narrow down the selection of patients who will undergo shunt evaluation studies prior to Y90 radioembolization.

ABSTRACT

**VSIO21-09 Response Assessment and the Concept of Treatment Failure**

**Presenter**

Riccardo A. Lencioni, MD, Pisa, Italy

**Participants**

Riccardo A. Lencioni, MD, Pisa, Italy (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To learn the imaging criteria used for response assessment in patients with HCC. 2) To understand the limitations and the pitfalls associated with conventional response evaluation models. 3) To know the basic concepts of modified RECIST (mRECIST) criteria and how response predicts survival. 4) To understand the concept of treatment failure in patients undergoing loco-regional therapies. 5) To learn the novel volumetric response criteria currently undergone clinical evaluation.

**ABSTRACT**

**VSIO21-10 Which Response Criteria can Predict Early Tumor Progression in Hepatocellular Carcinoma Patients Treated with Conventional TACE: RECIST, mRECIST, EASL or qEASL?**

**Presenter**

Yan Zhao, MS, Baltimore, MD

**Participants**

Yan Zhao, MS, Baltimore, MD (Presenter) Nothing to Disclose

Sonia P. Sahu, New Haven, CT (Abstract Co-Author) Nothing to Disclose

Wei Bai, Xian, China (Abstract Co-Author) Nothing to Disclose

Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

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Jae Ho Sohn, MD,MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose

Ruediger E. Schernthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

Ming De Lin, PhD, Cambridge, MA (Abstract Co-Author) Employee, Koninklijke Philips NV

Guoshong Han, Xian, China (Abstract Co-Author) Nothing to Disclose

Jean-Francois H. Geschwind, MD, Westport, CT (Abstract Co-Author) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

**PURPOSE**

In this preliminary study, we compared the ability of RECIST, modified RECIST (mRECIST), EASL and quantitative EASL [(qEASL), a volumetric enhancement criterion] to assess early tumor progression after transarterial chemoembolization (TACE) in hepatocellular carcinoma (HCC) patients.

**METHOD AND MATERIALS**

A total of 53 consecutive patients (77.4% men; mean age, 51 years) with intermediate-stage HCC were included. All patients underwent conventional TACE and contrast-enhanced computed tomography (CT) scan at baseline and 1 month after TACE. Tumor response was determined by RECIST, mRECIST, EASL, and qEASL on CT. qEASL classifies progression as ≥73% increase in
Enhancing tumor volume. The Kaplan-Meier method with the log-rank test was used to compare median overall survival (OS) between progression and non-progression.

**RESULTS**

Median follow-up period was 15.4 months (range 1.2-54.1). The mean value of enhancing tumor volume (qEASL) at baseline and post-treatment were 214± 263.5 cm³ and 58.5 ± 21.9 cm³, respectively. RECIST, mRECIST and EASL, identified progression in 2 (4%), 1(2%) and 2 (4%) patients at 1 month after TACE treatment. Notably, qEASL had a higher sensitivity for early tumor progression and it identified 9 (17%) patients with progression. Too few patients showed progression to perform survival analysis for the RECIST, mRECIST, and EASL. However, the patients who experienced progression according to qEASL demonstrated a significantly shorter median OS than those with non-progression (6.5 months (95%CI 4.2-8.8) vs. 21.1 months (95%CI 14.1-28.1), P<0.001).

**CONCLUSION**

qEASL is a more sensitive biomarker for tumor progression and survival than RECIST, mRECIST and EASL one month after TACE in hepatocellular carcinoma patients.

**CLINICAL RELEVANCE/APPLICATION**

Defining early tumor progression may help guide the decisions of further treatment. qEASL gave a better discrimination for early progression than other 1D or 2D criteria.

**Participants**

Nima Kokabi, MD, Atlanta, GA (Presenter) Nothing to Disclose
Minzhi Xing, MD, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Richard Duszak JR, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Kenneth E. Applegate, MD, MS, Zionsville, IN (Abstract Co-Author) Nothing to Disclose
Juan C. Caramo, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
David H. Howard, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

**Purpose**

To investigate the socio-demographic determinants of receipt of HCC-directed locoregional therapies (LRT’s) and comparative effectiveness of different therapies in American Joint Commission on Cancer (AJCC) Stage I and II unresectable hepatocellular carcinoma (HCC) using Surveillance Epidemiology and End Results (SEER) registries linked to Medicare database.

**METHOD AND MATERIALS**

Patients diagnosed with HCC during 2000 to 2010 were identified with unresectability defined using "no cancer-directed surgery recommended" and no HCC directed surgical claim. Patients were stratified by AJCC staging and the following therapies: ablation, trans-arterial chemoembolization (TACE), Yttrium-90 (Y90) radioembolization, sorafenib, systemic chemotherapy (CTX), external beam radiation (EBRT) or no cancer directed therapy (NCDT). Sociodemographic predictors of receipt of LRT’s (i.e. TACE and Y-90) were evaluated by chi-square. Overall survival (OS) was estimated using Kaplan-Meier analysis.

**RESULTS**

Total of 9,169 patients with unresectable HCC were identified with the following stages composition: I (25%), II (10%), III (13%), IV (17%), and unstaged (35%). All therapies demonstrated OS benefit compared to no therapy with the following median OS (months): ablation (30.8), Y90 (15.6), TACE (15.5), EBRT (7.6), Sorafenib (5.6), CTX (5.10), NCDT (3.7; p<0.001). One year survival rate of stage I and II patients treated with TACE was 67% and 53% vs. 27% and 14% for NCDT respectively (p<0.001). Overall, 38% of patients received any cancer directed therapy including TACE (18%), EBRT (8%), sorafenib (4%), ablation (3%), and Y-90 (2%) and CTX (1%). Specifically, 56% and 65% of stage I and II patients had NCDT respectively. There was no OS difference between TACE and Y90 group (p=0.31). There was a significantly prolonged OS in LRT group vs. EBRT/CTX groups (p<0.001) and the LRT vs. NCDT group (p<0.001). The receipt of LRT significantly correlated with being married and of Asian decent, living on the pacific coast and in urban areas, being insured with higher income and education levels (p’s <0.05).

**CONCLUSION**

Favorable sociodemographic factors were determinant of receipt of HCC directed LRT’s. Less than 50% of of Stage I and II patients received LRT’s. LRT’s in Stage I and II significantly prolonged survivals over CTX/EBRT/NCDT.

**CLINICAL RELEVANCE/APPLICATION**

There is a national underutilization of effective HCC directed LRT’s in patients with unresectable HCC.

**Participants**

Stephen B. Solomon, MD, New York, NY (Presenter) Research Grant, General Electric Company
**LEARNING OBJECTIVES**

1) To describe techniques and approaches used for image-guided ablation. 2) To understand the available data for novel thermal and non-thermal technologies. 3) To discuss strategies to improve clinical outcomes.

**VSIO21-14 Hepatocellular Crccinomas Treated with Percutaneous Ablation Using a High-power Microwave System with a Single Antenna: 5 Years' Experience**

Monday, Nov. 30 5:00PM - 5:10PM Location: S406B

**Participants**

Giovanni Mauri, MD, San Donato Milanese, Italy (Presenter) Consultant, Esaote SpA
Luca Cova, MD, Busto Arsizio, Italy (Abstract Co-Author) Nothing to Disclose
Tiziana Ierace, MD, Busto Arsizio, Italy (Abstract Co-Author) Nothing to Disclose
S. Nahum Goldberg, MD, Ein Kerem, Israel (Abstract Co-Author) Consultant, AngioDynamics, Inc; Research support, AngioDynamics, Inc; Research support, Cosman Medical, Inc; Consultant, Cosman Medical, Inc; Luigi Solbiati, MD, Busto Arsizio, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To report our 5 year experience treating hepatocellular carcinoma (HCC) using a third-generation high-power microwave system and a single antenna.

**METHOD AND MATERIALS**

From 2009, 223 HCCs (mean 2.2 cm, size range 0.7-5.5 cm) in 109 patients (mean age 67.7 ± 6.2 years) underwent US-guided ablation using a high-power (140 Watt, 2.45 GHz) microwave system (AMICA-Probe: Hospital Service, Aprilia, Italy) with a single insertion of an internally-cooled antenna. Power and time of energy application ranged between 45-100 Watts and 4-10 min, respectively. Follow-up from a minimum of 1 year to 6 years (mean: 2.2yr) was performed with contrast-enhanced CT at 4-6 months intervals. Results were classified according to index tumor size (<=2cm; 2.1-3 cm; > 3 cm).

**RESULTS**

Immediate complete ablation (i.e. technical success) was achieved in 221/223 (99.1%) HCCs. Local tumor progression within 1 year from ablation occurred in 23/223 (10.3%) HCCs: 4/103 (3.9%) <= 2cm; 8/68 (11.8%) sized 2.1-3 cm; and 11/52 (21.2%) > 3 cm (p = 0.003). In 9/23 (39.1%) HCCs, local progression underwent successful re-treatment. Major complications occurred in 6/151 (4.0%) ablation sessions and only 2 required surgical repair. No deaths related to ablation were seen. In 29/109 (26.6%) patients, new HCCs were detected on follow-up.

**CONCLUSION**

With an affordable and efficient high-power microwave system, local control of HCCs can be safely achieved in the vast majority of cases with the simplest and fastest technique, i.e. single insertion of single antenna.

**CLINICAL RELEVANCE/APPLICATION**

Percutaneous ablation with a high-power, affordable microwave system allows successfully treatment for a large majority of HCCs using a simple technique of single insertion of a single antenna with a short energy deposition time.

**VSIO21-15 TACE Segmentectiony for Small, Solitary HCC: Just for the Unfit for Resection and Ablation?**

Monday, Nov. 30 5:10PM - 5:30PM Location: S406B

**Participants**

Jin Wook Chung, MD, Seoul, Korea, Republic Of (Presenter) Research Grant, BTG International Ltd

**LEARNING OBJECTIVES**

1) Describe the current role of TACE for small solitary HCC in the routine daily practice. 2) Explain the technical aspects of subsegmental or ultraselective TACE. 3) Estimate curative potential of subsegmental TACE for small solitary HCC. 4) Appraise the role of subsegmental TACE for small solitary HCC.

**VSIO21-16 A Prospective Study of the Safety and Efficacy of Small Caliber Drug-Eluting Beads in TACE for the Treatment of Hepatocellular Carcinoma**

Monday, Nov. 30 5:30PM - 5:40PM Location: S406B

**Participants**

Sonia P. Sahu, New Haven, CT (Presenter) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ruediger E. Schermenthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Yan Zhao, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Jae Ho Sohn, MD,MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Jean-Francois H. Geschwind, MD, Westport, CT (Abstract Co-Author) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

**PURPOSE**

There has been a growing interest in smaller caliber beads which can penetrate deeper into tumors for transarterial chemoembolization (TACE). This prospective clinical trial examined the safety and efficacy of TACE using 70-150 µm doxorubicin-eluting beads (LC BeadM1,BTG, UK) in patients with hepatocellular carcinoma (HCC).
METHOD AND MATERIALS

This single-center prospective study was HIPPA compliant and IRB approved. Patients with HCC who were locoregional therapy naïve, Eastern Cooperative Oncology Group performance status 0-2, Barcelona Clinic Liver Cancer stage A-C, and Child-Pugh A-B were eligible. Adverse events were graded by severity and in relationship to TACE using CTCAE V4.03. Tumor response at 1 month follow-up was assessed by modified RECIST (mRECIST), European Association for the Study of the Liver (EASL), and volumetric tumor enhancement [quantitative EASL (qEASL)] on T1-weighted contrast-enhanced MR. qEASL response was defined as ≥65% decrease in volumetric tumor enhancement.

RESULTS

24 patients (men: 21, median age: 62 years) with a mean tumor size of 4.28 cm (range: 1.2 - 21.2) were enrolled and successfully treated with TACE. 2 serious adverse events unrelated to TACE occurred in 2 patients [upper GI bleed (n=1) and cardiac arrest (n=1)]. Possible to definitive device related toxicities were seen in 10 patients and were all grade 1-2 in severity [hypoalbuminemia (n=3), pain (n=3), elevated AP (n=2), headache (n=2), fatigue (n=2), leukopenia (n=1), anemia (n=1), anorexia (n=1), elevated AST (n=1), fever (n=1), flu-like symptoms (n=1), hyperbilirubinemia (n=1), weight loss (n=1)]. One month tumor response was assessed in 21 patients [died before follow-up (n=1), pending follow-up (n=2)]. 10 (45.5%) patients were classified as responders regardless of the criteria utilized.

CONCLUSION

TACE with 70-150 µm doxorubicin-eluting beads was well tolerated and had good tumor response after 1 month in patients with HCC.

CLINICAL RELEVANCE/APPLICATION

Smaller caliber 70-150 µm doxorubicin-eluting beads are a safe and promising alternative to the conventional sized 100-500 µm beads in TACE for patients with hepatocellular carcinoma.
LEARNING OBJECTIVES

1) Present the multimodality management of selected gynecologic cancers including surgery, radiation and chemotherapy. 2) Highlight the importance of imaging in the diagnosis and followup of gynecologic cancers. 3) Highlight the importance of imaging in the planning and delivery of radiation.

ABSTRACT

The care of patients with gynecologic cancers requires the collaboration of imaging specialists as well as gynecologic and radiation oncologists. Radiologic imaging is key in defining disease at diagnosis and following patients for detection of recurrence after treatment. In conjunction with computerised planning, sectional imaging allows for sophisticated planning of external beam and brachytherapy and is key in maximizing the benefits of radiation while minimizing the risks. Case examples of the pivotal impact of imaging and its importance in multidisciplinary care will be highlighted in this session.
LEARNING OBJECTIVES

1) Review common tumors of the head and neck. 2) Review imaging findings in head and neck malignancies that specifically change staging. 3) Review the value of imaging in directly affecting management and treatment.

ABSTRACT

This session will be tumor board that includes a head and neck radiologist, head and neck surgeon, medical oncologist and radiation oncologist. We will discuss a variety of head and neck cancer cases and illustrate the value-added benefits and highlight of imaging affects staging, treatment and management.
Purpose/Objective(s): To assess outcomes of patients with anal canal cancer treated with intensity-modulated radiation therapy (IMRT) after a long time follow-up. Materials/Methods: From August 2007 to January 2011, 39 patients were treated by IMRT for anal squamous cell carcinoma. Radiation course consisted in delivering 45 Gy in 1.8 Gy daily-fractions, 5 days a week, to the primary tumor and the risk area including pelvic and inguinal nodes (PTV1). A second plan of 14.4-20 Gy was administered to the primary tumor and the risk area including pelvic and inguinal nodes (PTV2) in 1.8-2 Gy-daily fractions, also 5 days a week. PTV1 and PTV2 were treated continuously without gap and without Simultaneously Integrated Boost (SIB). Concurrent chemotherapy based on 5FU and mitomycin was added for locally advanced tumors. Clinical outcome and toxicities were evaluated according to the Common Toxicity Criteria for Adverse Events 4.0 scale.

Results: Thirty-one women and eight men were included in the analysis. Tumors were classified as stages I, II, III and IV in 2, 7, 27 and 2 patients, respectively. Median age was 59 years (range, 38-85). 3 patients were known to be HIV-positive or suffering from AIDS. Radiotherapy alone (RT) or with concurrent chemotherapy (RCT) was delivered in 6 (15%) and 33 (85%) patients, respectively. Median age was 59 years (range, 38-85). 3 patients were known to be HIV-positive or suffering from advanced tumors. Clinical outcome and toxicities were evaluated according to the Common Toxicity Criteria for Adverse Events 4.0 scale.

Conclusion: Stereotactic body radiation therapy is a safe and effective alternative option for inoperable patients with low toxicity.

Abstract Co-Author

Presenter

Malys de Meric de Bellefon, Montpellier, France (Presenter) Nothing to Disclose
Pascal Fengilletto, DiplPhys, Montpellier, France (Abstract Co-Author) Nothing to Disclose
David Azria, MD, PhD, Montpellier, France (Abstract Co-Author) Nothing to Disclose
Carmen Lacer Moscardo, MD, montpellier, France (Abstract Co-Author) Nothing to Disclose
Sophie Gourgou, MONTPELLIER, France (Abstract Co-Author) Nothing to Disclose
Norbert Allieres, PhD, montpellier, France (Abstract Co-Author) Nothing to Disclose
Claire Lemanski, Montpellier Cedex 5, France (Abstract Co-Author) Nothing to Disclose
respectively. Median follow-up was 66 months CI95%[62-73]. 24 patients (77.4%) had at least one grade 1 toxicity among anal incontinence, intestinal, urinary or skin disorders. One patient had grade 3 vaginal toxicity. 5-year overall survival rate was 79.2% CI95%[62.6-89.0], and 5-year local disease-free survival was 68.6% CI95% [51.3-80.9], with a 5-year colostomy-free survival rate of 76.6% CI95% [58.1-87.8].Conclusion: IMRT is effective and well tolerated in the long term.

SSE24-05  Implementing a Well Follow-up Care Plan for Colorectal Cancer Patients: Quality Assurance and Lessons Learned

Monday, Nov. 30 3:40PM - 3:50PM Location: S104A

Participants
Chunzi Jenny Jin, MD, Oak Brook, IL (Presenter) Nothing to Disclose
Jim Biagi, MD, Kingston, ON (Abstract Co-Author) Nothing to Disclose
Hugh Langley, Kingston, ON (Abstract Co-Author) Nothing to Disclose
Candice Christmas, Kingston, ON (Abstract Co-Author) Nothing to Disclose
Julia Niblett, Kingston, ON (Abstract Co-Author) Nothing to Disclose
Aamer Mahmud, MD, FRCR, Kingston, ON (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): With an increasing number of cancer survivors and limited resources, a trend of follow-up outside cancer clinics is emerging. There is little consensus on how to operationalize plan delivery. Our aims were to pilot a sustainable colorectal cancer well follow-up care plan (WFU) with embedded quality assurance measures, to ascertain satisfaction of stakeholders and identify potential barriers. Materials/Methods: Toolkits were developed for primary care providers (PCP) i.e. standardized discharge letters, guidelines on frequency of visits and investigations, CEA form and a receipt letter. Patients received a discharge letter; a brochure on follow-up; a list of symptoms, common issues and questions; and healthy living and useful community resources. Toolkits are also available on the hospital website. Satisfaction surveys were developed for patients, PCPs and specialists. Results: Since July 2014, 48 stable patients meeting the criteria for transfer of care were discharged to PCPs for WFU when seen at the 3-month visit following treatment completion. Completion rate of patient survey was 25%, reporting an overall satisfaction. Feedback from PCPs has been positive with an interest in additional information and timely access to specialists. Some raised concerns over additional work load. Receipt letters were received in 35% of cases and reminders are being sent for the rest. Oncology specialists supported this initiative when surveyed. Barriers to discharge included not having a PCP, concern about communication between physicians, and a lack of patient education. We continue to collect data and will update the results. Conclusion: Key features of a sustainable WFU care plan includes user-friendly toolkits for patients, PCPs and engagement of specialists. We are evaluating feasibility and safety as well as satisfaction measures. This study may also help to identify ways of knowledge translation to meet the needs of patients and PCPs.

SSE24-06  Use of Functional MRI Imaging to Identify Area to be Boosted in Anal Cancer Treatments

Monday, Nov. 30 3:50PM - 4:00PM Location: S104A

Participants
Ivan Fazio, MD, Palermo, Italy (Presenter) Nothing to Disclose
Vittorio Macchiarella, MD, Palermo, Italy (Abstract Co-Author) Nothing to Disclose
Massimiliano Spada, MD, Cefalu, Italy (Abstract Co-Author) Nothing to Disclose
Antonella Mazzonello, MD, Palermo, Italy (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Evaluating if functional MRI imaging in the treatment of anal cancer, can help in identifying hypercellularity in the site of the primary tumor or in case of nodal involvement, selecting patients in which dose has to be increased to obtain remission of disease. Materials/Methods: from January to September 2013, 10 patients affected by anal cancer in different stage of disease, had a simulation using CT and MRI imaging. In the MRI imaging we performed the DWI B 800 study which can identify in squamous cell carcinomas areas of hypercellularity which can suggest the presence of tumor tissue. All patients underwent IMRT radiation for 45 Gy in 25 fractions plus chemotherapy and a boost of 14.4 Gy using VMAT only on DWI MRI positive areas. Results: In the short follow-up (2-8 months), we observed a clinical and radiologic complete response in 8 patients and a partial response in 2 patients (with inguinal nodes involvement). The treatment was well tolerated with only grade II skin and rectal toxicity in all 10 patients. In the follow-up functional MRI imaging we observed a progressive decreasing of the extension of DWI positivity (fig.1) up to the disappearance of it. Conclusion: Clinical use of hyperconformal treatments as IMRT or VMAT need a precise identify of areas to be treated with high doses. Functional MRI DWI study can help in squamous cell carcinomas (less in other hystologies) in recognizing areas of subclinical extension of disease. Functional MRI imaging seems to be effective in differentiate inflammatory areas which seems to be positive at FDG-PET imaging.
Molecular Imaging Symposium: Case-based MI

Monday, Nov. 30 3:30PM - 5:00PM Location: S405AB

CA NR VA MI RO

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

FDA

Discussions may include off-label uses.

Participants
Vikas Kundra, MD, PhD, Houston, TX (Moderator) License agreement, Introgen Therapeutics, Inc
Jeffrey T. Yap, PhD, Salt Lake City, UT (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify molecular imaging. 2) Comprehend the basis of aspects of molecular imaging. 3) Describe molecular imaging performed in a radiology setting.

ABSTRACT
This course will describe molecular imaging, identify the mechanisms of some aspects of molecular imaging, and give examples of molecular imaging in oncology. Cases will include those from current practice. Mechanisms and scientific basis of examples will be discussed. Sample applications will be discussed and illustrated. Translational examples, including those that have good potential for clinical application, will be used to illustrate interesting aspects of molecular imaging in oncology.

Sub-Events
MSMI24A Oncology

Participants
Vikas Kundra, MD, PhD, Houston, TX (Presenter) License agreement, Introgen Therapeutics, Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMI24B Neurology

Participants
Rathan M. Subramaniam, MD, PhD, Baltimore, MD, (rsubram4@jhmi.edu) (Presenter) Travel support, Koninklijke Philips NV

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMI24C Cardiology

Participants
Robert J. Gropler, MD, Saint Louis, MO (Presenter) Advisory Board, Bracco Group Advisory Board, GlaxoSmithKline plc Advisory Board, Pfizer Inc Advisory Board, Bayer AG Research Grant, GlaxoSmithKline plc Research Grant, Pfizer Inc Research Grant, Clinical Data, Inc Research Grant, Lantheus Medical Imaging, Inc

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMI24D Vascular Inflammation

Participants
Chun Yuan, PhD, Seattle, WA (Presenter) Research Grant, Koninklijke Philips NV; Consultant, Koninklijke Philips NV;

LEARNING OBJECTIVES
View learning objectives under main course title.

MSMI24E Instrumentation

Participants
Jeffrey T. Yap, PhD, Salt Lake City, UT (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.
Participants
Sarah S. Donaldson, MD, Palo Alto, CA (Moderator) Nothing to Disclose
Peter R. Mueller, MD, Boston, MA (Moderator) Consultant, Cook Group Incorporated

LEARNING OBJECTIVES
1) To understand the role of interventional radiologists in the care of patients with cancer. 2) To understand the increasing role of imaging in radiation oncology. 3) To learn which aspects of oncology must be taught to interventional radiologists in order to enable them to care for cancer patients appropriately. 4) To understand the overlap between radiation oncology and interventional oncology, and how these disciplines can become stronger by collaborating with each other.

Sub-Events

**SPSI21A Interventional Oncology: The Fourth Pillar of Cancer Care**

Participants
Andreas Adam, MD, London, United Kingdom, (andy.adam@kcl.ac.uk) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

**SPSI21B It Takes More than Technology to Be an Oncologist: What Interventional Radiologists Can Learn from Radiation Oncology**

Participants
Lizbeth Kenny, MD, FRANZCR, Herston, Australia (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

**SPSI21C Image Targeted Oncology: The Birth of a New Specialty**

Participants
Anthony L. Zietman, MD, Boston, MA (Presenter) Editor, Reed Elsevier

LEARNING OBJECTIVES
View learning objectives under main course title.
LEARNING OBJECTIVES

1) Review the pertinent anatomy of the upper aerodigestive tract. 2) Discuss the spread patterns of various head and neck tumors. 3) Illustrate the importance of multimodality imaging for tumor contouring.

ABSTRACT

This e-contouring session will be given by a head and neck radiologist and radiation oncologist. This session will review the pertinent anatomy of the upper aerodigestive tract, discuss the spread patterns of various head and neck tumor and illustrate the importance of multimodality imaging for tumor contouring.
**Participants**
Cristina Fuss, MD, Portland, OR, (fussc@ohsu.edu) (*Presenter*) Nothing to Disclose
Jean L. Wright, MD, New York, NY (*Presenter*) Nothing to Disclose

**LEARNING OBJECTIVES**
1) Understand breast and regional lymph node anatomy. 2) Be familiar with how the basic anatomic images appear on a variety of imaging modalities. 3) Be familiar with breast and regional lymph node contouring techniques used in radiation treatment planning for breast cancer. 4) Apply principles of critical thinking to ideas from experts and peers in the radiologic sciences.
LEARNING OBJECTIVES

1) Describe the imaging characteristics of gliomas. 2) Recognize substantial heterogeneity exists within these tumor types and understand the prognostic and predictive variables to allow for the selection of the appropriate therapy. 3) Explain the role of each modality including surgery, radiotherapy and chemotherapy in managing gliomas.

ABSTRACT

Significant progress has been made in the treatment of CNS tumors with an emphasis on molecular prognostic and predictive biomarkers that allow for appropriate treatment selection. The role of advanced neuro-imaging will help clinicians improve the diagnosis, treatment and response assessment for CNS tumors will be emphasized. This session highlights the need for a multidisciplinary treatment approach.
Confluence of Diagnostic Radiology and Radiation Oncology in Management of Pediatric Malignancies

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S403A

Participants
Stephanie A. Terezakis, MD, Baltimore, MD (Moderator) Speaker, Elekta AB

Sub-Events

RC320A  Supratentorial CNS Tumors

Participants
Stephanie M. Perkins, MD, Saint Louis, MO (Presenter) Nothing to Disclose
Tina Y. Poussaint, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify the common supratentorial brain tumors of childhood. 2) Evaluate the imaging features of supratentorial brain tumors.

ABSTRACT
The most common type of solid tumor among children is the pediatric brain tumor, which is the second most frequent childhood malignancy after leukemia, and the leading cause of death from solid tumors in this population. Among children aged 0-19, the incidence rate for all primary brain and central nervous system tumors was roughly 5.3 per 100,000, with approximately 4350 cases of new cases of childhood primary malignant and non-malignant CNS tumors were expected to be diagnosed each year in the United States in 2013. Supratentorial tumors are most common in the first 2-3 years of life and in children older than 10 years, supratentorial and infratentorial are of equal frequency. This lecture will focus on the standard and advanced MR imaging features of the common supratentorial tumors of childhood affecting the cerebral hemispheres, suprasellar/sellar regions and pineal regions.

RC320B  Infratentorial Central Nervous System Tumors

Participants
David B. Mansur, MD, Cleveland, OH (Presenter) Nothing to Disclose
Thierry Huisman, MD, Baltimore, MD, (thuisma1@jhmi.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify the types of diagnostic imaging most useful in the management of infratentorial CNS tumors. 2) Describe how proper diagnostic imaging aids in target delineation, staging, and treatment planning in posterior fossa CNS radiotherapy. 3) Define how conventional and advanced neuroimaging may characterize and differentiate brain neoplasms from treatment-related imaging findings following radiotherapy.

ABSTRACT
The radiotherapeutic management of infratentorial CNS tumors requires close collaboration between neuroradiology and radiation oncology. This process begins with accurate initial tumor description and delineation in the pre-operative setting. Detection of drop metastases is another critical role for neuroimaging which can be done either preoperatively or post operatively. Post-operative imaging is essential to assist with determining extent of resection as well as defining radiotherapy treatment volumes. Finally, neuroimaging after radiotherapy can aid in determining benign radiation therapy changes from recurrent or progressive tumor.

RC320C  Pediatric Sarcomas: MR Imaging

Participants
Oren Cahlon, Princeton, NJ (Presenter) Investor, ProCure Treatment Centers, Inc
Laura M. Fayad, MD, Baltimore, MD (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Examine the roles MRI plays in the evaluation of pediatric sarcomas. 2) Assess the utility of various imaging sequences for the initial assessment and post-treatment follow-up of sarcomas. 3) Apply anatomic, functional and metabolic techniques for the identification of tumor extent and character.

ABSTRACT
MRI plays a critical role in the assessment of pediatric musculoskeletal tumors, both osseous and soft tissue masses. Although such neoplasms may initially be evaluated on other modalities, such as sonography or radiography, the most salient role for MRI is in determining the extent of disease. MRI sequences also offer information for tumor detection, characterization, the assessment of treatment response and the distinction of post-operative scar from recurrence. With conventional MRI, excellent anatomic detail is obtained, but with the advent of non-contrast chemical shift imaging, diffusion weighted imaging and MR spectroscopy, functional and metabolic features of a neoplasm can be evaluated noninvasively. In this presentation, a comprehensive MRI approach to assessing pediatric musculoskeletal tumors will be reviewed, focusing on the roles of anatomic, functional and metabolic MRI sequences.
Proton: Imaging for Treatment Planning

Tuesday, Dec. 1 8:30AM - 10:00AM Location: S102D

AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Jon J. Kruse, PhD, Rochester, MN (Moderator) Research Grant, Varian Medical Systems, Inc

ABSTRACT

Proton therapy has the potential to deliver very conformal dose distributions which may lead to higher cure rates or lower treatment toxicities than conventional or intensity modulated x-ray therapy. Like modern photon modalities, proton therapy relies heavily on advanced imaging techniques for treatment planning and dose calculation. This course will describe imaging requirements which are unique to proton therapy treatment planning. Much of the advantage of proton therapy is derived from the particle beam's finite range, and calculation of proton range within a patient requires a conversion between CT Hounsfield Units (HU) and proton stopping power. This calibration process is significantly different from the HU to electron density conversion which is performed for x-ray dose calculation. Uncertainties in the stopping power conversion are currently managed by expanding normal tissue margins around the clinical target volume and through appropriate beam selection. Improved CT techniques and alternative imaging modalities promise to deliver a more reliable image of stopping power within the patient, allowing for reduced treatment volumes. Tumor motion also presents a unique challenge in proton therapy, as a moving target exhibits not only variable position within a beam's eye view, but varying range as well. Modern proton therapy facilities which deliver treatments via a scanning beam are additionally susceptible to the interplay effect, in which the time dependent dose delivery is altered by motion of the target and surrounding anatomy. Four-dimensional imaging and dose calculation are then critically important in proton therapy to ensure that the treatment plan is robust against tumor motion.

LEARNING OBJECTIVES

1) Describe the stoichiometric calibration technique for deriving proton stopping power from CT Hounsfield Units. 2) Identify common sources of uncertainty in the predicted proton range within a patient. 3) Explain near- and long-term developments in CT imaging and alternative modalities which may reduce the uncertainty in proton range calculation.

Sub-Events

RC322A Imaging Considerations for Proton Treatment Planning

Participants
Andrew Wroe, PhD, Loma Linda, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Describe the impact of tumor motion on a proton dose distribution. 2) Compare the relative value of various four-dimensional imaging modalities in the evaluation of a proton plan for a mobile target. 3) Explain the process for incorporating four-dimensional imaging into dose calculation.

RC322B Uncertainties in Motion for Treatment Planning

Participants
Heng Li, Houston, TX (Presenter) Research funded, Varian Medical Systems, Inc

LEARNING OBJECTIVES

1) Describe the impact of tumor motion on a proton dose distribution. 2) Compare the relative value of various four-dimensional imaging modalities in the evaluation of a proton plan for a mobile target. 3) Explain the process for incorporating four-dimensional imaging into dose calculation.
Molecular Imaging Mini-Course: Clinical Applications of Molecular Imaging - Neuro

Tuesday, Dec. 1 8:30AM - 10:00AM Location: N226

AMA PRA Category 1 Credits™: 1.50
ARRT Category A+ Credits: 1.50

Participants

Sub-Events

RC323A Oncology Applications

Participants

Hyunsuk Shim, PhD, Atlanta, GA, (hshim@emory.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) To learn about the potential of combining an advanced MR spectroscopic imaging with standard MR images to reduce the recurrence rate in glioblastomas.

ABSTRACT

Radiation therapy (RT) is as good as the images that guide RT planning. RT based on conventional MRIs may not fully target tumor extent in glioblastomas (GBM), which may, in part, account for high recurrence rates (60-70 percent at 6 months). Magnetic resonance spectroscopic imaging (MRSI), a molecular imaging modality that quantifies endogenous metabolite levels without relying on perfusion, leakage and diffusion of injected material, may better define extent of actively proliferating tumor. In addition, advances in this technology now permit acquisition of full-brain high-resolution 3D MRSIs in 12-14 minutes. We correlated state-of-the-art MRSI metabolite maps with tissue histopathology to validate further its use for identifying tumor that may not be fully imaged by conventional MRI sequences and provide support for its adjunctive use in tumor contouring for RT planning. Integration of histologically-verified, whole brain 3D MRSI into RT planning is feasible and may considerably modify target volumes. Thus, RT planning for GBMs may be augmented by MRSI potentially leading to reduced recurrence rates.

RC323B Functional Applications

Participants

Satoshi Minoshima, MD, PhD, Salt Lake City, UT (Presenter) Royalties, General Electric Company; Consultant, Hamamatsu Photonics KK; Research Grant, Hitachi, Ltd; Research Grant, Nihon Medi-Physics Co, Ltd; Research Grant, Astellas Group; Research Grant, Seattle Genetics, Inc;
LEARNING OBJECTIVES
1) To learn the genetic mutations present in Endometrial and Ovarian Cancer. 2) Pathogenesis of Ovarian Cancer. 3) Implications on image interpretation.

ABSTRACT
Endometrial cancer is the most common female gynecologic malignancy. Epithelial ovarian cancer is the most common cause of gynecological cancer death in the United States. More recently epithelial ovarian tumors have been broadly classified into two distinct groups. The type I tumors have low grade serous, clear cell, endometrioid, and mucinous histological features. Typically, these tumors have low grade serous cancers of the ovary, peritoneum, and fallopian tube. These tumors are clinically aggressive and are often widely metastatic at the time of presentation. We will discuss the gene mutations associated with different endometrial and epithelial ovarian cancer, pathogenesis, implications on therapy and imaging.

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Participants
Aradhana M. Venkatesan, MD, Houston, TX (avenkatesan@mdanderson.org) (Presenter) Institutional research agreement, Koninklijke Philips NV

LEARNING OBJECTIVES
1) List the elements of common prostate MRI acquisition protocols, defining the roles for each pulse sequence in prostate cancer detection. 2) List imaging findings critical to accurate prostate cancer detection and staging. 3) Identify imaging pitfalls in the detection and staging of prostate cancer. 4) Describe common MRI findings of treated prostate cancer. 5) List the elements of the Prostate Imaging-Reporting and Data System (PI-RADS) structured reporting scheme. 6) List the updated changes reflected in the most recent PI-RADSv2 structured reporting scheme.

ABSTRACT
Prostate cancer is one of the most frequently diagnosed cancers in the male population. It is the second most common type of cancer detected in American men and their second leading cause of cancer death. The proposed refresher course will provide an overview of MRI for prostate cancer imaging, including a discussion of salient imaging findings on multi-parametric MRI, pitfalls in imaging interpretation, and an overview of existing standardized reporting templates for prostate MR interpretation.

Participants
Mukesh G. Harisinghani, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) MR techniques to image the bladder and urethra will be discussed. 2) Pointers for optimal MR evaluation will be discussed. 3) Pointers for accurate diagnosis on MRI will be discussed.

ABSTRACT
The proposed course will be provide an overview of applying MR for imaging the bladder and urethral region
Materials/Methods: Between April 2010 and November 2011 we treated 61 patients after NACT (+/- chemotherapy) and are reporting the DFS after a median of 4 years of follow up. To our knowledge this is the first time that data concerning intraoperative radiotherapy with a 50 kV X-ray source after neoadjuvant chemotherapy (NeoCh) who remained inoperable, is a feasible treatment approach. It has allowed almost half of them to become eligible to non-operated patients, 3 years OS, were respectively 75% and 50% (p Conclusion: NeoRT in patients with poor response to NeoCh, 34 (52%) showed stable disease (SD); 24 (36%), progression disease (PD) and 8 (12%), partial response (PR). After NeoRT, 33 (50%) showed SD; 24 (36%), PR and 4 (6%) had clinical complete response (CR). 5 cases (8%) showed PD. 32 patients (48.5%) were eligible to mastectomy. In pathological study, 4 (12.5%) had pathological CR and 20 (61%) showed PR, with a response rate of 73.5% and median volume of surgical specimen of 2.68 cm³. Axillary dissection was performed in all patients, and the mean number excised and positive nodes were respectively 11 (5-22) and 2 (0-18). In the hypofractionated group (13 cases), 4 (31%) patients were considered operable. In the conventional group (49 cases), 28 (57%) had their tumor respected. 4 patients received an additional whole breast boost of 10 Gy @ 5 fractions. Median time of RT was, respectively, 26 and 37 days in the hypofractionated and in the conventional group (including boosted patients). Patients who remained inoperable after RT, showed 91% of distant metastasis. With a median follow up of 84 months, 7 operated patients (21.8%) are alive without evidence of disease and no patients at the inoperable group; last follow-up: Dec/2014. Regarding operated and non-operated patients, 3 years OS, were respectively 75% and 50% (p Conclusion: NeoRT in patients with poor response to NeoCh, who remained inoperable, is a feasible treatment approach. It has allowed almost half of them to become eligible to surgery, with significant benefit on OS when compared to those that remained inoperable. Although, further studies should be done before this protocol becomes standard of care for advanced breast cancer patients.

ABSTRACT

Purpose/Objective(s): The expected local recurrence rate in 5 year follow-up after breast conserving therapy and whole breast irradiation is 7.6%. Adding a boost of the index region results in a reduced recurrence rate of 4.3%. The boost irradiation as an intraoperative procedure showed a further decrease of local recurrence rates down to 1.75%. We adapted this approach to patients after neoadjuvant chemotherapy (NACT) and are reporting the DFS after a median of 4 years of follow up. To our knowledge this is the first time that data concerning intraoperative radiotherapy with a 50 kV X-ray source after neoadjuvant chemotherapy are presented.

Materials/Methods: Between April 2010 and November 2011 we treated 61 patients after NACT (+/- chemotherapy) and are reporting the DFS after a median of 4 years of follow up. To our knowledge this is the first time that data concerning intraoperative radiotherapy with a 50 kV X-ray source after neoadjuvant chemotherapy (NeoCh) and 229 failed it. In 66 cases, they received neoadjuvant radiotherapy (NeoRT). Endpoints were resectability and response rate. Chi-square test was used for comparison among groups. NeoRT was delivered in a conventional course of 50 Gy @ 25 fractions or 40 Gy @ 16 fractions to breast, supraclavicular fossae and axila, with tangential and non-pair irregular opposed fields, and 6 MV photons energy. If inoperable, they received a 10 Gy boost on the breast area. Surgery was intended to be done four weeks after RT. Results: From a total of 66 patients analyzed, the median age was 55 years, and 97% of patients were staged as IIIB. Invasive ductal carcinoma was the most frequent histopathological diagnosis. Regarding NeoCh, 43 (65.15%) received FAC; 16 (24.2%) FAC plus Docetaxel and 6 (10%) CMF. Tamoxifen was used in 8 (12%) cases. After NeoCh, 34 (52%) showed stable disease (SD); 24 (36%), progression disease (PD) and 8 (12%), partial response (PR). After NeoRT, 33 (50%) showed SD; 24 (36%), PR and 4 (6%) had clinical complete response (CR). 5 cases (8%) showed PD. 32 patients (48.5%) were eligible to mastectomy. In pathological study, 4 (12.5%) had pathological CR and 20 (61%) showed PR, with a response rate of 73.5% and median volume of surgical specimen of 2.68 cm³. Axillary dissection was performed in all patients, and the mean number excised and positive nodes were respectively 11 (5-22) and 2 (0-18). In the hypofractionated group (13 cases), 4 (31%) patients were considered operable. In the conventional group (49 cases), 28 (57%) had their tumor respected. 4 patients received an additional whole breast boost of 10 Gy @ 5 fractions. Median time of RT was, respectively, 26 and 37 days in the hypofractionated and in the conventional group (including boosted patients). Patients who remained inoperable after RT, showed 91% of distant metastasis. With a median follow up of 84 months, 7 operated patients (21.8%) are alive without evidence of disease and no patients at the inoperable group; last follow-up: Dec/2014. Regarding operated and non-operated patients, 3 years OS, were respectively 75% and 50% (p Conclusion: NeoRT in patients with poor response to NeoCh, who remained inoperable, is a feasible treatment approach. It has allowed almost half of them to become eligible to surgery, with significant benefit on OS when compared to those that remained inoperable. Although, further studies should be done before this protocol becomes standard of care for advanced breast cancer patients.
Trastuzumab according to HER2-status) with an intraoperative boost of 20 Gy with a 50 kV X-ray source followed by an external
radiation with 50 Gy. The patient characteristics were as follows and represent the high risk cohort typical for a cohort of patients
tried with NACT: median age 54.9 years, 24 pts premenopausal / 37 pts postmenopausal, 31 pts G2 / 30 pts G3, 39 pts ER
positive / 22 pts ER negative, 29 pts PR positive / 32 pts PR negative, 24 pts HER2 positive / 37 pts HER2 negative, 36 pts T1 / 24
pts T2 / 1 pt T3, 28 pts node negative / 33 pts node positive. 19 patients reached a pCR. 17 patients needed more than one
operation. No patient was lost to follow up and at the time of data closure the median follow up was 49.56 months.

Results: At a median follow up of 49.55 months the DFS was 86.89%, the DDFS 93.44%. 18 of the 19 patients were disease free in the group of
patients who reached a pCR (DFS 94.74%). In the group of 42 patients who had residual tumor after NACT, 35 were disease free
(DFS 83.33%). Conclusion: A DFS of 86.89% compares favorably to the DFS expected for patients after NACT. The higher DFS in
the pCR-group was expected due to the fact that a pCR after NACT +/- Trastuzumab is predictive for DFS. Still the DFS in the non
pCR-group compares favorably to the known data for patients not reaching a pCR. Our data are the first on IORT as a boost after
neoadjuvant chemotherapy and show a favorable outcome of the patients in this high risk group. They strongly encourage the
design of prospective trials in this indication.

**MSR032-04** Preliminary Results of a Phase I Trial Evaluating Nipple Sparing Mastectomy with Immediate
Reconstruction Followed by Prophylactic Nipple Areola Complex Irradiation in Early-Stage Breast
Cancer: Patient Reported Satisfaction and Cosmesis Outcomes

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S103AB

Participants
Cristiane Taikita, MD, Miami, FL (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): Breast conserving therapy has become the standard option for patients with early stage breast cancer. Still,
there are some patients in need for mastectomy due to multicentric disease or diffuse microcalcifications. If mastectomy is to be
performed, keeping the nipple areola complex (NAC) is still controversial. Studies have shown that preservation of the NAC provided
higher patient’s satisfaction and less psychological impact after mastectomy. Previous studies have used nipple sparing approach
using intraoperative radiation (RT) to the NAC. This study is to report preliminary data of a prospective phase I trial using nipple
sparing mastectomy with immediate reconstruction, followed by prophylactic NAC RT at weeks 5 to 8
postoperative.

Materials/Methods: From 2009 to 2014, 10 patients with 11 breast cancers primary (one patient had bilateral
disease) were enrolled in the study. The first 6 patients were treated to the NAC using 25 Gy in 10 fractions, BID, 6 hours apart,
over 5 consecutive days, using electrons (dose level II; dose escalation/de-escalation design). The next 3 patients received dose
level III, 30 Gy in 10 fractions, using same regimen. Radiation was delivered 5 to 8 weeks postoperative. Patient’s cosmesis was
assessed by the patient and physicians during 1, 3, 6, and 12 months after completion of protocol therapy. Patient’s satisfaction
satisfaction was also evaluated at same interval.

Results: Nine out of ten patients were able to complete treatment per protocol. At the last follow up, patient’s evaluation of cosmesis was excellent in 78% (7/9), good in 11% (1/9), and poor in 11% (1/9). Overall patient
satisfaction with nipple sparing protocol was Good/Excellent in all patients during the time interval of evaluations. Physician’s
evaluation of NAC cosmesis was excellent in 34% (3/9), good 66% (6/9). In regard toxicity, only one patient developed grade 3
infection and loss of NAC postoperative; this patient did not receive NAC RT. Of the 9 evaluable patients in the protocol, there was
no NAC loss or need for treatment interruption. There was no grade 4, 5 toxicity in patients treated with NAC RT. The most
common toxicity was acute radiation dermatitis of the NAC, mostly grade 2, which completely resolved in subsequent follow
up.

Conclusion: The preliminary results of this nipple sparing protocol for early stage breast cancer showed a high level of patient’s
satisfaction and self-reported good/excellent cosmesis in the majority of patients treated. Toxicity appeared to be acceptable so
far, mostly related to acute radiation dermatitis, grade 2. There was no NAC loss with the use of prophylactic NAC RT. Final results
will be presented at completion of the trial.

**MSR032-06** Dose to Organs in the Supraclavicular Region When Covering the Internal Mammary Nodes (IMN) in
Breast Cancer Patients: A Comparison of VMAT Versus 3-D and VMAT

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S103AB

Participants
Vishruta A. Dumane, PhD, Chicago, IL (Presenter) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Sheryl Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): VMAT has been reported to offer improved dosimetric sparing of the ipsilateral lung, total lung and heart
compared to 3D conformal planning while covering IMNs. However OARs in the supraclavicular region often receive higher doses
compared to 3D conformal planning. We aim to compare VMAT versus a combination of 3D and VMAT to improve sparing of OARs in
this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT
alone.

Materials/Methods: 10 patients previously treated with VMAT at our institution were re-planned with 3D conformal planning in
this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT
alone.

Results: Combining 3D with VMAT significantly reduced the maximum dose to the esophagus, and PTV D05 = 115%. Doses to the esophagus, trachea, larynx, brachial plexus, thyroid and cord were noted in addition to the
heart, lungs and contralateral breast. A statistically significant increase in the V20 Gy to the ipsilateral lung and total lung was observed but was = 2%. Conclusion: 3D conformal planning in the supraclavicular region while restricting VMAT to the chestwall helps reduce dose to additional OARs without compromising doses to the heart, lungs and contralateral breast when VMAT alone is used. OARVMAT3D + VMAT Esophagus Max (Gy)45.65* (SE 2.32)30.8* (SE 2.54) Esophagus Mean (Gy)9.16* (SE 0.64)6.54* (SE 0.54) Trachea Max (Gy)43.97* (SE 1.51)33.24* (SE 5.44) Trachea
contralateral breast when VMAT alone is used. OARVMAT3D + VMAT   Esophagus Max (Gy)45.65* (SE 2.32)30.8* (SE 2.54) Esophagus Mean (Gy)9.16* (SE 0.64)6.54* (SE 0.54) Trachea Max (Gy)43.97* (SE 1.51)33.24* (SE 5.44) Trachea

**MSR032-07** Dose to Organs in the Supraclavicular Region When Covering the Internal Mammary Nodes (IMN) in
Breast Cancer Patients: A Comparison of VMAT Versus 3-D and VMAT

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S103AB

Participants
Vishruta A. Dumane, PhD, Chicago, IL (Presenter) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Sheryl Green, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): VMAT has been reported to offer improved dosimetric sparing of the ipsilateral lung, total lung and heart
compared to 3D conformal planning while covering IMNs. However OARs in the supraclavicular region often receive higher doses
compared to 3D conformal planning. We aim to compare VMAT versus a combination of 3D and VMAT to improve sparing of OARs in
this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT
alone.

Materials/Methods: 10 patients previously treated with VMAT at our institution were re-planned with 3D conformal planning in
this region without compromising target coverage or the dosimetric advantage that is already offered on using VMAT
alone.

Results: Combining 3D with VMAT significantly reduced the maximum dose to the esophagus, and PTV D05 = 115%. Doses to the esophagus, trachea, larynx, brachial plexus, thyroid and cord were noted in addition to the
heart, lungs and contralateral breast. A statistically significant increase in the V20 Gy to the ipsilateral lung and total lung was observed but was = 2%. Conclusion: 3D conformal planning in the supraclavicular region while restricting VMAT to the chestwall helps reduce dose to additional OARs without compromising doses to the heart, lungs and contralateral breast when VMAT alone is used. OARVMAT3D + VMAT Esophagus Max (Gy)45.65* (SE 2.32)30.8* (SE 2.54) Esophagus Mean (Gy)9.16* (SE 0.64)6.54* (SE 0.54) Trachea Max (Gy)43.97* (SE 1.51)33.24* (SE 5.44) Trachea
contralateral breast when VMAT alone is used. OARVMAT3D + VMAT   Esophagus Max (Gy)45.65* (SE 2.32)30.8* (SE 2.54) Esophagus Mean (Gy)9.16* (SE 0.64)6.54* (SE 0.54) Trachea Max (Gy)43.97* (SE 1.51)33.24* (SE 5.44) Trachea
**MSRO32-07 SBRT for Secondary Lung and Liver Lesions in 35 Breast Cancer Oligometastatic Patients**

**ABSTRACT**

Purpose/Objective(s): This retrospective study explores the impact of SBRT as an aggressive local treatment on the disease evolution and survival of patients with oligometastatic breast cancer treated for lung and liver metastases. Materials/Methods: 24 lung lesions in 11 patients and 39 liver lesions in 24 patients (total of 63 lesions) were irradiated using SBRT between Feb’07-Nov.’14. All 35 patients treated (KPS =70) were oligometastatic which according to our criteria implied the presence of = 5 in lung- or in liver-only metastases, or = 3 if presented in > 1 site. 7 patients (20%) were with single metastases while 28 (80%) with multiple. 11 patients were irradiated for lung lesions while 24 for liver lesions. Histology was ductal ADK in 81% of patients, lobular in 10%, mixed in 2% and other histologies or no data in 7%. The median diameter of the lung lesions was 1 cm (range 0.5-5) and of the liver metastases 3.5 cm (range 1-9.1). Planning Target Volume was created by adding a 3 mm margin to the Gross Tumor Volume. SBRT was delivered with VMAT by 6 MV LINAC and planned by TPS with Montecarlo algorithm. All lesions were treated in Breath-hold with different dose levels depending on tumor size and site. Almost all lung lesions (83.3%) were irradiated with 26 Gy in a single fraction prescribed to the 70% isodose (BED10 to isocenter = 175). Liver lesions were treated mainly (72%) with 37.5 Gy in 3 fractions prescribed to the 67% isodose (BED10 to isocenter = 161). Set-up and isocenter were assessed by CBCT. All patients treated for liver lesions underwent Gold fiducials insertion 1 week before CT simulation. The response was evaluated after 60 days by CT and PET, and every 3 months subsequently. Toxicity was assessed by CTCAE score. Results: Considering all treated lesions, both in lung and liver, only 5 (7.9%) “in field” recurrences were observed, all occurred in liver during the first year from SBRT so the local control rate at 1 year was 92.1%; Dividing irradiated lesions by anatomic site 1 year local control rate for lung lesions was 100% while for liver group 87.2%. At 1 and 2 years Overall Survival (OS) rates were 86% and 69% (91% and 70% in lung-group vs. 83% and 50% in liver-group), and Progression Free Survival rates were 37% and 20%, respectively (median F.U. 19.9 months, range 2.2-60). No predictive factors of local failure were found. No toxicity > G2 (4 patients) was recorded. Conclusion: SBRT for Lung and Liver metastases in Breast oligometastatic patients is a safe and well tolerated treatment. High local control rate (only 5 recurrences in field) confirms the ablative role of SBRT using high BED doses (> 100). The low number of relapses does not allow statistical analysis on predictive factors of local failure but high local control rate in the subset of patients with primary breast cancer indicates an trend for better local control respect to other primitive tumors (92.1% at 1 year that appears stable over the time).

**MSRO32-08 Salvage Radiation Therapy for 2nd Oligo-Recurrence in Patients With Breast Cancer**

**ABSTRACT**

Purpose/Objective(s): A new concept of “oligo-recurrence (OR)” indicates one to several distant metastases/recurrences in one or several organs which can be treated with local therapy, while the primary site of the cancer was once controlled. A previous study demonstrated that first failure detected as the state of OR (e.g. isolated loco-regional recurrence (LRR) or isolated pulmonary metastasis) could be salvaged by local therapy. However, a subset of once salvaged patients with OR could have a second failure which is also detected as the state of OR. We have often experienced this situation in patients with breast cancer and have defined that as “2nd OR.” The purpose of this study was to assess the efficacy and toxicity of salvage radiotherapy (RT) for the 2nd OR of breast cancer.Materials/Methods: All the 23 patients satisfied the following requirements of our definition for 2nd OR: (i) disease-free status after initial therapy for clinically localized breast cancer had been once confirmed; (ii) first failure was detected as OR (1st OR), and disease control of the 1st OR after salvage local therapy was confirmed, while simultaneously there were no other distant metastases/recurrences; (iii) second failure was also detected as OR (2nd OR) which was treated with salvage RT. The sites of the 2nd OR were LRR in 9 patients and distant metastasis in 14 patients. The total radiation dose of the salvage RT ranged from 40–76 Gy (median, 60.0 Gy), the daily dose was 2.0–3.0 Gy (median, 2.0 Gy). Efficacy and toxicity of the salvage RT for the 2nd OR were retrospectively evaluated, and the predictors of a long-term survival were analyzed. Results: Twenty-one (91%) patients had an objective response. The median overall survival and progression-free survival times were 40 and 20 months after salvage RT for the 2nd OR, respectively. The three-year local (in-field) control rates were 84%. The toxicities were mild; acute toxicities = Grade 3 were seen in one patient with Grade 3 dermatitis, and no late toxicity = Grade 2 was observed, except for one patient who had a Grade 3 lymphatic edema of the arm. The first sites of disease progression after the salvage RT for the 2nd OR were out-field alone in 11 patients (48%) and both in-field and out-field in 4 patients (17%); none of the patients had first sites in local (or in-field) alone. The univariate analyses indicated that age (Conclusion: Salvage RT for the 2nd OR was able to achieve a better local control rate and longer progression-free survival time without inducing severe toxicity, and therefore may be a potentially effective modality for inducing long-term survival in select patients.

**MSRO32-09 Cost-Effectiveness of Pertuzumab in HER2-positive Metastatic Breast Cancer**

**ABSTRACT**

Purpose/Objective(s): The Clinical Evaluation of Pertuzumab and Trastuzumab (CLEOPATRA) study showed a benefit in overall
survival with the addition of pertuzumab (P) to docetaxel (T) and trastuzumab (H) (THP) compared to TH as first-line treatment for patients with HER2-positive metastatic breast cancer. With median follow-up of 50 months, median overall survival for the THP and TH groups were 56.5 and 40.8 months, respectively [Swain, NEJM 2015]. Based on these results, we performed a cost-effectiveness analysis to determine the impact of pertuzumab on the treatment of HER2-positive metastatic breast cancer.

Materials/Methods: Cost-effectiveness was evaluated from a societal perspective. A four-state Markov model was constructed to evaluate the cost-effectiveness of TH with or without P. Health states included: stable disease, progression of disease, hospice, and death. The model was run over 10 years with cycle length of 1 week. Transition probabilities were based on the results of the CLEOPATRA study. Costs were based upon 2014 Medicare reimbursement rates and manufacturers' Average Sales Price. Interventions were evaluated with a willingness-to-pay threshold (WTP) of $100,000 per quality-adjusted life years (QALY) gained. One-way and multi-way sensitivity analyses were performed to explore the effects of specific assumptions.

Results: Our modeled overall survival and progression-free survival intervals compared well with the results of the CLEOPATRA study. Modeled median survival was 171 weeks (39.5 months) and 253 weeks (58.3 months) for TH and THP group, respectively. The addition of P resulted in an additional 0.73 QALY at an increased cost of $426,039 compared with TH, resulting in an incremental cost-effectiveness ratio (ICER) of $582,141 per QALY. Two-way sensitivity analysis showed that in the scenario where baseline costs (including cost of trastuzumab) were half of predicted, THP would not become cost-effective until discounted by 96% of the current Medicare Average Sales Price.

Conclusion: The addition of pertuzumab to docetaxel and trastuzumab in metastatic HER2(+) breast is unlikely to be cost-effective at a WTP threshold of $100,000 per QALY gained. This finding is attributed to 1) the expense of pertuzumab, and 2) that patients treated with pertuzumab have prolonged progression-free survival, and, therefore, accrue higher costs for prolonged treatment with both pertuzumab and trastuzumab. Additional results from the adjuvant trials of pertuzumab will be important to characterize the overall cost-benefit of this agent in both metastatic and early stage HER2-positive breast cancer.
Among these, 67 patients developed brain metastasis and 126 patients did not. In a univariate analysis, factors for patients with NSCLC to develop brain metastasis were examined. Information on age, sex, and tumor stage were also collected. Results: A total of 193 patients were identified and different factors were assessed, including age, sex, tumor stage, and biomarkers (TTF-1, CK7, CK20, Synaptophysin, p63, and CK 5/6) and histology (adenocarcinoma or SCLC, with neuroendocrine differentiation). Radiological reports were examined for tumor site(s), tumor size information, nodal involvement, and number of nodules present. Information on age, sex, and tumor stage was also collected. Details of patients that received radiotherapy to the brain were collected for further data collection using the EPIC database. Pathology records of these patients were examined for presence of certain biomarkers.

Purpose/Objective(s): The medical community has suspected a correlation between Non-Small Cell Lung Cancer and brain metastasis for quite some time. Identifying reliable predicting characteristics of brain metastasis in NSCLC patients can allow for effective treatment with Prophylactic Cranial Irradiation (PCI) to minimize the risk of metastasis. We sought to identify predictive factors for patients with NSCLC to develop brain metastasis. Materials/Methods: MOSAIC databases were queried for patients that received radiotherapy treatment at the institution. Details of patients that received radiotherapy to the brain were collected for further data collection using the EPIC database. Pathology records of these patients were examined for presence of certain biomarkers (TTF-1, CK7, CK20, Synaptophysin, p63, and CK 5/6) and histology (adenocarcinoma or SCLC, with neuroendocrine differentiation). Radiological reports were examined for tumor site(s), tumor size information, nodal involvement, and number of nodules present. Information on age, sex, and tumor stage was also collected. Results: A total of 193 patients were identified and included in this analysis. Among these, 67 patients developed brain metastasis and 126 patients did not. A univariate analysis of
data determined that tumor stages 3 and 4 (pA multivariable logistic regression model of data determined higher stage (stages 3 or 4: p=0.004, Adjusted OR=3.612) and tumor size (Above 3 cm: pAdditionally, the presence of CK7 and Synaptophysin showed a trend and non-significant increased risk of brain metastasis (OR=2.22 and 2.90, p=0.06 and 0.40, respectively).

Conclusion: Identifying the presence of predictive characteristics in NSCLC patients can help patient survival through the administration of prophylactic cranial irradiation. In this study, we showed that NSCLC of stages 3 or 4, with tumors greater than 3 cm in at least one dimension, or more than two nodes or nodules involved are predictive of brain metastasis. Presence of CK7 may also be a reliable predictor of brain metastasis. This evidence can be helpful to doctors in evaluating whether or not patients should receive PCI.

**MSRO35-04 Roles of Tumor Size and Histology in Outcomes Following Resection and Stereotactic Radiosurgery for Brain Metastases**

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S103CD

**Awards**

**Trainee Research Prize - Medical Student**

**Participants**

Chase Escott, Lebanon, NH *(Presenter)* Nothing to Disclose
Linton T. Evans, MD, Lebanon, NH *(Abstract Co-Author)* Nothing to Disclose
Zhongze Li, Lebanon, NH *(Abstract Co-Author)* Nothing to Disclose
Nathan Simmons, MD, Lebanon, NH *(Abstract Co-Author)* Nothing to Disclose
David W. Roberts, MD, Lebanon, NH *(Abstract Co-Author)* Scientific Advisory Board, Carthera AB; Scientific Advisory Board, IMRIS Inc; Scientific Advisory Board, RTOG's Radiation Therapy (WBRT).
Zhongze Li, Lebanon, NH *(Abstract Co-Author)* Nothing to Disclose
Andrew Zureick, BA, Ann Arbor, MI *(Abstract Co-Author)* Nothing to Disclose
Alan C. Hartford, MD, PhD, Lebanon, NH *(Abstract Co-Author)* Nothing to Disclose

**PURPOSE**

Stereotactic radiosurgery (SRS) following resection of a brain metastasis improves disease control at the surgical site. Our prior published work demonstrated a relationship between size of the resected tumor and risk of local recurrence (LR). In this analysis we expanded our database to examine the role of tumor histology among factors that may predict recurrence and overall survival (OS).

**METHOD AND MATERIALS**

We retrospectively reviewed all patients treated through Jan 2013 who underwent SRS to the surgical bed, deferring whole brain radiation therapy (WBRT). Multiple factors - including histology, tumor size, planning target volume (PTV), dose, meningeval contact (SUP), development of leptomeningeal disease (LMD), gross total resection (GTR), number of metastases (MET#), and the RTOG's histology-specific Graded Prognostic Assessment (GPA) - were analyzed for time to local recurrence at the tumor bed (LR), to distant recurrence within the brain (DR), to intracranial recurrence (ICR), to salvage WBRT, and for OS.

**RESULTS**

122 lesions in 118 patients were treated with resection and SRS between February 2002 and January 2013. With median follow-up 18.3 months, local control rates at the resection cavity were 91.2% at 1-year, 83.4% at 2-years. Overall survival (OS) rates at 1-year and 2-years were 51.2% and 24.4%, respectively. On univariate analysis tumors > 3.0 cm, compared to smaller tumors, had a marginally significant higher risk of local recurrence (LR). In this analysis we expanded our database to examine the role of tumor histology among factors that may predict recurrence and overall survival (OS). Multivariate Cox regressions showed pre-op size to be significant for risk of LR in patients with non-lung tumors (p<.05), but not significant for patients with NSCLC metastases. In multivariate analysis of the entire dataset, only GPA was significantly associated (p<.0001) with OS, while size, PTV, GTR, histology, SUP, dose, LMD, and MET# were not -- arguing for successful salvage of recurrences.

**CONCLUSION**

SRS without WBRT is efficacious in controlling disease recurrence following resection of brain metastases. This study supports tumor size and histology as important factors prognostic for disease control in this group of patients.

**CLINICAL RELEVANCE/APPLICATION**

Pre-operative tumor size and tumor histology are important prognostic factors for efficacy of stereotactic radiosurgery following resection for brain metastases.

**MSRO35-05 Gamma Knife Radiosurgery for Intracranial Grade 2 Meningiomas**

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S103CD

**Participants**

Tamer Refaat Abdelrhman, MD, PhD, Chicago, IL *(Presenter)* Nothing to Disclose
Michelle S. Gentile, MD, PhD, Cambridge, MA *(Abstract Co-Author)* Nothing to Disclose
Onh Bloch I, MD, Chicago, IL *(Abstract Co-Author)* Nothing to Disclose
Maryanne Marymont, MD, Chicago, IL *(Abstract Co-Author)* Nothing to Disclose
James P. Chandler, MD, Chicago, IL *(Abstract Co-Author)* Nothing to Disclose
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**PURPOSE**

There has been few reports addressing the treatment outcomes of Gamma knife radiosurgery (GKRS) for grade 2 meningiomas. This study aims to report clinical outcomes after GKRS for intracranial grade 2 meningiomas.

**METHOD AND MATERIALS**

In this IRB approved study, we reviewed the records of all patients with histopathologically confirmed meningiomas treated with GKRS between 1998 and 2014. The median GKRS dose was 15 Gy (range 11-20) prescribed to the 50% isodose line.
RESULTS
A total of 209 meningiomas were treated consecutively and postoperatively with GKRS; of them 96 were histopathologically confirmed grade 2 meningiomas and were included in this study. Median age was 61 years, 57.3% were females and 42.7% were males. Tumor sites included anterior (11.5%), middle (11.5%), and posterior (18.7%) cranial fossae, convexity (32.3%), parasagittal (12.5%), temporal (10.4%), and others (3.1%). Mean tumor size was 3.3 cm³ (median 2.2 cm³). Among 41 (48.8%) symptomatic patients, most common symptoms were headache (21.9%), visual impairment (14.6%), hearing deficit (5.2%) and motor deficits (9.4%). After a mean follow up of 40 months (range 3 - 174), the local control rate was 70% of all treated meningiomas. The median time to recurrence was 89 months (range 47 - 168 months). Of symptomatic patients, 54%, 39%, and 7% reported improved, stable, or worse initial symptoms, respectively. The 3, and 5-year actuarial local control rates were 69.9%, and 55.6%, respectively. The 3, and 5-years overall survival were 80.7%, and 65.6%, respectively. Multivariate analysis including tumor size, site, status (residual versus recurrent), dose, age, sex, race, previous irradiation, previous surgery, time since surgery, will be represented during the meeting in order to identify most contributing factors for local failure and provide recommendations for optimal treatment. The most common acute toxicities after GKRS were headache (1.1%), sensory loss (1.1%), visual impairment (1.1%), and dementia (3.4%). Chronic toxicities included, headache (1.1%), and visual impairment (2.2%). There were no radiation necrosis or second malignant tumors noted in our series.

CONCLUSION
This report, one of the largest GKRS series for grade 2 meningiomas, demonstrates that GKRS is a safe and effective treatment modality for grade 2 meningiomas with durable tumor control and minimal toxicity.

CLINICAL RELEVANCE/APPLICATION
GKRS is a safe and effective treatment modality for grade 2 meningiomas patients.

MSRO35-07 Stereotactic Radiosurgery for Treatment of Brain Metastases from Colorectal Cancer: A Single-Institution Experience

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S103CD

Participants
Michael A. Cummings, MD, MS, Rochester, NY (Presenter) Nothing to Disclose
Kevin Walter, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Kenneth Usuki, Rochester, NY (Abstract Co-Author) Nothing to Disclose
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Alan W. Katz, MD, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Michael T. Milano, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To review outcomes of patients with colorectal adenocarcinoma who underwent stereotactic radiosurgery for brain metastasisMaterials/Methods: A retrospective review of patients with biopsy proven colorectal adenocarcinoma treated with stereotactic radiosurgery for brain metastases from 2001-2013 was conducted under an IRB approved protocol. End points were radiologic response, neurologic symptom response, overall survival, and treatment related complications. Radiographic response to treatment was defined as stable or shrinking lesion size (accounting for expect post-radiation changes) on follow-up imaging, which was MRI in all except 1 patient. Neurologic symptom response was defined as improved or stable deficits on follow up exam with decreasing steroid dosage and no interval novel-to-patient systemic therapy. Results: Twenty-three patients received single fraction SRS using either a frame based (2002-2010) or frameless (2011-2013) technique. Mean follow up was 5.4 months (range 1 to 13) which was dictated by overall survival. A total of 46 lesions were treated. The mean lesion size on MRI was 17 mm in greatest dimension (range 2 – 35 mm) with mean PTV size of 3.4 cm³ (0.02 to 14.94 cm³). The median number of lesions treated in a single course was 2 (range 1 to 5). Median prescribed dose to isocenter was 16.5 Gy (12.5 to 20) with median minimal PTV dose of 14 Gy (10 to 19.6). Eight lesions were recurrent after previous resection. Six lesions were treated with SRS and then required retreatment with SRS. Eleven patients had previous WBRT with median dose of 30 Gy. Radiographically 72% of lesions were stable or decreasing in size using last available assessment with mean interval of 4.1 months (1 to 19.2). Mean overall survival was 6 months. Two patients died within 1 month of treatment from causes other than disease (MI, MVA). Sixteen courses of treatment coincided with presentation of neurologic symptoms, with previous WBRT in 14. Seven of these sixteen patients had improvement in their presenting deficit, first noted on assessment at median interval of 2 months after SRS (range 1.3 to 6 mos). Two patients remained steroid dependent, both on substantially decreased doses. None of the patients with neurologic response had recurrence of their presenting neurologic symptom prior to death. No patients required hospitalization for adverse effects of treatment. Two patients proceeded to resection post SRS for progressive lesion. Two patients who did not have WBRT had progression of CNS disease outside the treatment volumes. Conclusion: Stereotactic radiosurgery was well tolerated with excellent radiographic response and no major reported adverse events. In this review 44% of patients with neurologic symptoms prior to SRS had clinical improvement with length and time course not attributable to steroid therapy.

MSRO35-08 Long-term Follow-up of Intensive Chemotherapy Followed by Reduced Dose and Field Irradiation for Intracranial Germ Cell Tumors

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S103CD

Participants
Akio Taka, MD, Tsu, Japan (Presenter) Nothing to Disclose
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Takao Deguchi, MD, PhD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose
Yutaka Toyomasa, MD, Tsu, Japan (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To review outcomes of patients with intracranial germ cell tumors treated with intensive chemotherapy followed by reduced dose and field irradiationMaterials/Methods: A retrospective review of patients with biopsy proven intracranial germ cell tumors treated with intensive chemotherapy followed by reduced dose and field irradiation was conducted under an IRB approved protocol. Results: Twenty-nine patients received chemotherapy followed by reduced dose and field irradiation. The median number of cycles was 2 (range 1 to 15). The median prescribed dose to isocenter was 16 Gy (10 to 19). Eight patients proceeded to resection post chemotherapy. Six patients who did not have prior chemotherapy for progression of disease. Two patients underwent chemotherapy with exception post-radiation changes. One patient with previous chemotherapy in 10. Six patients had improvement in their presenting deficit, first noted on assessment at median interval of 2 months after SRS (range 1.3 to 6 mos). Two patients remained steroid dependent, both on substantially decreased doses. None of the patients with neurologic response had recurrence of their presenting neurologic symptom prior to death. No patients required hospitalization for adverse effects of treatment. Two patients proceeded to resection post SRS for progressive lesion. Two patients who did not have WBRT had progression of CNS disease outside the treatment volumes. Conclusion: Stereotactic radiosurgery was well tolerated with excellent radiographic response and no major reported adverse events. In this review 44% of patients with neurologic symptoms prior to SRS had clinical improvement with length and time course not attributable to steroid therapy.
ABSTRACT

Purpose/Objective(s): The purpose of this study is to report the treatment outcomes of intensive chemotherapy followed by reduced dose and field irradiation for the treatment of intracranial germ cell tumors (GCTs).

Materials/Methods: 22 patients (18 males and 4 females) with intracranial GCTs were treated at our facility between 1991 and 2012. They were classified into three groups based on serological and histological findings. Five patients (23%) with pure germinoma were treated with conventional-dose chemotherapy (ifosphamide-cisplatin-etoposide) followed by 24 Gy ventricular field irradiation as good prognosis group, and 14 patients (64%) germinoma with syncytiotrophoblastic giant cells and 3 patients (14%) with nongerminomatous GCTs were treated with high-dose chemotherapy (HDC) with stem-cell support followed by 24-50.4 Gy reduced field irradiation as intermediate and poor prognosis group, respectively. The Median age was 14 years and primary sites were at pineal region for 11(50%) patients, suprasellar region for 4(18%) patients and others for 7(32%) patients. Disseminated tumors were present in 4 patients. Ten patients (45%) were diagnosed with hydrocephalus before treatment. Four patients who relapsed after initial chemotherapy were included in this study.

Results: The medium follow-up duration was 113 months, 10-year overall survival rate and progressive-free survival rate was 80.1% and 69.8%, respectively. Regarding late adverse effect, pituitary dysfunction (short stature, insufficiency of secondary sexual feature, hypothyroidism); 8 patients (36%), hearing impairment; 5 patients (23%), intelligence diminution; 6 patients (27%), convulsion•electroencephalogram abnormality; 5 patients (23%), treatment induced secondary neoplasm; 2 patients (9.1%), motility disorder; 2 patients (9.1%), azoospermia; 1 patient (4.5%) and treatment-related death (brain hemorrhage); 1 patient (4.5%) appeared. In addition, 5 (23%) patients needed intervention of a psychiatrist due to school refusal, anxiety disorder, eating disorder and self-injury behavior etc. In contrast, patients who received irradiation less than 30 Gy tended to have no late adverse effect.

Conclusion: Intensive chemotherapy followed by reduced dose and field irradiation resulted in preferable outcomes. Based on our results, further study will be required from the perspective of radiation dose and field, especially for patients classified as intermediate and poor prognosis group.

Participants
Esther Yu, MD, Boston, MA (Presenter) Nothing to Disclose

PURPOSE

Purpose/Objective(s): Sacral chordomas represent approximately a third of all chordomas, a rare neoplasm of notochordal remnants. Current NCCN guidelines recommend surgical resection with or without adjuvant radiotherapy, or definitive radiation for unresectable cases. Recent advances in radiation for chordomas include conformal photon and proton beam radiation. We investigated the incidence, treatment, and survival outcomes for sacral chordomas to observe any trends in response to improvements in surgical and radiation techniques over a near 40 year time period.

METHOD AND MATERIALS

Materials/Methods: 345 microscopically confirmed cases of sacral chordoma were identified between 1974 and 2011 from the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute. Incidence and survival rates were adjusted for age. Cases were divided into three cohorts by calendar year, 1974-1989, 1990-1999, and 2000-2011, as well as into two groups by age less than or equal to 65 versus greater than 65 to investigate trends over time and by age via Chi-square analysis. Kaplan-Meier analyses were performed to determine effects of treatment on survival.

RESULTS

Results: Median age at diagnosis was 64. The age-adjusted incidence rate of sacral chordomas was .03 per 100,000. 5-year relative survival for the entire cohort was 60%. Overall survival correlated significantly with treatment modality, with 44% surviving at 5 years with no treatment, 52% with radiation alone, 82% surgery alone, and 78% surgery and radiation (pTable 1. Trends of Radiation, Surgery, and Survival by Time.1974-1989(N=68)1990-1999(N=78)2000-2011(N=199)P-valuePatients Receiving Radiation1

53%40%33%.03Patients Receiving Surgery1

65%74%70%.555-year Overall Survival (%)63%59%63%2.991Treatments were not mutually exclusive.2Calculated from 94 cases between 2000-2006 with median follow-up 84 months.

CONCLUSION

Conclusion: Surgery remains an important component in the treatment of sacral chordomas in current practice. Fewer patients were treated with radiation more recently despite advances in photon and proton beam radiation. Overall survival remains unchanged. Additional analyses of margin status, radiation modality, and local control in current practice are warranted.

ABSTRACT

Conclusion: Surgery remains an important component in the treatment of sacral chordomas in current practice. Fewer patients were treated with radiation more recently despite advances in photon and proton beam radiation. Overall survival remains unchanged. Additional analyses of margin status, radiation modality, and local control in current practice are warranted.
**Molecular Imaging (Gynecologic Oncology)**

**Tuesday, Dec. 1 10:30AM - 12:00PM Location: S504CD**

**SSG09-01 First Clinical Trial on Ultrasound Molecular Imaging Using KDR-Targeted Microbubbles in Patients with Breast and Ovarian Lesions**

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S504CD

Participants
Kathryn A. Morton, MD, Salt Lake City, UT (Moderator) Nothing to Disclose
Zaver M. Bhujwalla, PhD, Baltimore, MD (Moderator) Nothing to Disclose

Sub-Events

**SSG09-01 First Clinical Trial on Ultrasound Molecular Imaging Using KDR-Targeted Microbubbles in Patients with Breast and Ovarian Lesions**

Tuesday, Dec. 1 10:30AM - 10:40AM Location: S504CD

Participants
Juergen K. Willmann, MD, Stanford, CA (Presenter) Research Consultant, Bracco Group; Research Consultant, Triple Ring Technologies, Inc; Research Grant, Siemens AG; Research Grant, Bracco Group; Research Grant, Koninklijke Philips NV; Research Grant, General Electric Company
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Sanjiv S. Gambhir, MD, PhD, Stanford, CA (Abstract Co-Author) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc

**PURPOSE**
To assess if clinical ultrasound molecular imaging (USMI) using a novel clinical grade human kinase domain receptor (KDR)-targeted microbubble (BR55, Bracco) is safe and allows assessment of KDR expression in patients with breast and ovarian lesions, using immunohistochemistry (IHC) as gold standard.

**METHOD AND MATERIALS**
21 women (34-66 yrs) with focal breast lesions and 24 women (48-79 yrs) with focal ovarian lesions were injected IV with BR55 (0.03-0.08 mL/kg bw) and 2D USMI of the target lesions was performed dynamically every 2 min starting 5 min after injection up to 29 min, using the linear 15L8 probe (Siemens) or the endocavitary 1123 probe (Esaote). Normal breast tissues surrounding the lesion or the contralateral presumed normal ovary served as intra-patient controls. Blood pressure, EKG, oxygen levels, heart rate, CBC, and metabolic panel were obtained before, and 30 min, 1h, 24h after BR55 administration. Persistent focal BR55 binding on USMI was visually assessed in consensus by 2 blinded offsite radiologists as none, possibly or definitely. Patients underwent surgical resection of the target lesions and tissues were stained for CD31 and KDR. A pathologist assessed vascular KDR expression using a 4-point scale (none, weak, intermediate, high). Adjudication was performed in consensus (offsite radiologists and pathologist) to match clinically.

**RESULTS**
USMI with BR55 was well tolerated by all patients at all doses, without safety concerns. Among the 40 patients included in the analysis, KDR expression was higher in malignant breast and ovarian lesions (score 2.40±0.63 and 2.08±0.64, respectively) compared to benign breast and ovarian lesions (2.08±0.64 and 1.33±0.50). KDR expression matched well with presence of focal BR55 binding on USMI in malignant breast (13/15; 86.7%) and ovarian (11/13; 84.6%) lesions, as well as benign breast (2/3; 66.7%) and ovarian (8/9; 88.9%) lesions. Focal USMI signal could be detected up to 29 min after injection.

**CONCLUSION**
Use of BR55 in USMI of breast and ovarian lesions is safe and effective and preliminary data indicate that KDR-targeted USMI signal matches well with vascular KDR expression on IHC.

**CLINICAL RELEVANCE/APPLICATION**
This study provides proof of principle on feasibility and safety of KDR-targeted USMI in patients with breast and ovarian lesions and lays the foundation for further clinical trials.

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**SSG09-02 Imaged EGFR Expression Level Reflects Inhibited Growth-Pathway Node in Model of Triple-Negative Breast Cancer**

Tuesday, Dec. 1 10:40AM - 10:50AM Location: S504CD

Participants
Eric Wehrenberg-Klee, MD, Boston, MA (Presenter) Nothing to Disclose
Nafize S. Turker, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Pedram Heidari, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Mauri Scaltritti, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth
Further work on FACBC as a radiotracer in locally advanced breast cancer is warranted.

**CLINICAL RELEVANCE/APPLICATION**

This pilot trial of FACBC PET/CT in locally advanced breast cancer demonstrates potential uses of FACBC PET/CT before and after neoadjuvant therapy.

**CONCLUSION**

We demonstrate in a murine model of triple-negative breast cancer that changes in EGFR expression predictive of treatment response could be non-invasively assessed using a 64Cu-DOTA-EGFR F(ab’)_2 PET imaging probe. We demonstrate that changes in the level of EGFR expression, potentially indicative of therapeutic response, differ depending on the growth-pathway inhibited.

**CLINICAL RELEVANCE/APPLICATION**

Noninvasive assessment of changes in EGFR expression could be a valuable clinical tool for rapid assessment of therapeutic efficacy of targeted growth pathway inhibitors in TNBC, allowing for dynamic clinical decision making in response to imaged resistance profiles.

**SSG09-03 FACBC PET/CT Before and After Neoadjuvant Therapy in Locally Advanced Breast Cancer: A Prospective Pilot Clinical Trial**

**Participants**

Gary A. Ulaner, MD, PhD, New York, NY (**Presenter**)
Research support, General Electric Company; Research support, F. Hoffmann-La Roche Ltd
Serge Lyashchenko, New York, NY (**Abstract Co-Author**)
Nothing to Disclose
Hanh Pham, New York, NY (**Abstract Co-Author**)
Nothing to Disclose
Jason S. Lewis, PhD, New York, NY (**Abstract Co-Author**)
Nothing to Disclose

**METHOD AND MATERIALS**

This prospective clinical trial is being performed under IRB approval. In this trial, newly diagnosed breast cancer patients that are planned for neoadjuvant systemic therapy followed by surgical resection undergo FACBC PET/CT prior to systemic therapy and then again following completion of systemic therapy. Maximum Standardized Uptake Values (SUVmax) and other quantitative measures of FACBC-avidity are measured for the primary breast tumor and nodal metastases before and after systemic therapy. Following surgery, FACBC results are correlated with postoperative histopathologic results.

**RESULTS**

Of 28 planned patients, we have currently accrued 23. All 23 accrued patients have undergone the pre-neoadjuvant therapy FACBC PET/CT. All 23 primary breast lesions were FACBC avid with SUVmax values of 2.3 to 17.5. 18 of 23 patients (78%) had FACBC avid axillary nodes with SUVmax values of 1.2 to 14.6. In 2 of 23 patients (9%), an unsuspected extra-axillary local nodal metastasis was detected on the pre neoadjuvant therapy FACBC PET/CT. SUVmax of these nodes was 2.1 and 2.2, and both were pathologically proven to be metastases. 15 of 23 patients (65%) have completed both pre- and post-neoadjuvant PET/CT scans and histological analysis following surgical resection. In 13 of these 15 patients (87%), a reduction of SUVmax in the primary breast cancer of greater than 90% could accurately identify the presence or absence of complete response/near complete response as defined by post surgical histologic analysis.

**CONCLUSION**

This pilot trial of FACBC PET/CT in locally advanced breast cancer demonstrates potential uses of FACBC PET/CT before and after neoadjuvant therapy.

**SSG09-04 Operation-naive Invasive Ductal Carcinoma of the Breast. Comparison of Staging Performed with**
**Whole Body DWI, PET, PET-CT, and PET-MR**

Tuesday, Dec. 1 11:00AM - 11:10AM Location: S504CD

Participants

Onofrio A. Catalano, MD, Napoli, Italy (Presenter) Nothing to Disclose
Bruce R. Rosen, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Consultant, Siemens AG
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Mark Vangel, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
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Umar Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Emamuele Nicolai, Napoli, Italy (Abstract Co-Author) Nothing to Disclose
Andrea Sorcetti, MD, Napoli, Italy (Abstract Co-Author) Nothing to Disclose
Marco Salvatore, MD, Napoli, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To compare the performance of whole body (WB) DW, WB-PET, WB-PETCT, and WB-PETMR in patients with newly diagnosed invasive ductal breast cancer, before undergoing treatment.

**METHOD AND MATERIALS**

49 consecutive women with newly diagnosed invasive ductal carcinoma of the breast underwent WB-DWI, WB-PET, WB-contrast enhanced (CE) PETCT and WB-CE-PETMR before treatment. A radiologist and a nuclear medicine physician evaluated in consensus the studies and searched for occurrence, number, and location of metastases. Final staging and number of lesions, according to each technique, were compared. Pathology and imaging follow up were used as the ground truth reference.

**RESULTS**

All the techniques correctly staged 32/49 patients: stage2b in 8, 2c in 7, 3c in 4, 4 in 13. They provided discordant stages in 17/49 patients: 1 (stage 2a): staged-4 by WB-PET; 4 (stage 2b): 3/4 staged-2a by WB-PET and WB-PETCT; 1/4 staged-4 by WB-DWI; 3 (stage 3a): 2/3 staged-2b by WB-PET and WB-PETCT, 1/3 staged-4 by WB-DWI; 3 (stage 3c): 2/3 staged-2a by WB-PET and WB-PETCT, 1/3 staged-2b by WB-PET and WB-PETCT, 1/6 staged-2b by WB-PET and WB-PETCT, 1/6 staged-2b by WB-PET, WB-DWI, and WB-PETCT, 1/6 staged-3a by WB-DWI, 1/6 staged-3c by WB-DWI, and 1/6 staged-3a by WB-PET, WB-PETCT and 3c by WB-DWI. Staging performance of WB-PETMR (49 correctly staged) was significantly better than WB-PETCT (38 correctly staged) (P<0.001, chi square-test). The best performing modality for malignant lymph-node detection was WB-PETMR (47 of 49 patients), followed by WB-DWI (37/49), followed by WB-PET and WB-PETCT (15 patients each). Significantly more malignant nodes were detected by WB-PETMR (P<0.0001, paired t-tests). At least as many true-positive lesions were detected by WB-PETMR than by any of the other three modalities for 46 patients. The corresponding number of patients for WB-PET, WB-PETCT, and WB-DWI were 40, 39 and 34, respectively.

**CONCLUSION**

PETMR allows a better accuracy in initial staging of surgical-naive ductal invasive breast cancer. The higher performance is likely related to the additive information of PET, DWI, as well as of the other sequences (STIR, T1-weighted Dixon, HASTE, ADC maps, and CE-T1-weighted images) of WB-PETMR

**CLINICAL RELEVANCE/APPLICATION**

When available WB-PETMR should be considered for proper staging of naive ductal invasive breast cancer.

**SSG09-05 Multiparametric 18F-FMISO PET/MRI for Assessment of Treatment Response to Chemo-radiation and Hypoxia Monitoring in Cervix Cancer Patients: A Feasibility Study**

Tuesday, Dec. 1 11:10AM - 11:20AM Location: S504CD

Participants

Petra Georg, MD, PhD, Wiener Neustadt, Austria (Abstract Co-Author) Nothing to Disclose
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Pascal A. Baltzer, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Stephan H. Poianec, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Wolfgang Wadosk, Vienna, Austria (Abstract Co-Author) Speaker, General Electric Company; Consultant, THP Medical; Research Grant, ABX GmbH; Research Grant, Rotem GmbH
Alina Sturdza, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Georgios Karanikas, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Stephan Poletauer, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Richard Poetter, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Thomas H. Helbich, MD, Vienna, Austria (Abstract Co-Author) Research Grant, Medicor, Inc; Research Grant, Siemens AG; Research Grant, C. R. Bard, Inc
Dietmar Georg, PhD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Katja Pinker, MD, New York, NY (Presenter) Nothing to Disclose

**PURPOSE**

To demonstrate feasibility of combined multiparametric positron emission tomography/magnetic resonance imaging at 3T (3T MP PET/MRI) and to assess treatment response and hypoxia monitoring in cervix cancer patients undergoing chemo-radiation therapy.

**METHOD AND MATERIALS**

In this IRB-approved prospective study 7 patients underwent sequential 3T MP 18F-FMISO PET/MRI at baseline; 2 and 5 weeks (w) after start and 3 months (FU) after treatment. MRI protocol consisted of a high-resolution isotropic T2-w SPACE, a DWI EPI (b=50/850 sec/mm²) and a high-resolution contrast-enhanced (CE) T1-w VIBE sequence. Patients were injected with 330 MBq 18F-FMISO and scanning was started 240 min after injection. CT data was used for attenuation correction. PET and MR image registrations were performed using Mirada RTx (Mirada Medical, Oxford, UK, ver. 1.4.0.23) software. Gross tumour volume (GTV)
was contoured by an experienced radiation oncologist on PET/MRI data sets. The volume of GTV was assessed for tumor size, CE-kinetics, restricted diffusivity and 18F-FMISO-avidity using SUVmax and SUV (SUVnorm) normalized to gluteal muscle uptake. At follow up, cervix was contoured, since all patients showed clinically complete remission.

RESULTS

3T MP 18F-FMISO PET/MRI was successfully performed in all patients at every time-point. Median GTV volume was 43.9 cc at baseline, 22.4 cc after 2w (20-25Gy) and 7.7 cc after 5w (40-45Gy). Mean ADC values were 1.02x10^-3 mm^2/sec increasing to 1.18x10^-3 mm^2/sec after 2w and to 1.27x10^-3 mm^2/sec after 5w and to 1.37x10^-3 mm^2/sec at FU. All GTVs showed mean initial-enhancement (IE) followed by a plateau with an increasing IE at 2w and 5w and wash-out at 5w. At FU, there was a persistent enhancement. The mean 18F-FMISO SUVnorm was 3.1 at baseline and decreased to 2.3 at 2w and 2.0 at 5w and follow-up. In all patients there was never the whole tumor 18F-FMISO-avid, but 18F-FMISO-avid spots within the tumor indicative of hypoxia could be identified before and during the course of therapy.

CONCLUSION

MP 18F-FMISO PET/MRI in cervix cancer patients at 3T is feasible and enables non-invasive monitoring of morphological and functional changes during treatment.

CLINICAL RELEVANCE/APPLICATION

3T MP 18F-FMISO PET/MRI can depict areas of tumor hypoxia during therapy and thus identify patients at risk who need an aggressive treatment approach.

SSG09-06 Correlation of PET-MR Biomarkers with Breast Cancer Molecular Subtypes, Grading and Presence of Distant Metastases at Time of Presentation

Tuesday, Dec. 1 11:20AM - 11:30AM Location: S504CD

Participants
Onofrio A. Catalano, MD, Napoli, Italy (Presenter) Nothing to Disclose
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Mark Vangel, PhD, Charlestown, MA (Abstract Co-Author) Nothing to Disclose
Umair Mahmood, MD, PhD, Charlestown, MA (Abstract Co-Author) Research Grant, Sabik Medical Inc; Advisory Board, Blue Earth Diagnostics Limited;
Maria Lepore, MD, Avellino, Italy (Abstract Co-Author) Nothing to Disclose
Bethany L. Niell, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
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Andrea Sorcinci, MD, Napoli, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate if PET-MR biomarkers correlate with molecular genetic subtypes, grading, and presence of distant metastases at time of presentation in naive ductal invasive breast cancers.

METHOD AND MATERIALS

21 consecutive patients with naive ductal invasive breast cancer and genetic molecular subtype profiling underwent whole-body contrast enhanced FDG-PET-MR (Biograph mMR, Siemens). Two readers, using commercially available software, measured the following PET-MR biomarkers: ADC, Ktrans, Ve, Kep, IAUC, SUVmax, SUVmean, and MTV. They were correlated with genetic molecular subtypes, grading and occurrence of distant metastases.

RESULTS

Genetic molecular subtypes were as follows: ER-7, ER+14; PR-8, PR+13; HER2-11, HER2+10; Ki67-low (<=35%), Ki67 medium/high (>35%). Grading was G2 in 14 and G3 in 7. Six patients had distant metastases. The following biomarkers were higher in the ER- and PR- compared to ER+ and PR+ patients: Kep (9234±1320 versus 6492±2358, p=0.01), SUVmax (14.19±7.17 versus 6.17±4.24, p=0.004), and SUVmean (8.44±4.01, p=0.004). ADC directly correlated with the degree of Ki67 expression (1019±256 for Ki67<=35%, 1338±105 for Ki67>35%, p=0.002). The following biomarkers were lower in HER2- patients compared to HER2+ cases: ADC (1050±280 versus 1306±122, p=0.009), Kep (6726±2240 versus 8599±2122, p=0.028), SUVmax (6.29±4 versus 1306±122, p=0.004), and SUVmean (6.83±4.73 versus 12.89±7.65, p=0.046). In all patients there was never the whole tumor 18F-FMISO-avid, but 18F-FMISO-avid spots within the tumor indicative of hypoxia could be identified before and during the course of therapy.

CONCLUSION

In naive ductal invasive breast cancers, PET-MR biomarkers correlate with molecular genetic subtypes and with grading, but not with the presence of distant metastases.

CLINICAL RELEVANCE/APPLICATION

PET-MR biomarkers might have prognostic and therapeutic implications on patients' management.

SSG09-07 Impact of Estrogen Receptor Gene Mutations on [18F]-Fluoroestradiol Uptake in Breast Cancer

Tuesday, Dec. 1 11:30AM - 11:40AM Location: S504CD

Participants
Manoj Kumar, MS, Madison, WI (Abstract Co-Author) Nothing to Disclose
Ginny L. Powers, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Justin Jeffery, Madison, WI (Abstract Co-Author) Nothing to Disclose
Yongjun Yan, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Amy M. Fowler, MD, PhD, Saint Louis, MO (Presenter) Nothing to Disclose
PURPOSE
Accurately predicting therapeutic responsiveness in women with breast cancer remains challenging. Positron emission tomography (PET) imaging using [18F]-16alpha-17beta-fluoroestradiol (FES) provides a way to non-invasively and longitudinally examine the subset of tumors expressing estrogen receptor alpha (ERα) which comprise approximately 70% of all breast cancers. However, the effect of mutations in the gene encoding ERα, recently identified in patients with endocrine-resistant, metastatic breast cancer, on FES uptake is unknown. We developed a model system to test how mutations in ERα influence the uptake of FES.

METHOD AND MATERIALS
Stable cell lines expressing either wild-type ERα (231-ER) or a point mutation in the ligand-binding pocket, G521R (231-G521R), were created in the ERα-negative human breast cancer cell line MDA-MB-231. ERα-positive MCF7 human breast cancer cells were used as a positive control and parental MDA-MB-231 cells were used as a negative control. Cell uptake of FES was measured in vitro with microPET/CT imaging and gamma counting. In addition, in vivo FES uptake was measured in MCF7 and 231-ER tumors grown as xenografts in athymic nude mice.

RESULTS
FES uptake was observed both in vitro and in vivo in the MCF7 and 231-ER cells/tumors. However, there was no significant FES uptake in the 231-G521R cells or parental MDA-MB-231 cells. The 231-ER cells had a similar dose response curve to MCF7 in competition assays using increasing doses of cold estradiol, and as consistent with the uptake data, 231-G521R binding was not altered by cold competition.

CONCLUSION
These data support the use of stable cell lines expressing variant forms of ERα as models for demonstrating the effects of ERα gene mutations on FES uptake. Ongoing studies are focusing on the effects of recently identified clinically-relevant ERα mutations on FES uptake and on the prediction of response to ER-targeted therapies.

CLINICAL RELEVANCE/APPLICATION
FES-PET imaging provides a non-invasive way to probe ERα function and may prove useful in identifying the development of ERα gene mutations and thus predicting endocrine resistance in ERα-positive breast cancer patients.

SSG09-08 Imaging Patients with Breast and Prostate Cancers Using Combined 18F NaF/18F FDG and TOF simultaneous PET/ MRI

Tuesday, Dec. 1 11:40AM - 11:50AM Location: S504CD

Participants
Ryogo Minamimoto, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose
Andreas M. Loening, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Valentina Taviani, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Sanjiv S. Gambhir, MD, PhD, Stanford, CA (Abstract Co-Author) Board Member, Enlight Biosciences; Board Member, ImaginAb, Inc; Board Member, FUJIFILM Holdings Corporation; Board Member, ClickDiagnostics, Inc; Consultant, FUJIFILM Holdings Corporation; Consultant, Gamma Medica, Inc; Speaker, ImaginAb, Inc; Stock, Enlight Biosciences; Stock options, Enlight Biosciences; Travel support, Gamma Medica, Inc
Shreyas S. Vasanawala, MD, PhD, Palo Alto, CA (Abstract Co-Author) Research collaboration, General Electric Company; Consultant, Arterys; Research Grant, Bayer AG; Andrei Iagaru, MD, Stanford, CA (Abstract Co-Author) Research Grant, General Electric Company; Research Grant, Bayer AG

PURPOSE
We previously reported the pilot evaluation of a simultaneous PET/MRI scanner with TOF capability, as well as the use of combined 18F NaF/18F FDG PET/CT in cancer patients. Here we prospectively compared the combined 18F NaF/18F FDG PET/ MRI against 99mTc-MDP in patients with breast and prostate cancers for the detection of metastatic disease.

METHOD AND MATERIALS
Fifteen patients referred for 99mTc-MDP bone scans were prospectively enrolled from Oct 14 - Mar 15. The cohort included 7 men with prostate cancer and 8 women with breast cancer, 41 - 85 year-old (average 61 ± 13). 18F NaF (0.7-2.2 mCi, mean: 1.2 mCi) and 18F FDG (3.8-5.2 mCi, mean: 4.2 mCi) were subsequently injected from separate syringes. The PET/MRI was done 6-30 days after bone scan. The whole body MRI protocol consisted of T2-weighted, DWI, and contrast-enhanced T1-weighted imaging. Lesions detected with each test were tabulated and the results were compared.

RESULTS
All patients tolerated the PET/MRI exam, and PET image quality was diagnostic despite the marked reduction in the administered dosage of radiopharmaceuticals (80% less for 18F NaF and 67% less for 18F FDG compared to standard protocols). Five patients had no bone metastases identified on either scans. Bone scintigraphy and PET/MRI showed osseous metastases in 9 patients, but more numerous bone findings were noted on PET/MRI than on bone scintigraphy in 3 patients. One patient had negative bone scan, but bone metastases were seen on PET/MRI. Lesions outside the skeleton were identified by PET/MRI in 3 patients.

CONCLUSION
The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent. Further, it detected extra-skeletal disease that may change the management of these patients, while allowing a significant reduction in radiation exposure from lower dosages of PET radiopharmaceuticals administered. A combination of 18F NaF/18F FDG PET/MRI may provide the most accurate staging of patients with breast and prostate cancers prior to the start of treatment.

CLINICAL RELEVANCE/APPLICATION
The combined 18F NaF/18F FDG PET/MRI is superior to 99mTc-MDP scintigraphy for evaluation of skeletal disease extent.

SSG09-09 In Vivo Assessment of Ovarian Tumor Response to Tyrosine Kinase Inhibitor Pazopanib using Hyperpolarized 13C-Pyruvate MRS and 18F-FDG PET/CT Imaging in a Mouse Model
PURPOSE

Early response measures for ovarian cancer are needed to common targets such as tyrosine kinases. Via effects on signaling within tumor cells or via effects on angiogenesis, such inhibitory drugs have the potential to alter tumor metabolism. 18Fluorodeoxyglucose (18F-FDG) mimics glucose and can be used to evaluate early glycolysis. Hyperpolarization magnetic resonance spectroscopy (MRS) imaging can be used to study pyruvate, which can be produced by glycolysis and other pathways and sits at a decision point for aerobic versus anaerobic metabolism. Our purpose was to assess whether either early or late components of metabolism can serve as indicators of response of ovarian cancer to tyrosine kinase inhibitor (including angiogenesis inhibitor via VEGF receptor inhibition) Pazopanib.

METHOD AND MATERIALS

Seventeen days after injection of 2 x 106 human ovarian SKOV3 tumors cells into female nude mice, treatment with vehicle or Pazopanib (2.5 mg/mouse po) was initiated. Longitudinal T2-weighted MR, hyperpolarized pyruvate MRS, and 18F-FDG PET/CT imaging were performed pre-treatment as well as 2 days and 2 weeks after treatment.

RESULTS

Pazopanib was effective in inhibiting ovarian tumor growth compared to control (p<0.05). Significantly higher pyruvate to lactate conversion (lactate/pyruvate+lactate ratio) was found 2 days after treatment with pazopanib compared to pre-therapy (p<0.005, n=8). This was not seen with control or with 18F-FDG PET/CT imaging.

CONCLUSION

Findings suggest that later metabolic events (pyruvate to lactate conversion) may serve as as an early indicator of response of ovarian cancer to tyrosine kinase (angiogenesis) inhibitor pazopanib in mouse models, even when early glycolytic events do not.

CLINICAL RELEVANCE/APPLICATION

Hyperpolarized 13C-Pyruvate MRS may serve as an early indicator of response to tyrosine kinase (angiogenesis) inhibitors such as pazopanib in ovarian cancer even when 18F-FDG PET/CT does not.
Radiation Oncology Tuesday Poster Discussions

Tuesday, Dec. 1 12:45PM - 1:15PM Location: RO Community, Learning Center

Ro243-SD-Tub5

Cosmetic Outcome after Breast Conserving Surgery and Intraoperative Radiation Therapy for Early Breast Cancer: Objective Assessment of Patients Participating in a Randomized Controlled Trial in Lublin, Poland

Station #5

Participants
Norman S. Williams, London, United Kingdom (Presenter) Nothing to Disclose
Andrzej Kurylcio, Lublin, Poland (Abstract Co-Author) Nothing to Disclose
Malgorzata Jankiewicz, Lublin, Poland (Abstract Co-Author) Nothing to Disclose
Jaroslaw Romanek, Lublin, Poland (Abstract Co-Author) Nothing to Disclose
Wojciech Polkowski, Lublin, Poland (Abstract Co-Author) Nothing to Disclose
Nikolaos Michalopoulos, London, United Kingdom (Abstract Co-Author) Nothing to Disclose
Mohamed R. Keshtgar, London, United Kingdom (Abstract Co-Author) Nothing to Disclose

Purpose/Objective(s): The international randomised controlled TARGIT A (TARGETed Intraoperative radiotherapy) trial demonstrated non-inferiority between the technique of TARGIT (Intra-Operative RadioTherapy (IORT) with Intrabeam®) and whole-breast external beam radiotherapy (EBRT) in women with early breast cancer. The aim of this study was to see if the single high dose of TARGIT leads to impaired cosmesis in a group of patients participating in the trial in Lublin, Poland.

Materials/Methods: Frontal digital photographs were taken of women in the TARGIT Trial at the Medical University in Lublin and analysed, blinded to treatment received, by BCCT.core software. This produced overall Harris scores, and scores for various measures of symmetry, colour and scar. Data on tumour and patient characteristics were obtained from hospital notes.

Results: 29 women (16 EBRT, 13 IORT), median age 56 years (range 49 to 79) had photographs taken at baseline (up to 2 days prior to surgery), and again at 12 months (median 364 days). There were no significant differences in overall classification or measures of symmetry between treatment groups. At 12 months there was a significant difference in cEMDL (p=0.002, Wilcoxon Two-Sample test, 2-sided), indicating more “redness” in the breasts of the women in the EBRT group compared with the IORT group. This difference remained after adjusting for tumour size, body mass index and age (p=0.0198, multiple regression analysis).

Conclusion: This objective assessment of aesthetic outcome in patients from a randomised trial demonstrates that “redness”, a surrogate for radiation induced erythema grade I or II, is significantly greater after one year in patients receiving EBRT compared with those receiving IORT. This study provides further evidence that the objective scoring of cosmesis using BCCT.core may be an approach for standardisation, and confirms the early beneficial effect of TARGIT on cosmesis.

Table. Median (first and third quartiles) of the measure of “redness”. Measure EBRT IORT p*

<table>
<thead>
<tr>
<th>Measure</th>
<th>EBRT</th>
<th>IORT</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td>cEMDL</td>
<td>0.69 (0.43 - 1.10)</td>
<td>0.002</td>
<td>0.86</td>
</tr>
</tbody>
</table>

ABSTRACT

Purpose/Objective(s): The purpose of this study is to report the treatment outcomes of intensive chemotherapy followed by reduced dose and field irradiation for the treatment of intracranial germ cell tumors (GCTs).

Materials/Methods: 22 patients (18 males and 4 females) with intracranial GCTs were treated at our facility between 1991 and 2012. They were classified into three groups based on serological and histological findings. Five patients (23%) with pure germinoma were treated with conventional-dose chemotherapy (ifosfamide-cisplatin-etoposide) followed by 24 Gy ventricular field irradiation as good prognosis group, and 14 patients (64%) germinoma with syncytiotrophoblastic giant cells and 3 patients (14%) with non-germinomatous GCTs were treated with high-dose chemotherapy (HDC) with stem-cell support followed by 24-50.4 Gy reduced field irradiation as intermediate and poor prognosis group, respectively. The Median age was 14 years and primary sites were at pineal region for 11(50%) patients,
suprasellar region for 4(18%) patients and others for 7(32%) patients. Disseminated tumors were present in 4 patients. Ten patients (45%) were diagnosed with hydrocephalus before treatment. Four patients who relapsed after initial chemotherapy were included in this study. Results: The medium follow-up duration was 113 months, 10-year overall survival rate and progressive-free survival rate was 80.1% and 69.8%, respectively. Regarding late adverse effect, pituitary dysfunction (short stature, insufficiency of secondary sexual feature, hypothyroidism); 8 patients (36%), hearing impairment; 5 patients (23%), intelligence diminution; 6 patients (27%), convulsion•electroencephalogram abnormality; 5 patients (23%), treatment induced secondary neoplasm; 2 patients (9.1%), motility disorder; 2 patients (9.1%), azoospermia; 1 patient (4.5%) and treatment-related death (brain hemorrhage); 1 patient (4.5%) appeared. In addition, 5 (23%) patients needed intervention of a psychiatrist due to school refusal, anxiety disorder, eating disorder and self-injury behavior etc. In contrast, patients who received irradiation less than 30 Gy tended to have no late adverse effect. Conclusion: Intensive chemotherapy followed by reduced dose and field irradiation resulted in preferable outcomes. Based on our results, further study will be required from the perspective of radiation dose and field, especially for patients classified as intermediate and poor prognosis group.

**RO238-SD-TUB8**

**A Prospective Study of the Effect of Valproic Acid on Outcomes and Survival in Patients with Glioblastoma Multiforme**

Station #8

**Participants**

Deepthi Valiyaveettil, Hyderabad, India (Presenter) Nothing to Disclose
Monica Malik, MD, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Syed Fayaz Ahmed, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Deepa Joseph, MD, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Akram Kothwal Syed, MD, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Suresh Pamidighantam, PhD, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Jyothi Jonnadula, Hyderabad, India (Abstract Co-Author) Nothing to Disclose
Rama Vaghmare, Hyderabad, India (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

**Purpose/Objective(s):** Glioblastoma multiforme (GBM) is the most frequent and the most malignant primary brain tumor in adults. Even when a combination of surgery, chemotherapy and radiotherapy is used, the median survival time of patients with glioblastoma multiforme (GBM) is still 14.6 months, with 2- and 5-year survival rates of 27.2% and 9.8%, respectively. To cure or even to prolong the survival of patients with GBM beyond 2 years remains an elusive goal. Valproic acid has been recognized as HDAC inhibitor (histone deactetylase) which has shown to increase survival in few studies. We conducted a prospective study to evaluate the effect of valproic acid as antiepileptic on progression free survival and overall survival in GBM patients receiving post operative chemoradiation.

**Materials/Methods:** 14 patients with post operative patients with histopathological confirmed diagnosed glioblastoma multiforme were selected for this study. The patients received External beam radiotherapy (EBRT) to a dose of 60Gy in 30 fractions, 5 fractions per week along with concurrent Temozolomide at 75mg/m² every day during radiotherapy (RT). Post RT patients received six cycles of adjuvant Temozolomide at 150mg/m² for five days for every 28days. All patients received Valproic acid as antiseizure medication. Results: Male: Female ratio was 3.6:1 and the median age was 49.5 years. 28% (4), 64%(9) and 7% (1) were in RPA Class III, IV and V/VI respectively. 5 patients had gross total or near total excision, 7 patients had subtotal excision and 2 patients had only debulking done.2 patients had seizures during radiotherapy and 4 patients had seizures on follow up. These 6 patients required an additional antiepileptic medication to control seizures.7 patients progressed on follow up. Median overall survival was 14 months and progression free survival was 11 months. Conclusion: Median overall survival of these patients who received concurrent chemoradiation and valproic acid as an antiepileptic agent was 14 months. Median overall survival is similar to historical controls. Progression free survival was 11 months. Further large prospective studies are warranted to establish the role of Valproic acid in treatment of GBM patients.
Participants
Matthew R. Callstrom, MD, PhD, Rochester, MN (Moderator) Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Gall Medical Ltd

LEARNING OBJECTIVES
1) Review role of SBRT in the primary management of early stage NSCLC. 2) Review updates to the literature on SBRT including: a. Dose and schedule of SBRT. b. Comparison of SBRT to surgery.

ABSTRACT
Stereotactic Body Radiotherapy (SBRT) is an important treatment modality for patients with inoperable Non-Small Cell Lung Cancer. It provides effective local control of early stage Lung Cancers and is associated with minimal toxicity. In this presentation I will review this role and discuss the current literature comparing SBRT to observation and surgery.

RESULTS
We identified a total of 53 lung adenocarcinomas treated with lung ablation and which had genetic testing to identify both EGFR and KRAS mutations. Overall stage of tumor ranged from stage 1A to stage IV. Median tumor size was 1.6 cm (range: 0.8-3.3 cm). Of the 53 lung ablations, 53% (28) were on wild type (WT) lung adenocarcinomas, 34% (18) were on KRAS mutants and 13% (7) were on EGFR mutants. Local recurrence was either biopsy proven or based on a combination of clinical and imaging parameters. Chi-square test was used to identify statistically significant association with local recurrence.

CONCLUSION
KRAS mutations are associated with statistically significant increased risk of local recurrence compared to WT. The local recurrence
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying events.

**LEARNING OBJECTIVES**

1) Understand the most common adverse events related to lung ablation. 2) Learn how to prevent and treat some of these adverse events. 3) Illustrate some of the more severe adverse events (grade 3-5) with clinical examples.

**ABSTRACT**

Care of the patient with lung metastases (PM) has evolved through the years to now include a larger group of patients who may benefit from metastasectomy. The two most consistent prognostic factors for overall survival remain disease free interval (DFI) and number of pulmonary nodules. The one consistent factor in all series is that only patients achieving a complete (R0) resection have a longer survival. Many series find the # of nodules is no longer a factor determining survival if R0 resection can be obtained, even repeated metastasectomy. We no longer view extra-PM as a disqualifier for resection, as long as the dz can be completely resected and controlled. Patients are typically referred for immediate surgery if they present with a single PM or have a limited # of mets and a long DFI. Those who develop metastatic dz early are treated initially with chemotherapy to determine the pace of dz progression, if any, on treatment. Patients responding to chemotherapy, those with stable dz, and those with slow progression are referred for resection while those with rapidly progressive metastatic dz receive alternative chemotherapy treatment. Adjuvant chemotherapy is continued only if there is evidence of clinical benefit from preoperative chemotherapy. CT scanning is routinely performed to monitor dz progression. The surgical approach should be individualized. As imaging improves our ability to localize smaller nodules, less invasive options become more appealing and may facilitate less difficult repeat metastasectomy. Ablation (SABR/SBRT or lung CT-guided ablation by cryoablation, radiofrequency ablation or microwave ablation) has been used to treat patients with PM, and our institution uses a lung ablation tumor board to review which lesions are best treated with each modality, focusing on R0 treatment, lung preservation, and location of the tumor. Lung preservation achieved by ablation is important in patients who have had previous resections or who have compromised pulmonary function or in whom a lobectomy would be required for nodule removal. More prospective studies are needed and are underway. Better understanding of the biology of the tumor and more developed histologic-specific nomograms may ultimately improve our ability to better select patients. As systemic therapy improves, treatment of local residual oligometastic dz will become an increasingly important consideration.

**REFERENCES**

Morphological Appearance of Radiofrequency Ablated Stage I NSCLC in Medically Inoperable Patients as Related to Recurrence: Results from the ACOSOG Z4033 (Alliance Trial)

Tuesday, Dec. 1 3:20PM - 3:30PM Location: S405AB

Participants
Lillian Xiong, MD, Providence, RI (Presenter) Nothing to Disclose
Erica S. Alexander, BS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Shauna Hillman, MS, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Angelina D. Tan, BS,BA, Rochester, MN (Abstract Co-Author) Nothing to Disclose
Grayson L. Baird, MS, Providence, RI (Abstract Co-Author) Nothing to Disclose
Hiran Fernando, MD, Boston, MA (Abstract Co-Author) Consultant, CSA Medical, Inc Research Consultant, Galil Medical Ltd Research Grant, Deep Breeze Ltd
Damian E. Dupuy, MD, Providence, RI (Abstract Co-Author) Research Grant, NeuWave Medical Inc Board of Directors, BSD Medical Corporation Stockholder, BSD Medical Corporation Speaker, Educational Symposia

PURPOSE
This study evaluates tumor and ablation zone morphology as related to recurrence in medically inoperable patients with stage I NSCLC undergoing CT-guided RFA in a prospective multi-center trial.

METHOD AND MATERIALS
This prospective, multicenter group trial was approved by each institutional review board. 54 patients from 16 US sites were enrolled, of these, 50 patients (23 Men, 27 Women; mean age 75.3±7.5 years) met eligibility requirements. Patients were followed using CT; evidence of CT recurrence and pre- and post-ablation imaging characteristics were recorded. Characteristics evaluated included tumor/ablation zone shape (round, ovoid, bilobed, irregular), size, borders (smooth, speculated, lobulated), distance to large vessels/airway and distance to pleura.

RESULTS
A difference was observed for months to recurrence between those with ablation zones greater than 3cm and less than 3cm (p=.0023). The median time of recurrence for those with ablation zones less than 3cm was 8.16 months, while the median recurrence time for those with zones greater than 3cm could not be determined. Recurrence free probability was 30% for those with ablation zones less than 3cm and 75% for those with zones greater than 3cm. No significant differences were found between those with and without recurrence for age (p=.47), performance score (p=.43), histology (p=.34), baseline tumor SUV (p=.91), tumor size (p=.59), peak power (p=.92), peak current (p=.63), max temp (p=.65), total time (p=.28), shape (p=.30), cavitation (p=.29), sphericity (p=.45), distance from tumor edge to large vessel (p=.62), and distance to pleura (p=.25).

CONCLUSION
Of those morphological characteristics considered, size of ablation zone appears to be most predictive of recurrence-free survival for those patients treated with RFA for early stage lung cancers.

CLINICAL RELEVANCE/APPLICATION
Post-radiofrequency ablation zones greater than 3-cm were significantly less likely to be associated with recurrent disease, in a multi-institutional prospective study of 50 stage I NSCLC patients.

Learning Objectives
1) To understand why cementoplasty alone is not always appropriate for bone fracture management (palliation and/or prevention).
2) To introduce the percutaneous screw fixation technique. 3) To present clinical outcomes of percutaneous screw fixation in bone cancer patients.

Abstract
Educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Damian E. Dupuy, MD - 2012 Honored Educator

Lung Tumor Board
Tuesday, Dec. 1 3:00PM - 3:20PM Location: S405AB

Participants
Matthew R. Callstrom, MD, PhD, Rochester, MN (Moderator) Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd

Percutaneous Hardware for Bone Metastases—Where and When
Tuesday, Dec. 1 4:00PM - 4:20PM Location: S405AB

Participants
Frederic Deschamps, Villejuif, France (Presenter) Research Consultant, Medtronics, Inc
Bone fractures can result in significant pain and loss of function in cancer patients. Percutaneous screw fixation is a very new technique that consists in the insertion of screws in bone structures through a very small skin incision under imaging guidance. The indications are twofold for bone fracture; palliative and preventive. 1/ For patients suffering from pathological or non-pathological fracture the goal of the screw fixation is to achieve a stabilization of the fracture fragments that will result in pain palliation. Typically, the fractures that can be fixed are located in the sacrum, the iliac crest, the acetabulum roof, the pubic ramus and the proximal femur. Cementoplasty can be performed in association (augmented screw fixation) in order to improve the screw’s tip anchorage. 2/ For patients with impending osteolytic metastases, the decision to perform percutaneous augmented screw fixation instead of cementoplasty alone is done by the fact the strength properties of the cement are strong in compression but weak for tensile or shear stresses. Typically, the impending osteolytic metastases that can be consolidate using percutaneous augmented screw fixation are located in the iliac crest, the acetabulum and in the proximal femur. Percutaneous screw fixation is a very effective tool that must be considered as a part of the therapeutic arsenal of the interventional radiologists. Firstly, because it is a minimally invasive procedure that avoids extensive surgical exposure and secondly because the accuracy provided by CT- or Flat panel- guidances results in high technical success and very low complication rate for the screw placement.

**VSIO31-10 Patient Selection and Outcomes with MRgFUS**

**Tuesday, Dec. 1 4:20PM - 4:40PM Location: S405AB**

**Participants**

Alessandro Napoli, MD, Rome, Italy, (alessandro.napoli@uniroma1.it) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To become familiar with the basic principles of HIFU and the potential of MR guidance. 2) To approach selection criteria in MRI screening examinations for accurate indications and identify contraindications and non-suitable patients. 3) To appreciate current results and potential therapy regimens. 4) To understand recent technical developments and their potential.

**ABSTRACT**

Bone metastases are common in patients with advanced cancer and are the greatest contributor to cancer-related pain, often severely affecting quality of life. Many patients with advanced cancer are undertreated for pain. Radiation therapy (RT), together with systemic therapies and analgesics, is the standard of care for localized metastatic bone pain, although up to two-thirds of patients have residual pain after RT, leaving them with limited treatment options. These include reirradiation, which results in temporary pain reduction in some patients, surgical intervention, and percutaneous cryoablation. More effective systemic therapies are prolonging survival of cancer patients with metastatic disease, resulting in an increased need for alternative therapies for painful bone metastases. Focused ultrasound is a noninvasive technique that delivers acoustic energy to heat lesions focally to ablative temperatures of more than 65°C. The combination of focused ultrasound with magnetic resonance (MR) imaging enables physicians to perform precise localized tumor tissue ablation, while using MR thermometry for real-time temperature monitoring. Clinical studies on the use of MR-guided focused ultrasound surgery (MRgFUS) for palliation of painful bone metastases demonstrated excellent response rates and safety. Results of a randomized controlled trial will be reviewed to discuss safety and efficacy of MRgFUS for treating bone metastases in patients with persistent or recurrent pain after RT, or who were otherwise not candidates for RT, or who declined RT. MRgFUS has several advantages that may positively influence safety and effectiveness compared with other ablative therapies. These include high-resolution imaging of the targeted tumor and nontargeted normal anatomy, intraprocedural MR thermometry accurate within approximately 2° to verify adequate temperatures to achieve ablation while respecting normal tissue tolerances, and immediate post-treatment validation of the extent of ablation.

**VSIO31-11 Minimally Invasive Treatment of Osteoid Osteoma: Experience of a Single Center Using MR Guided Focused Ultrasound Surgery (MRgFUS) or Radiofrequency Ablation (RFA)**

**Tuesday, Dec. 1 4:40PM - 4:50PM Location: S405AB**

**Participants**

Francesco Arrigoni, Coppito, Italy (Presenter) Nothing to Disclose
Alice La Marra, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Silvia Mariani, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To evaluate effectiveness and safety of minimally invasive treatment of Osteoid Osteoma (OO) with ablation techniques: Magnetic Resonance guided Focused Ultrasound Surgery (MRgFUS) and Radiofrequency Ablation (RFA).

**METHOD AND MATERIALS**

From March 2011 to March 2014 we treated 40 OO, 18 with MRgFUS (ExAblate InSightech, Israel) and 22 with RFA ( Needle Electrode, Boston Scientific-USA). For each patient we chose the less invasive treatment, when applicable. When the lesion could be easily reached with the US beam, the patient was treated with MRgFUS; otherwise, the patient was treated with RFA. Sixteen OO were treated with MRgFUS in the lower arm and 2 in the upper. The treatments lasted a mean time of 110 minutes. The lesions treated with RFA were 18 in the lower extremities, 2 in the upper ones and 2 in the vertebral body. They were treated in less than 100 min. The follow-up was performed by MRI and CT up to a maximum of two years; the clinical evaluation was performed using the visual analogue scale (VAS).

**RESULTS**

All patients, except one treated with MRgFUS and subsequently re-treated with RFA, showed a regression of painful symptomatology. After treatment, they no longer needed any pain medication. The mean hospitalization time was 2 days for patients treated with MRgFUS and 2.4 days for those submitted to RFA. The mean VAS value, 2 years after treatment, showed an overall improvement of 100% (from 8.2 to 0). At the first control at one week after the procedure, patients treated with MRgFUS showed a lower mean VAS value (0.5) as compared with that of RFA (0.8). The results of MRI and CT, 2 years after the treatment, showed in all cases the disappearance of both bone edema (MRI) and nidus with central calcification and peripheral osteosclerosis (CT), that are typical findings of the osteoid osteoma. In no case, major complications were observed.
CONCLUSION

Though based on a limited group of patients, our study demonstrates the safety and effectiveness of both techniques in the treatment of OO, by which it was possible to obtain an optimal clinical and imaging outcome. Compared with RFA, MRgFUS is less invasive, but to be successful, it is mandatory that the US beams properly reach the region of interest.

CLINICAL RELEVANCE/APPLICATION

To evaluate safety and efficacy of an innovative technique of ablation, MRgFUS, which promises to be even less invasive than RFA, which is currently the gold standard in the treatment of OO.

VSIO31-12  Spine Metastases Palliation-Ablation Stabilization

Participants
Jonathan M. Morris, MD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1. Learn the basics of ablative technologies available for use in the spine and sacrum. 2. Define current indications for percutaneous ablation in the Spine and Sacrum. 3. How we do it. Lessons learned and resources needed. 4. Define local control rates for the varied tumors treated. 5. Discuss our experience with palliative outcomes for pain relief. 6. Limitations of ablation in the neurosis. 7. Postablative kyphoplasty/vertebroplasty. 8. Discuss unique considerations for cervical, thoracic, lumbar spine and sacrum.

ABSTRACT

Oligometastatic disease involving the spine and sacrum is growing due to an aging population as well as improved survival rates of varied primary malignancies. 70% of all cancer patients will have metastatic disease with 40% involvement of the neuroaxis and 20% with epidural disease. While radiation therapy continues to be the primary treatment a subset of tumors are not radiosensitive and of those which are there are non responders. Starting in 2009 this clinical need led us to develop an ablation service dedicated to the spine and sacrum to aid in the treatment of oligometastatic disease. This talk will enable the attendee to learn the basics of ablative technologies in the spine and sacrum. Learn current indications for this technologies. Learn “how we do it” including lessons learned and resources need to perform this type of treatment. We will discuss the role of post ablative kyphoplasty/vertebroplasty. Finally we will review our palliative pain relief results as well as local control rates in the increasing types of tumors treated.

VSIO31-13  Ablation is Front-line Therapy for Desmoid Tumors

Participants
Afshin Gangi, MD, PhD, Strasbourg, France (Presenter) Nothing to Disclose

Handout:Afshin Gangi

VSIO31-14  CT-guided Cryoablation as Single Treatment or Combined with Radiotherapy in the Management of Bone and Soft Tissue Lesions

Participants
Francesco Arrigoni, Coppito, Italy (Presenter) Nothing to Disclose
Silvia Mariani, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Alice La Marra, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Luigi Zugaro, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Antonio Barile, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Masciocchi, MD, L’Aquila, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate safety and efficacy of percutaneous CT-guided cryoablation, performed with multiple cryoprobes (also in combination with Radiotherapy) in the treatment of bone and soft tissue lesions.

METHOD AND MATERIALS

Up to April 2015, we treated 27 patients with percutaneous CT-guided cryoablation. All patients but one had osteolytic bone metastases; one patient had a recurrence of aggressive fibromatosis of the shoulder. Prior to treatment, the patients were evaluated with the VAS questionnaire for pain which resulted in a mean value of 7.6. For a faster and more comfortable procedure, we employed three to six cryoprobes for each lesion under fluoroscopic guide. The area of cryoablation (iceball) and the position of the cryoprobes were controlled during the procedure with a wide-volume acquisition, employing 3D and MPR reconstruction. Follow-up studies at 3 and 6 months were performed with CT and VAS questionnaire. No major complications occurred during the procedures.

RESULTS

We observed a reduction of pain in all patients. The mean VAS value dropped from 7.6 to 1.6 one week after treatment and remained substantially unchanged until the end of follow-up (6 months). CT follow-up showed progression of the disease in no case. Only size reduction or stationary CT findings were observed.

CONCLUSION

Our results show the effectiveness of cryoablation, particularly in combination with RT, in terms of tumoral mass control and particularly of pain relief. Through thermoablation in fact it is possible to obtain a prompt relief of pain, and enhancement of the
quality of life immediately after the treatment. The main advantages are the possibility to treat the whole lesion at the same time with the use of multiple cryoprobes and to check in real time the treated volume; the main limitations are represented by the low number of patients recruited and by the length of the follow-up.

**CLINICAL RELEVANCE/APPLICATION**

To evaluate safety and effectiveness of cryoablation also in combination with RT in the management of painful bone and soft tissue lesions, with the aim of reducing tumoral mass and pain.

**VSIO31-15 Bone Metastases Tumor Board**

Participants
Matthew R. Callstrom, MD, PhD, Rochester, MN (Moderator) Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd
BOOST: Breast-Case-based Review (An Interactive Session)

Tuesday, Dec. 1 3:00PM - 4:15PM Location: S103AB

AMA PRA Category 1 Credits™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Steven J. Chmura, MD, PhD, Chicago, IL (Presenter) Nothing to Disclose
Nora M. Hansen, MD, Chicago, IL (Presenter) Speakers Bureau, F. Hoffmann-La Roche Ltd
Karen Y. Oh, MD, Portland, OR (Presenter) Nothing to Disclose
Lucy Chen, MD, Chicago, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Improve basic knowledge and skills relevant to radiation therapy use in breast cancer patients. 2) Apply information learned from provided breast cancer case scenarios to clinical practice. 3) Assess technological innovations and advances which can enhance clinical practice and problem-solving in the breast cancer population. 4) Apply principles of critical thinking to ideas from breast oncology experts and peers in the radiologic sciences.
BOOST: CNS Tumor Board-Case-based Review of PET/MR Imaging and Role in the Clinical Treatment Management of Brain Tumors (An Interactive Session)

Tuesday, Dec. 1 3:00PM - 4:15PM Location: S103CD

AMA PRA Category 1 Credits ™: 1.25
ARRT Category A+ Credits: 1.50

Participants
Christina I. Tsien, MD, Saint Louis, MO (Moderator) Speaker Bureau, Merck & Co, Inc
Soonmee Cha, MD, San Francisco, CA (Presenter) Nothing to Disclose
Michael Vogelbaum, MD, Cleveland, OH (Presenter) Stockholder, Infuseon Therapeutics, Inc
Patrick Y. Wen, MD, Boston, MA (Presenter) Research support, Agios Pharmaceuticals, Inc; Research support, Angiochem Inc; Research support, AstraZeneca PLC; Research support, Exelixis, Inc; Research support, F. Hoffmann-La Roche Ltd; Research support, GlaxoSmithKline plc; Research support, Karyopharm Therapeutics, Inc; Research support, Novartis AG; Research support, sanofi-aventis Group; Research support, Regeneron Pharmaceuticals, Inc; Research support, Vascular Biogenics Ltd; Advisory Board, AbbVie Inc; Advisory Board, Cavion; Advisory Board, Celldex Therapeutics, Inc; Advisory Board, Merck & Co, Inc; Advisory Board, F. Hoffmann-La Roche Ltd; Advisory Board, Midatech Pharma; Advisory Board, Momenta Pharmaceuticals; Advisory Board, Novartis AG; Advisory Board, NuvCure Ltd; Advisory Board, Sigma-Tau Pharmaceuticals, Inc; Advisory Board, Vascular Biogenics Ltd; Speaker, Merck & Co, Inc

LEARNING OBJECTIVES

1) Present latest advances in imaging of brain tumors with special emphasis on PET/MR Imaging. 2) Review strengths, pitfalls, and limitations of the advanced imaging methods in a case-based format. 3) Discuss key imaging methods and features to differentiate recurrent tumor and treatment effect and to identify brain tumor mimics.
**SSJ19**

**Lymph Node Imaging Reporting and Data System for Ultrasound and Real-time Elastography of Cervical Lymph Node: A Pilot Study**

**Tuesday, Dec. 1 3:00PM - 3:10PM Location: N228**

**Participants**
- Ashley H. Aiken, MD, Atlanta, GA (Moderator) Nothing to Disclose
- Barton F. Branstetter IV, MD, Pittsburgh, PA (Moderator) Nothing to Disclose

**Method and Materials**
Between 2013 and 2014, 291 consecutive patients underwent US guided biopsies and follow-up for cervical lymph nodes were enrolled in a single institution. US features were analyzed as follows; shape, margin, echogenicity, echogenic hilum, gross necrosis, calcification, matting and vascular pattern. RTE features were analyzed; elasticity score and strain ratio. By logistic regression analysis, a score for each significant factor was assigned and multiplied by the β coefficient, and then fitted probability of malignancy was calculated. The risk of malignancy of lymph node was determined, based on the number of suspicious features.

**Results**
Imaging features to be significantly associated with malignancy were round shape, not circumscribed margin, hyperechogenicity, absence of hilum, presence of gross necrosis and calcification, peripheral/mixed vascularity, elasticity score 3 and 4, and high strain ratio (p< 0.05). The fitted probability and risk of malignancy increased, as a number of suspicious features increased. Lymph node imaging reporting and data system (LNARDS) was established using a 5-point scale; 1 (probably benign), 2 (low suspicion for malignancy), 3 (moderate suspicion for malignancy), 4 (high suspicion for malignancy), and 5 (highly suggestive for malignancy). The risk of malignancy according to LNARDS categories was as follows; 1: 3.3%, 2: 10.9%, 3: 26.7%, 4: 51.8%-74.4%, 5: 90.6%-98.8%.

**Conclusion**
LNARDS was proposed using risk stratification of cervical lymph node according to the number of suspicious US and RTE features.

**Clinical Relevance/Application**
LNARDS will help to determine the optimal strategies for management of cervical lymph node.

**SSJ19-02**

**How Can We Differentiate Follicular Nodular Lesions with Ultrasonographic Features?**

**Tuesday, Dec. 1 3:10PM - 3:20PM Location: N228**

**Participants**
- Sun Hye Jeong, MD, Bucheon, Korea, Republic Of (Presenter) Nothing to Disclose
- Hyun-Sook Hong, MD, PhD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
- Eun Hye Lee, MD, Bucheon, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
- Bora Lee, Bucheon-Si, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**Purpose**
We retrospectively evaluated the ultrasonographic (US) features used to differentiate follicular nodular lesions of thyroid gland (or follicular cell-derived thyroid nodules) and tried to identify specific US features of nodular hyperplasia (NH).

**Method and Materials**
The study included 178 patients (mean age 46.6 (range 17-82) years) with surgically confirmed NH (n=100), follicular adenoma (FA) (n=56), or follicular carcinoma (FC) (n=22). Two radiologists retrospectively analyzed the US features. To determine the predictors of follicular-patterned lesions, univariate and multivariate multinomial logistic regression analyses were conducted. Receiver operating characteristic (ROC) analyses were performed to determine the effectiveness of the final model at predicting NH, FA, and FC. The inter-observer agreement was calculated.

**Results**
Tumor diameter, margin, echotexture, cystic changes, calcification, hypoechoic rim, and vascularity were significant in the
univariate analyses. The multivariate multinomial logistic regression analyses revealed that tumor diameter (FA: p=0.002, odds ratio (OR)=1.75, 95% confidence interval (CI) 1.12, 2.51; FC: p=0.001, OR=2.02, 95% CI 1.32, 3.10), absence of cystic changes (FA: p=0.127, OR=2.21, 95% CI 0.80, 6.13; FC: p=0.001, OR=17.74, 95% CI 4.00, 78.73), and spongiform appearance (FA: p=0.234, OR=0.31, 95% CI 0.04, 2.15; FC: p<0.001, OR=1673.46, 95% CI 671.35, 4171.38) differed significantly among the three follicular nodular lesions, with NH as a reference group. The area under the curve (AUC) for NH, FA, and FC was 0.844, 0.858, and 0.705, respectively. The sensitivity for NH, FA, and FC was 0.698, 0.868, and 0.755, respectively, and the specificity was 0.820, 0.690, and 0.580. Using this model, the diagnostic accuracy of the original data was 72.6%. The inter-observer agreement was moderate to almost perfect.

CONCLUSION

Tumor diameter, cystic changes and spongiform appearance differed significantly among follicular nodular lesions. Using the US criteria, there was moderate diagnostic ability for NH, FA, and FC.

CLINICAL RELEVANCE/APPLICATION

Tumor diameter and the presence of cystic changes differed significantly among NH, FA, and FC (or follicular nodular lesions).

RESULTS

The short axis diameter achieved 72.13%, 45.45 %, 88.88%, 22.73% and 68.06% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Absent hilum criterion achieved 63.9%, 27.3%, 83.12% and 58.3% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Present necrosis criterion achieved 21.3%, 72.7%, 81.3%, 14.3% and 29.2% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Combined conventional criteria achieved 86.9%, 0%, 82.8%, 0% and 73.6% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Combined conventional criteria and DWI achieved 98.4%, 0%, 84.5%, 0% and 83.3% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Present necrosis criterion and DWI achieved 21.3%, 72.7%, 81.3%, 14.3% and 29.2% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. The added diagnostic value of DW-MRI to conventional parameters is significant in prediction of malignant cervical lymphadenopathy.

CONCLUSION

DW-MRI is carrying the highest sensitivity, specificity and accuracy among all conventional parameters, each alone and nearby lower sensitivity with higher specificity and accuracy than combined conventional parameters, thus use of DWI added significant diagnostic value to the ability of conventional parameters to predict malignant cervical lymphadenopathy with no extra time consuming.

CLINICAL RELEVANCE/APPLICATION

DW-MRI is non invasive and non time consuming method that can predict malignancy in cervical lymphadenopathy and its addition to conventional parameters increases their sensitivity with no significant extra time consuming.

SS319-04 Proposal for an MRI-based Score to Differentiate Pleomorphic Adenoma and Warthin Tumor in Patients with Benign Parotid Neoplasms

Participants

Beatrice Sacconi, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Angelo Iannarelli, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Renato Argio, Rome, Italy (Presenter) Nothing to Disclose
Marta Bottaro, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Emanuela Basile, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Piero Cascone, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Carlo Catalano, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Mario Bezzi, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate the diagnostic efficacy of an MRI-based score in the differential diagnosis between parotid pleomorphic adenoma (PA) and Warthin tumor (WT).
METHOD AND MATERIALS
Twenty patients (M=10, F=10; mean age=63.5 years, range=35-87) complaining of long-standing (stable for at least 3 months) painless parotid mass underwent a 3T MR (Discovery MR750, GE); T2-weighted, DWI and T1-weighted sequences before and after contrast administration (Gadobenic acid, 0.1 ml/kg) were performed. The lesions were evaluated by three radiologists in consensus using a complex score based on three-point scales rating four different MR features (T2-signal intensity, Apparent Diffusion Coefficient values, enhancement pattern, bilateral/multiple location); total scores of ≤3 and >3 were respectively considered as suggestive of PA or WT. Final diagnosis was based on pathology reports after US-guided fine-needle-aspiration cytology (FNAC) or surgical resection.

RESULTS
Twenty-four lesions were imaged; three lesions were excluded because of MR features suggesting less common histotypes (lipoma, sialolipoma, haemangioma, all confirmed at surgery). Radiologists correctly identified 6/6 PAs and 13/13 WTs; two lesions, defined as PAs, revealed to be an oncocytoma and a granulomatous lymph node (diagnostic accuracy 90.5%).

CONCLUSION
The score allowed the differential diagnosis in all cases of PAs and WTs; an oncocytoma and a granulomatous lymph node were misdiagnosed, but the incidence of benign lesions other than PA and WT is expected to be low. These data need to be confirmed in larger patient cohorts.

CLINICAL RELEVANCE/APPLICATION
In case of benign parotid lesions, the surgical plan depends on histology. MRI can suggest tumor histology in case of uncertain cytologic diagnosis and provide information over the entire neoplasm.


Tuesday, Dec. 1 3:40PM - 3:50PM Location: N228

Participants
Gongxin Yang, Shanghai, China (Presenter) Nothing to Disclose
Yu Qiang, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Pingzhong Wang, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Yingwei Wu, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Huimin Shi, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Wenjing Zhu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xiaofeng Tao, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Xin Gong, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Weiqing Gao, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the diagnostic value of the combination of echo-planner diffusion-weighted MR imaging (DWI), dynamic contrast enhanced MR imaging (DCE-MRI) and conventional MR imaging in the characterization of solid neoplasms from parotid gland.

METHOD AND MATERIALS
148 subjects (101 benign and 47 malignant) involved with parotid gland tumors were recruited in the study. Prior to surgery and pathologic verification, conventional maxillofacial MR imaging, DWI with b factor of both 0 and 1000 s/mm² and DCE-MRI were performed on each subject. Logistic regression analysis was performed to see differences of morphological MR features (margin,shape,envelope and signal intensity of masses) between benign and malignant groups. Mean ADC value was calculated from ADC map, and then ADC threshold values between benign and malignant tumors was obtained. Time-intensity curve (TIC) with parameters were obtained from DCE-MRI. Sensitivity, specificity, accuracy, and positive and negative predictive values were calculated for the combination of relative parameters.

RESULTS
Ill-defined margin,irregular shape, no envelope, ADC value lower than cut-off point of 1.12×10⁻³mm²/s and TIC pattern with time to peak less than 120s and low washout ratio(<30%)were the valuable parameters for predicting malignancy (P=0.005, 0.004, 0.001, <0.001, <0.001, respectively). However, no significant difference was found in signal intensity of tumors between benign and malignant lesions. A combination of ADC value and TIC pattern yielded a sensitivity, specificity and diagnostic accuracy of 91.5%, 97.0% and 95.3%, respectively. Positive and negative predictive value for distinguishing benign and malignant tumors was 93.5% and 96.1% respectively.

CONCLUSION
Conventional MR imaging combined DWI and DCE-MRI has the ability to improve the diagnostic accuracy in distinguishing between benign and malignant parotid gland tumors.

CLINICAL RELEVANCE/APPLICATION
It will be helpful for clinical diagnosis of Parotid gland tumors

SSJ19-06 Intravoxel Incoherent Motion Diffusion-weighted Magnetic Resonance Imaging for Monitoring of ZD6474 Therapy in Human Nasopharyngeal Carcinoma Xenografts

Tuesday, Dec. 1 3:50PM - 4:00PM Location: N228

Participants
Yanfen Cui, Shanghai, China (Presenter) Nothing to Disclose
Caiyuan Zhang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Huanhuan Liu, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Dengbin Wang, Shanghai, China (Abstract Co-Author) Nothing to Disclose
PURPOSE
To investigate the value of intravoxel incoherent motion (IVIM) diffusion-weighted (DW) imaging biomarkers for monitoring the early response to ZD6474 in an experimental tumor model by quantitative assessments of tumor microcirculation parameters with histopathological validation.

METHOD AND MATERIALS
Twenty-four female BALB/c nude mice bearing human nasopharyngeal carcinoma xenografts were scanned at baseline and after 1, 3, and 7 days of treatment with ZD6474 (n = 12) or vehicle (n = 12) at a 3T magnetic resonance imager using a custom-built 8-channel receiver coil with 2.5cm inner diameter. For IVIM DW imaging, parameters including apparent diffusion coefficient (ADC), true diffusion coefficient (D), perfusion fracture (f), and blood pseudodiffusion coefficient (D*) were measured with 12 b-values ranging from 0 to 2000 s/mm². All IVIM DW imaging parameters at different time points were compared between the treated and control groups using Student’s t tests or Mann-Whitney tests. Parameters were also analyzed within the treated group by one-way analysis of variance (ANOVA). The relationships between histopathological staining for Ki-67, TUNEL, or CD31 and all IVIM parameters were evaluated by Spearman’s rank correlation.

RESULTS
The percent change of the perfusion-related parameters f and D* decreased significantly in the treated group as early as the 1-day follow-up compared with those in the control group. In contrast, the diffusion-related parameters ADC and D were significantly higher in the treated group compared with the control group beginning on day 3 (P < 0.05). The substantial decreases in f at day 1 and D* at day 3 were moderately correlated with the smaller increase in tumor size over the week-long study (r = 0.66 and 0.58, respectively; P < 0.05 for both). Moderate correlations were found between microvessel density and the perfusion-related parameters f and D* and between increased TUNEL index or decreased Ki-67 index and the diffusion-related parameters ADC and D.

CONCLUSION
IVIM DW imaging was sensitive to ZD6474-induced changes in the tumor microenvironment. In particular, the f parameter had the potential to allow early prediction of tumor response to anti-angiogenic treatment.

CLINICAL RELEVANCE/APPLICATION
IVIM DW imaging was sensitive to ZD6474-induced changes in the tumor microenvironment. In particular, the f parameter had the potential to allow early prediction of tumor response to anti-angiogenic treatment.
Neuroradiology (Neuro-Oncology)

Tuesday, Dec. 1 3:00PM - 4:00PM Location: N229

Participants
Chad A. Holder, MD, Atlanta, GA (Moderator) Nothing to Disclose
Adam E. Flanders, MD, Penn Valley, PA (Moderator) Nothing to Disclose

Sub-Events

SSJ20-01 Non-invasive Detection IDH1 Gene Status in Astrocytoma by DSC MRI: A Retrospective Study of 91 Lesions

Participants
Wen Li Tan, MD, Shanghai, China (Presenter) Nothing to Disclose
Dao Ying Geng, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Songhua Zhan, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Ji Xiong, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Wei Yuan Huang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
Jin Song Wu, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

PURPOSE
To investigate the value of dynamic susceptibility contrast (DSC) magnetic resonance imaging (MRI) in the noninvasive evaluation of isocitrate dehydrogenase (IDH) 1 status in astrocytoma.

METHOD AND MATERIALS
We retrospectively analyzed the preoperative DSC MRI data of 91 lesions with pathologically confirmed astrocytoma. We obtained the normalized maximum ratios of relative cerebral blood volume (rCBV) of tumor parenchyma. The enrolled astrocytoma patients were divided into six groups according to the World Health Organization (WHO) classification method and IDH1 gene status. We compared the differences in the rCBV ratio of tumor parenchyma between the IDH1 gene mutant and wild-type groups of WHO grades II, III, and IV and plotted receiver operating characteristic (ROC) curves for imaging indicators showing statistically significant differences.

RESULTS
The IDH1 gene mutant and wild-type groups of WHO grades II, III, and IV astrocytoma showed statistically significant differences in the rCBV ratio. In WHO grade II astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.83, and the cutoff value was 2.20; in WHO grade III astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.86, and the cutoff value was 3.14; in WHO grade IV astrocytoma, the area under the ROC curve value for the rCBV ratio was 0.94, and the cutoff value was 5.63.

CONCLUSION
The rCBV ratio value provided by DSC MRI provides a new imaging method for the noninvasive evaluation of the IDH1 status in astrocytomas of various WHO grades.

CLINICAL RELEVANCE/APPLICATION
DSC MRI can noninvasively judge the IDH1 gene status of astrocytomas.

SSJ20-02 IDH Mutation Status in Human Glioma is Associated with Differential Activation of Hypoxia and Angiogenesis Related Signaling and is Non-invasively Predictable with rCBV-imaging

Participants
Philipp Kickingereder, Heidelberg, Germany (Presenter) Nothing to Disclose

PURPOSE
The recent identification of isocitrate dehydrogenase (IDH) mutations in gliomas and several other cancers suggests that this pathway is involved in oncogenesis; however, effectors functions are complex and yet incompletely understood. To study the regulatory effects of IDH on hypoxia-inducible-factor 1-alpha (HIF1A), a driving force in hypoxia-initiated angiogenesis, we performed mRNA-expression and functional, as well as genotype/imaging phenotype correlation analysis.

METHOD AND MATERIALS
We studied differential mRNA-expression profiles from 288 samples with low-grade and anaplastic gliomas from The Cancer Genome Atlas (TCGA) of HIF1A and related downstream signaling on a single-gene and pathway level, as well as upstream biological causes and probable downstream effects between mutant and wild-type IDH tumors. Genotype/imaging phenotype correlation analysis was performed in a separate (local) dataset with relative cerebral blood volume (rCBV) MRI - an estimate of tumor angiogenesis - in 72 treatment-naive patients with low-grade and anaplastic gliomas.

RESULTS
We show decreased expression of HIF1A-target genes on a single-gene and pathway level, strong inhibition of upstream regulators such as HIF1A and downstream biological functions such as angio- and vasculogenesis in IDH-mutant tumors. Our radiogenomic imaging approach revealed increased levels of rCBV in IDH wild-type tumors, where a one-unit increase in rCBV corresponded to a two-third decrease in the odds for an IDH-mutation and correctly predicted IDH mutation status in 87% of patients.

CONCLUSION
Together, these findings show that IDH-mutation status is associated with a distinct angiogenesis transcriptome signature which correlates with rCBV-imaging findings and highlight the potential future role of radiogenomics for noninvasive profiling of cancer genomic key events.

CLINICAL RELEVANCE/APPLICATION
IDH-mutation status in human glioma is associated with a distinct angiogenesis transcriptome signature which correlates with rCBV-imaging findings and highlight the potential future role of radiogenomics for noninvasive profiling of cancer genomic key events.

SSJ20-03 The Added Prognostic Value of ADC in Glioblastomas Treated with Temozolomide: Correlation with MGMT Promoter Methylation Status and Survival Analysis

Tuesday, Dec. 1 3:20PM - 3:30PM Location: N229

Participants
Yoon Seong Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ho Joon Lee, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Mina Park, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Sung Soo Ahn, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jinna Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Seung-Koo Lee, MD, PhD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
The added prognostic value of ADC in glioblastomas treated with temozolomide, and the relationship between ADC and MGMT promoter methylation status are controversial. We investigated the added prognostic value of ADC in combination with MGMT in glioblastomas treated with temozolomide, and the association between ADC and MGMT promoter methylation status, using histogram analysis.

METHOD AND MATERIALS
This retrospective study consisted of 72 consecutive patients who underwent preoperative DTI for glioblastoma, and operation followed by CCRT with temozolomide. The histogram parameters of ADC, including mean, minimum, 5th (p5), 25th (p25), 50th (p50), 75th (p75), 95th (p95) percentile and maximum values, skewness and kurtosis were calculated from entire enhancing tumors. Univariate analyses for overall survival (OS) were performed with ADC parameters according to MGMT methylation status and other clinical factors. Multivariate Cox regression was performed to build prognostic models with and without ADC parameters. The performance of each model was compared using Harrell’s concordance index. In addition, the difference of ADC histogram parameters according MGMT promoter methylation status was assessed using Student t-test.

RESULTS
In univariate analysis, only lower p75 of ADC was significantly associated with worse OS in overall patients, and lower mean and p75 of ADC in patients with unmethylated MGMT. No parameters of ADC were significantly prognostic in patients with methylated MGMT. Other significant prognostic factors were age and enhancing tumor volume, as well as MGMT methylation status. In multivariate analysis, mean and p75 of ADC were independently prognostic in patients with unmethylated MGMT. The performance of prognostic models were significantly improved when mean and p75 of ADC were added to dichotomize the patients with unmethylated MGMT. Any of ADC parameters was significantly different according MGMT methylation status.

CONCLUSION
Lower ADC histogram parameters were associated with worse prognosis of glioblastomas treated with temozolomide, especially those with unmethylated MGMT. ADC histogram parameters may have the added prognostic value in combination with MGMT in patients with glioblastoma.

CLINICAL RELEVANCE/APPLICATION
Preoperative ADC histogram analysis has the added prognostic value in combination with MGMT methylation status, in patients with glioblastomas treated with temozolomide.

SSJ20-04 The Role of Advanced CT and MRI Perfusion Imaging in Differentiating Diagnosis between Gliomas Masquerading as Acute Cerebral Stroke- Eight-year Experience in a Single Institution

Tuesday, Dec. 1 3:30PM - 3:40PM Location: N229

Participants
Xiang Liu, MD, Rochester, NY (Presenter) Nothing to Disclose
Wei Tian, MD, PhD, Rochester, NY (Abstract Co-Author) Nothing to Disclose
Sven E. Ekholm, MD, Rochester, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Stroke mimics could account for 3 - 13% of patients primarily diagnosed and treated as acute stroke, thrombolysis in stroke mimics is not only unnecessary and costly, but will delay a correct diagnose/treatment and may result in complications, including hemorrhage. Gliomas could present similar clinical symptom and conventional neuroimaging finding as acute brain stroke. The purpose of this study is to evaluate the value of advanced CT and MRI perfusion imaging in such differential diagnosis.

METHOD AND MATERIALS
CT and/or MR perfusion imaging findings in 1096 cases with suspected acute stroke onset in eight years of period were reviewed.
There were 22 cases with pathology confirmed gliomas, presenting acute onset of symptoms and conventional neuroimaging findings similar as acute stroke. The ratios of relative cerebral blood volume (rCBV), relative cerebral blood flow (rCBF), and mean transit time (MTT) were evaluated and compared with these stroke patients.

RESULTS

These 22 stroke-mimicking gliomas are malignant, including 13 Anaplastic astrocytomas, WHO grade III; and 9 glioblastomas, WHO Grade IV. All these gliomas showed non-enhancement or mild enhancement in post-contrast T1WI, and increased rCBV, rCBF and MTT compared to contralateral references, (p<0.001, paired t-test). The mean rCBV, rCBF and MTT values of ischemic stroke lesions were significantly lower than contralateral hemisphere (p<0.001, paired t-test). The ischemic lesions with re-perfusion could present mixed decreased and increased perfusion within the lesions. The maximal rCBV ratio (1.83±0.57, p=0.022) and rCBF ratio (2.91±0.82, p<0.001) of gliomas were significantly higher than ischemic lesions with re-perfusion (maximal rCBV ratio 1.64±0.13, maximal rCBF ratio 1.35±0.18; mann-whitney U test)

CONCLUSION

Our study shows that the gliomas mimicking symptom and imaging of acute stroke present higher perfusion than acute cerebral ischemic lesions. Carefully interpretation of multi-parameters derived from advanced CT and MRI perfusion imaging is useful in differentiating between gliomas mimicking acute stroke lesions.

CLINICAL RELEVANCE/APPLICATION

The perfusion imaging is important and adjuvant tool for accurate diagnosis in differentiating between gliomas mimicking acute stroke lesions.

SSJ20-05 Clinical Performance Characteristics of Multivoxel Magnetic Resonance Spectroscopy in Distinguishing Between True Progression and Pseudoprogression in a Series of Patients with High-Grade Glial Neoplasm

Participants
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PURPOSE

Rates of pseudoprogression (PsP) following chemoradiotherapy can be as high as 30% and can present a significant clinical and diagnostic burden. Early differentiation between true progression (TP) and PsP affects management decisions particularly in the era of progressive individualized treatments. We sought to review the clinical performance characteristics of MRS in a group of high-grade glial based neoplasm presenting for differentiation of PsP from TP.

METHOD AND MATERIALS

66 patients with high-grade glial neoplasm (GBM or AA) imaged during 2014 with MRI of the brain including multivoxel MRS with TE of 144 ms were evaluated. Patients were required to have either pathology follow-up or six-months of clinical and imaging follow-up to assess for accuracy. MRS solely was assessed for choline to NAA ratio within suspicious tissue as well as relative choline within suspicious tissue to normal brain parenchyma. A threshold of 2 for Cho/NAA and of >1.5 for relative choline concentrations were used as a guideline. Prior imaging and concurrent anatomic brain sequences were not reviewed.

RESULTS

Out of the 66 cases reviewed 23 patients were removed from further analysis due to unreliable MRS data. Of the remaining 33 cases (mean age 56 years, 19 males), high-grade glial neoplasm was suspected in 16 cases and not suspected in 17 cases. 15 out of 16 cases suspicious for TP were correct. MRS not thought to be consistent with TP was correct in 16/17 cases. Sensitivity = 93.8%; Specificity = 94.1%; PPV = 93.8%; NPV = 94.1%. The majority of excluded cases were due to calvarial lipid contamination into the shim box. Modest choline elevations were seen in many voxels of suspicious tissue.

CONCLUSION

High-quality multivoxel MRS is an excellent predictor of high-grade glial neoplasm versus pseudoprogression. Rigorous choline elevation thresholds for tumor versus radiation necrosis must be applied due to the common presence of modestly elevated choline concentrations in the post-treated tissue. Relying upon choline to NAA ratios alone should be done cautiously when a comparative voxel of normal appearing brain is not available for review.

CLINICAL RELEVANCE/APPLICATION

High quality multivoxel MRS at TE of 144 can provide a high level of accuracy and additional confidence in the evaluation of the post-treatment brain for recurrent high-grade glial based neoplasm.

SSJ20-06 Investigating Dynamic Susceptibility-weighted Contrast-enhanced (DSC) Perfusion MR Imaging in Posterior Fossa Tumors: Differences and Similarities with Supratentorial Tumors

Participants
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**PURPOSE**

DSC perfusion is routinely used in brain tumor imaging, for its added value in glioma grading and tumor differentiation. However, compared to supratentorial tumors (ST), there are only few data about its reliability and its cut-off values for infratentorial tumors (IT). Thus, the aims of our study were: 1) to assess the accuracy of DSC perfusion in the evaluation of IT, for glioma grading and tumor differentiation 2) to evaluate differences and similarities with ST.

**METHOD AND MATERIALS**

This retrospective study included 114 patients (3-85 years) with a pathologically proven diagnosis of brain tumor (40 IT, 70 ST), divided in 4 groups: high grade glioma (HGG), low grade glioma (LGG), metastases (MET), primary central nervous system lymphoma (PCNSL). rCBV, mean and min PSR were calculated. For statistical analysis lesions were divided according to the location and histology. Mann-Whitney U test was used to test the differences; accuracy, sensitivity, specificity, PPV and NPV for rCBV and PSR were calculated from ROC curves.

**RESULTS**

For IT, rCBV had high accuracy in differentiating HGG from LGG (p<0.001) and PSR (mean and min) resulted significantly higher in PCNSL and HGG compared to MET (p<0.001), showing a good accuracy (AUC>0.9). Comparing IT with ST, some perfusion parameters resulted similar: high rCBV in HGG, high mean PSR in PCNSL, low mean PSR in MET. Main differences between ST and IT were: the optimum threshold value of rCBV (3.05 for ST, 1.89 for IT), the mean PSR significantly higher in LGG than in HGG in ST (p=0.001) and a trend of higher perfusion values in ST. Exchanging of rCBV threshold values between ST and IT decreased both sensitivity and specificity.

**CONCLUSION**

rCBV and PSR are helpful in grading and differentiating IT. The overall behaviour of perfusion parameters was similar between ST and IT, but some differences in rCBV and PSR were demonstrated. The difference of rCBV threshold value between ST and IT -to distinguishing HGG from LGG- might be of high clinical relevance, and in our opinion deserves consideration.

**CLINICAL RELEVANCE/APPLICATION**

Our study suggests that different rCBV cut-off values should be applied in IT. In fact, our results demonstrated a different optimum threshold value of rCBV for IT (1.89) compared to ST (3.05).
Purpose/Objective(s): Hidradenitis Suppurativa (HS) is a chronic condition affecting the apocrine glands and their ducts which can be debilitating and devastating for patients. Patient distress has resulted in chronic anxiety and even suicide in some patients. Standard therapy consists of, weight loss in obese patients, improved skin hygiene, antibiotics, and radical surgery. Radical surgery can be debilitating and for patients for whom conventional therapy is ineffective there are few more morbid options. For this benign disease, we have successfully used low dose radiotherapy in four patients.

Materials/Methods: Four consecutive female patients with long standing and refractory HS were treated to multiple sites (axillae, the groins, and the inframammary regions) with low dose electron radiotherapy. Between 600 and 750 cGy was delivered in 3 equal fractions using 6 MeV electrons (Dmax) with a 0.5 cm bolus and a 1.0 cm margin surrounding the lesions to treat the apocrine glands in the dermis of the skin and the epidermis to limit follicular hyperkeratosis. In the lone patient who was treated with 600 cGy, retreatment was necessary in 50% of the sites treated. One patient supplemented her therapy with a sustained weight loss facilitated by careful dieting. Another patient had been treated one year prior with 6 MV photon radiotherapy that mimicked our prescribed total dose, but effectively provided only about 25% of prescribed dose to the dermis and epidermis.

Results: With a mean follow up of 28.5 months (range 4-48 months), all patients were free of recurrence. One patient (4 month follow up patient) had such anxiety about her disease that she decided to undergo radical surgery 4 months from the radiotherapy despite progressive improvement. The time to complete resolution averaged 3-6 months from radiotherapy. One patient developed long term pruritus (the patient previously treated with photons). This remains as a controlled but minor intermittent problem. No other patients had side effects of radiotherapy.

Conclusion: Conservative management of HA with oral antibiotic therapy and a strict weight loss regimen is an optimal first line approach. However, when more radical and invasive surgical options fail or are undesirable, low dose radiotherapy is a viable option.

ABSTRACT

Purpose/Objective(s): In 2013, the American Society of Therapeutic Radiology (ASTRO) released its list of Choosing Wisely Initiatives. One of these initiatives, was to use fractionation schemes which allow less than 10 fractions for the palliation of bone metastatic disease. Such schemes may use one or five fractions to treat an uncomplicated case of bone metastases. This project looks at a rural radiation practice, both before and after a decision was made to employ the Choosing Wisely guidelines whenever appropriate.

Materials/Methods: This is a non randomized, retrospective analysis of 12 months of bone metastasis treatments in a single provider practice comparing the 6 months before Choosing Wisely to the six months after Choosing Wisely. A total of 37 consecutive patients, 63 treatment sites were examined. Fifteen treatment fractions were saved before, 84 treatment fractions were saved after the guidelines were published.

Results: More fractions of radiotherapy were saved when compared to the same length of time prior to the decision to employ Choosing Wisely Initiatives. This finding, however is seen in a retrospective analysis of a single physician practice, who decided to adopt the Initiative, thus built in bias exists. Before the Choosing Wisely Initiative was released, 14% of patients received shorter fraction schemes, compared with 68% after. Because of these shorter treatment schedules, and assuming similar patient charges for treatments, savings after the Initiatives were released were over 5.5 times as much as prior to the release for the patient population, as a whole ($69,000 versus $12,000). In a time when health care costs are growing faster than the GDP, any savings we can achieve can benefit society as a whole.

Numerous assumptions must be made in the analysis and the numbers are subject to discussion, but no one can deny that a patient with painful bone metastases would benefit from saving almost 4 hours in the car on rural roads. Care givers may be retired, and may not loose wages, but at the average wage of $63,000, the average caregiver saved approximately $170.00 in lost wages bringing in their loved one. The average patient who received shortened fractionation saved 145 miles of travel and 5 hours and 35 minutes of commuting and treatment time.

Other savings were seen in one patient who needed to be hospitalized for her treatment. Her hospital stay was reduced by the use of shorter fractionation. No patient in this study required retreatment, the minimum follow up period was 6 months. Many patients have passed away from their disease within this follow up period. Conclusion: Shorter fraction schemes when used as clinically appropriate do offer savings not only to health care payers, but also to patients and patients families.

Consideration of Choosing Wisely Initiatives have saved patients time and expense as opposed to a similar time period before the initiative.
Participants
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ABSTRACT

Purpose/Objective(s): Many patients undergoing radiation therapy (RT) experience acute dermatitis, and topical emollients are used to ameliorate this condition, including creams with heavy metals. Patients are traditionally advised to avoid lotions for several hours before RT based on concern that creams might increase skin dose. With modern RT’s improved skin sparing, this traditional recommendation may be irrelevant. We hypothesize that the application of either metallic or non-metallic creams before treatment would have minimal effect on skin dose.

Materials/Methods: We conducted an online, 24-question survey of patients and providers to determine current practices regarding skin creams on the OncoLink website using a convenience sample of users. To evaluate the dosimetric effect of skin creams, we delivered 200 MU at 100 cm SSD to a 10 x 10 cm field and measured the dose at the surface and 2 cm depth in a tissue equivalent phantom, with and without application of two common skin creams, Aquaphor and silver sulfadiazine, using optically stimulated luminescent dosimeters. We assessed the effect of various photon and electron energies, cream thicknesses, and beam incidence on dose. Results: The survey showed that 22 of 25 patients and providers (85%) either gave or received the advice to avoid applying skin creams prior to RT treatments. This finding was not affected by diagnosis (p=0.6). Measurements showed no difference in dose at the surface or 2 cm depth with or without a relatively thick 1-2 mm application of either cream when using en face 6 or 15 MV photons. Similarly, there was no impact on surface dose for 6 MV photons delivered at incident angles ranging from 15°- 60°. The same application of cream had no effect on surface dose as a function of beam incident angle, with the exception of a 7% increase at 60° observed only with the silver cream. A significant increase in surface dose was noted for both 6 and 15 MV photons when a thicker (13 mm) layer of cream was applied. For 6 MV beams, the surface dose was 105 cGy with Aquaphor, 102 cGy for the silver cream, and 88 cGy for controls. For 15 MV, the doses were 70, 60 and 52 cGy, respectively. With 6 and 9 MeV electrons, there was only a 2-5% increase in the surface dose with use of no creams. No differences in doses were observed at 2 cm depth. Conclusion: To our knowledge, this is the first dosimetric assessment of the effect of skin creams for radiation dermatitis. Survey results confirmed that patients are routinely advised to avoid creams prior to RT. Our findings suggest that thin or moderately applied skin creams, even if applied just prior to radiation, have minimal impact on skin dose, regardless of beam energy or beam incidence. Applying very thick amounts of skin cream just prior to RT may have a bolus effect with increased surface dose and should be avoided. Studies in mouse models to evaluate the effect of creams on skin dose using gamma-H2AX IHC staining have been initiated.

RESULTS

Results: 153 patients were surveyed, 48 D patients and 105 ND. More D than ND patients were treated with chemotherapy alone (26% vs 6%) and fewer with RT alone (25% vs 47%) although combination therapy was about the same (50% vs 47%) (p=0.03). Median age of D individuals was 6 years older than the ND (p=0.21). D patients were more likely (31%) than ND (11%) to be single (p=0.01). Breast cancer was the most common tumor type (ND 43%, D 29%) followed by prostate (ND 26% D 8%) and lung cancer (ND 11% D 20%) With respect to the NCCN problem list, emotional (D 81% vs ND 48%) (p=0.0006) and physical problems (D 92% vs ND 44%) were significant in D compared to ND patients.

CONCLUSION

Conclusion: In this study, patients who demonstrated no distress at the start of cancer treatment had no increase in distress by the conclusion of treatment. This may relate to the difficulty of capturing changes in distress in a patient survey. Given that emotional and physical problems were significant complaints in patients with distress at the start of treatment, more attention needs to be directed at these issues by clinicians. [1]
The management of cancer treatment-related side-effects is a continuous challenge to patients and healthcare providers alike. In the therapeutic armamentarium, alternative medicine is slowly gaining popularity as a complementary or substitutive management option. Among well-known alternative medicine modalities, acupuncture has been shown in several studies to reduce or eliminate radiation therapy (RT) induced effects such as RT-induced xerostomia in head and neck cancer and RT-related fatigue. In this study, we analyzed the demographics among RT patients who chose acupuncture, which symptoms prompted referral, and prevalence of combined modalities among these patients.

METHOD AND MATERIALS
Records of 50 cancer patients who utilized acupuncture between May 2013 and April 2014 were reviewed at our institution. The subset chosen for final analysis was limited to patients who underwent radiation therapy either alone or in combination with other standard cancer treatment modalities. Variables measured included gender, age, payment method, cancer type, treatment modalities, chemotherapy class, and type and number of symptoms prompting acupuncture referral.

RESULTS
Among 50 pts analyzed in our initial set of acupuncture patients, 26 pts, 8 men (mean age = 64.5 yrs) and 18 women (mean age = 58.5 yrs) received radiation therapy. Twenty-two pts also received chemotherapy, and 15 pts among the chemoradiation cohort underwent surgery. Breast cancer pts (n=11) were the most prevalent users of acupuncture followed by head and neck (n=4) and lung cancer (n=3). Most patients (n=20) requested assistance with 1-2 symptoms with the most common symptoms being neuropathy (n=6), arthralgias (n=6), and nausea (n=6). Among the breast cancer cohort, the most common chief complaint were arthralgias (n=6), myalgias (n=5), and neuropathy (n=4) and the most commonly used chemotherapy were taxanes (n=9).

CONCLUSION
Among RT patients, women were more prevalent users of acupuncture with majority diagnosed with breast cancer. The majority of patients also received either concurrent or sequential chemotherapy. Neuromusculoskeletal complaints were the most common reason for acupuncture referral.

CLINICAL RELEVANCE/APPLICATION
These data will be used in future analyses to further characterize symptoms in order to strengthen outcomes evaluations and tailor emphasis to cancer subpopulations’ specific symptoms.

SSJ24-06 The Impact of Body Mass Index on Time from Diagnosis to Surgery and Time from Surgery to Radiation in Patients with Breast Cancer

Tuesday, Dec. 1 3:50PM - 4:00PM Location: S104A

ABSTRACT
Purpose/Objective(s): In breast cancer, both biological and social factors may delay the time from diagnosis to surgery and the time to initiation of radiation therapy (RT). In this study, we analyze the impact of body mass index (BMI) on time from initial diagnosis of breast cancer to surgery (TTS) and from surgery to RT (TTR) in a large cohort of breast cancer patients. Materials/Methods: A total of 1409 patients were diagnosed with breast cancer at our institution between 2004 and 2014. Of these, 1073 patients underwent surgery as first treatment and had BMI information available in the electronic health record. We classified patients as normal weight, overweight and obese by BMI (18.5-24.9, 25.0-29.9, ≥30). Results: BMI had no statistically significant impact on TTS. TTS for normal weight (N=252), overweight (N=345) and obese patients (N=476) was 35.2 days, 36.7 days and 33.7 days, respectively (p=0.555). In a subset analysis of 489 patients undergoing follow-up EBRT, BMI did have an impact on TTR. Patients with normal weight (N=104) had the lowest TTR at 64.6 days. Obese patients (N=241) reported longer TTR at 71.7 days however the finding failed to reach statistical significance (p=0.33). Patients who were classified as overweight (N=144) had a significantly higher TTR at 85.3 days (p=0.01). Conclusion: In this large retrospective analysis, BMI was associated with a delayed time from surgery to radiation in patients classified as overweight with a BMI between 25-<30. Interestingly, obese patients with a BMI over 30 did not have a statistically longer TTR; further analysis of the overweight patient subset may reveal the reason for their uniquely longer TTR. In breast cancer, several studies link a BMI over 25 to a higher breast cancer related mortality rate. Further research must be done to further explore the impact of BMI on the quality and timeliness of care as well as its potential impact on patient outcomes.
**Vascular/Interventional (Advances in Radioembolization)**

**Tuesday, Dec. 1 3:00PM - 4:00PM Location: E351**

**Participants**
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Robert J. Lewandowski, MD, Chicago, IL (Moderator) Advisory Board, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Consultant, ABK Medical Inc

**Sub-Events**

**SSJ25-01 The Effect of Yttrium-90 Radioembolization on the Growth Kinetics of Treated and Untreated Colorectal Liver Metastasis**

**Tuesday, Dec. 1 3:00PM - 3:10PM Location: E351**

**Participants**
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Faeezeh Sodagari, MD, Chicago, IL (Abstract Co-Author) Grant, Siemens AG
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Vahid Yaghmai, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate the effect of 90Y radioembolization (TARE) on the growth kinetics of both the treated and the contralateral untreated colorectal cancer liver metastases as well as on the portal vein (PV) diameter.

**METHOD AND MATERIALS**
78 chemorefractory liver metastases from colorectal cancer in 17 patients with two MDCT scans before and one after TARE were evaluated. Liver lesions were divided in two groups: 1) treated lesions and 2) untreated contralateral lobe lesions. Tumor growth kinetics of the two groups was evaluated before and one month after the unilobar TARE comparing reciprocal doubling time (RDT) based. The diameter of the PV in treated and untreated lobes were measured by two radiologists. Student's t-test was used for analysis. P< 0.05 was considered significant.

**RESULTS**
For the treated lesions, mean RDT decreased from 8.3 to -5.6 with TARE (P<0.0001), whereas for the untreated lesions, the mean RDT increased from 7.5 before TARE to 10.6 after TARE (P=0.028). The mean diameter of PV did not change in the treated or untreated lobes (P=0.12 and P=0.83, respectively).

**CONCLUSION**
Lobar / segmental TARE significantly decreases the growth kinetics for the treated metastases but may lead to increase in the growth kinetics of contralateral liver.

**CLINICAL RELEVANCE/APPLICATION**
90Y radioembolization may increase in the growth rate of untreated colorectal cancer liver metastasis in the contralateral lobe. This information may be helpful in future treatment planning of contralateral hepatic lobe metastasis.

**Honored Educators**
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Vahid Yaghmai, MD - 2012 Honored Educator
Vahid Yaghmai, MD - 2015 Honored Educator

**SSJ25-02 Semiautomatic Assessment of Whole-lesion Apparent Diffusion Coefficient (ADC) as an Early Predictor of Liver Tumor Response after Radioembolization**

**Tuesday, Dec. 1 3:10PM - 3:20PM Location: E351**

**Participants**
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Johannes Budjan, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
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Stefan O. Schoenberg, MD, PhD, Mannheim, Germany (Abstract Co-Author) Institutional research agreement, Siemens AG
Steffen J. Diehl, MD, Mannheim, Germany (Abstract Co-Author) Nothing to Disclose
PURPOSE
A semi-automatic, volume-based ADC measurement tool was evaluated as an early predictor of therapy response after radioembolization (RE) of primary and secondary liver malignancies.

METHOD AND MATERIALS
In a retrospective analysis, a total of 50 patients suffering from primary or secondary liver tumor treated with Yttrium-90 resin microspheres for RE were included. All patients underwent a baseline MR examination as well as an early follow-up MRI 1 month after intervention. The MRI protocol included diffusion-weighted imaging (DWI, b-Values 50,400,800) as well as contrast-enhanced T1 weighted sequences. Measurement of lesion diameter, mean ADC in a representative single-slice region-of-interest (ADCMROI) and mean ADC for the entire lesion volume (ADCVOL) were evaluated in both examinations. ADCVOL was measured using a semi-automatic, image analysis software (MROncotreat, Siemens Healthcare, Germany). The progression-free interval (PFI) of the individual patients, based on further MRI scans was assessed according to RECIST 1.1 criteria. Changes in lesion diameter, ADCROI and ADCVOL between baseline and early follow up were correlated to PFI.

RESULTS
Median PFI of all patients was 3.5 ± 5.8 months post RE. Patients with an increase of ADCVOL in the first control MRI showed a statistically significant longer PFI in comparison to patients with a decrease of ADCVOL (median PFI: 6.5 months vs. 2.5 months, p = 0.02). No correlation between PFI and early changes in lesion diameter or ADCROI was found.

CONCLUSION
In contrast to lesion diameter or single-ROI ADC evaluation, semi-automatic, software-based ADC-volume measurement seems to offer a clinically valuable parameter for early assessment of therapy response in patients after RE.

CLINICAL RELEVANCE/APPLICATION
Software-based ADC-volume assessment helps to early identify patients with tumor response already one month post therapy and therefore could help to triage patients with no response to RE to other therapy options without delay.

SSJ25-03 Quantitative Enhancement Measurements on Pre-procedure Triphasic CT Can Predict Response to Radioembolization of Colorectal Liver Metastases

Tuesday, Dec. 1 3:20PM - 3:30PM Location: E351

Participants
Franz E. Boas, MD,PhD, New York, NY (Presenter) Co-founder, ClariPACS
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Hooman Yarmohammadi, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Waleed Shady, MBBCh, New York, NY (Abstract Co-Author) Nothing to Disclose
Sinish Kishore, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
Colorectal liver metastases (CLM) demonstrate variable response to radioembolization. This may be at least partly due to differences in tumor arterial perfusion. This study examines whether quantitative enhancement measurements on pre-procedure triphasic CT can be used to predict response of CLM to radioembolization.

METHOD AND MATERIALS
The Institutional Review Board approved this retrospective review of patients with colorectal liver metastases treated with radioembolization, who had pre-treatment PET/CT and triphasic CT, and post-treatment PET/CT. 31 consecutive patients with 60 target tumors were included in the study. For each tumor, we calculated the hepatic artery coefficient (HAC), portal vein coefficient (PVC), and arterial enhancement fraction (AEF) based on the pre-treatment triphasic CT. HAC and PVC are estimates of the hepatic artery and portal vein blood supply. AEF is the arterial phase enhancement divided by the portal phase enhancement, and it provides an estimate of the hepatic artery blood supply as a fraction of total blood supply. Metabolic response to radioembolization for each tumor was classified into two categories - response (complete or partial response), or no response (stable disease or progression) - based on the initial (4-8 weeks) post-treatment PET/CT.

RESULTS
55% of CLM showed a complete or partial metabolic response. Arterial enhancement, HAC, and PVC did not predict which tumors responded to radioembolization. However, the AEF was significantly greater in responders compared to non-responders (p=0.038). AEF < 0.4 was associated with a 40% response rate, whereas AEF > 0.75 was associated with a 78% response rate.

CONCLUSION
Response to radioembolization can be predicted using the arterial enhancement fraction calculated from pre-procedure triphasic CT.

CLINICAL RELEVANCE/APPLICATION
AEF could enable better patient selection for radioembolization procedures.

SSJ25-04 Use of SPECT-CT Following Administration of Technetium-99m-labelled Macroaggregated Albumin Improves Lung Shunt Fraction (LSF) Calculation and May Allow for More Accurate Dosing of Yttrium-90 (Y-90) Treatment for Liver Tumors

Tuesday, Dec. 1 3:30PM - 3:40PM Location: E351

Participants
Colin J. McCarthy, MD, Boston, MA (Presenter) Nothing to Disclose
Daniel Tempesta JR, BS,RT, Boston, MA (Abstract Co-Author) Nothing to Disclose
Total Lesion Glycolysis and Sum of Largest Diameters of Target Lesions are Independent Predictors of Survival after 90Y Radioembolization of Colorectal Liver Metastases

Tuesday, Dec. 1 3:40PM - 3:50PM Location: E351

Participants
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Rahmi Oklu, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Leonard P. Connolly, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

Purpose
To identify predictors of overall survival (OS) after 90Y radioembolization of colorectal liver metastases.

Method and Materials
We conducted an IRB-approved retrospective review of our prospectively created and maintained 90Y radioembolization clinical database for the time period December 2009 through December 2013. We included all patients treated for colorectal liver metastases (CLM). We excluded patients without an FDG-PET/CT scan at baseline or on the first follow-up. On the baseline portal venous phase CT, up to 5 target tumors per patient were chosen and the sum of largest diameters were calculated. On FDG-PET/CT SUVmax, functional tumor volume (FTV), and total lesion glycolysis (TLG) (meanSUV x FTV) were measured for the target lesions chosen on CT and a sum for each metric was calculated for the patient. OS was calculated from the time of radioembolization until death or last follow-up. Log-rank test was used to analyze predictor of survival on univariate analysis and a Cox-regression model was used for multivariate analysis.

Results
The study enrolled 47 patients with 122 target tumors; a median of 2 (range: 1-5) tumors per patient. Thirteen patients were treated in 2 sessions, and 34 were treated in 1 session. The median OS was 12.7 months (95% CI: 7.2-16.3). The one-, two-, and three-year OS rates were 51%, 22% and 15% respectively. On univariate analysis predictors of poor survival were: CEA level >200 ng/ml (P=0.001), ECOG status >0 (P=0.001), SUVmax >30 (P=0.002), TLG >600 g (P<0.001), FTV >200 cc (P<0.001), and sum of largest diameters >10 cm (P<0.001). On multivariate analysis, only the TLG >600 g (P<0.001) (HR=4.3; 95% CI: 1.8-10.1) and sum of largest diameters >10 cm (P=0.01) (HR=2.8; 95% CI: 1.3-6.2) retained significance.
CONCLUSION
High tumor metabolic activity and sum of largest diameters >10 cm of the target tumors is associated with poor survival after 90Y radioembolization of CLM.

CLINICAL RELEVANCE/APPLICATION
Measurement of total lesion glycolysis and the size of target lesions prior to 90Y radioembolization of CLM can provide prognostic information and help predict patient survival.

SSJ225-06 Radiation Lobectomy: Single Center Investigation of Incidence, Degree, Prognostic Factors and Survival
Tuesday, Dec. 1 3:50PM - 4:00PM Location: E315

Participants
Andrew G. Kim, Chicago, IL (Presenter) Nothing to Disclose
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Ron C. Gaba, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
Yttrium-90 radioembolization (Y90 RE) is a minimally invasive therapy for liver tumors. A unique anatomical response pattern to Y90 RE, termed “radiation lobectomy (RL),” occurs in a subset of treated patients and consists of marked ipsilateral liver lobe atrophy and contralateral hypertrophy. While RL has been anecdotally described, there is limited characterization of this phenomenon in the literature. This study aimed to investigate the incidence and degree of RL, identify prognostic factors for occurrence, and examine association with survival.

METHOD AND MATERIALS
This single-center, retrospective study included 141 Y90 RE-treated patients from 2006-2012. Cases of right unilobar therapy were selected (n=33), while cases of bilobar treatment and inadequate imaging follow-up were excluded (n=108). Chart and imaging review were used to collect demographic, tumor, and treatment data, and pre-/post-RE hepatic volumes were measured. RL was defined as 25% relative atrophy of treated liver lobes. Measured outcomes included RL incidence, hepatic volumetric changes, parameters associated with RL, and survival.

RESULTS
The study cohort included 23 men and 10 women (median age 62 years). 58% (n=19) and 42% (n=14) had primary tumors and metastatic disease. Median index tumor size was 6 cm, and patients underwent median 1 (range 1-4) Y90 RE sessions (75% resin, 25% glass), with median cumulative dose of 2.33 (range 1.06-10.31) GBq. RL incidence was 33% (n=11). There were no differences in median pre-RE right (1284 vs. 1240 mL) and left (521 vs. 680 mL) lobe liver volumes between RL and non-RL groups (P>0.05). The median post-RE right (344 vs. 993 mL, P=0.002) lobe liver volume was significantly lower in the RL vs. non-RL group. A significant change between pre- and post-treatment relative right (69% to 25%, P<0.001) and left (31% to 75%, P<0.001) hepatic lobe volumes occurred in the RL group, while no significant change ensued in the non-RL group (right: 64% to 53%, left: 36% to 47%). No parameters had statistical association with RL occurrence. Median survival was significantly greater in patients exhibiting RL pattern response (1036 vs. 493 days, P=0.012).

CONCLUSION
RL occurs with relatively common frequency among patients undergoing Y90 RE. While associated with enhanced survival, predictive factors for RL occurrence remains elusive.

CLINICAL RELEVANCE/APPLICATION
RL occurs in about one-third of Y90 RE cases, and confers enhanced survival.
Participants
Simon S. Lo, MD, Cleveland, OH, (Simon.Lo@UHhospitals.org) (Moderator) Research support, Elekta AB;

LEARNING OBJECTIVES
1) To understand the basics of stereotactic body radiotherapy (SBRT) for spinal metastasis. 2) To know the basics of diagnostic imaging for spinal metastasis. 3) To learn the principles and methods of target delineation for SBRT for spinal metastasis. 4) To know the principles and methods of response evaluation after SBRT for spinal metastasis.

ABSTRACT
Stereotactic body radiotherapy (SBRT) has become an important treatment modality for spinal metastases in various settings. To facilitate safe and effective delivery of SBRT for spinal metastases, proper pre-SBRT evaluation including appropriate diagnostic imaging, and proper target delineation and contouring of organs-at-risk are necessary. The gold standard for post-SBRT response evaluation for spinal metastases is not well-defined and this is an emerging area of research interest. This refresher course will provide an overview of the spinal SBRT process, diagnostic imaging for spinal metastasis, target delineation for SBRT for spinal metastases, and post-SBRT response evaluation for spinal metastases.

Sub-Events
RC420A Overview of SBRT for Spinal Metastases

Participants
Simon S. Lo, MD, Cleveland, OH (Presenter) Research support, Elekta AB;

LEARNING OBJECTIVES
1) To know the indications for stereotactic body radiotherapy (SBRT) for spinal metastasis. 2) To know the technical aspects of SBRT for spinal metastasis. 3) To know the expected outcomes of SBRT for spinal metastasis. 4) To know the potential toxicities of SBRT for spinal metastasis.

ABSTRACT
This subsection will provide an overview of the indications, technical aspects, expected outcomes, and toxicities of stereotactic body radiotherapy (SBRT) for spinal metastasis.

RC420B Pre-SBRT Imaging of Spinal Metastases

Participants
Pejman Jabehdar Maralani, MD, FRCPC, Toronto, ON, (pejman.maralani@utoronto.ca) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the role of different imaging modalities in diagnosis of spinal metastasis. 2) To understand relevant imaging characteristics of spinal metastasis.

ABSTRACT
This section will provide an overview of multiple imaging modalities used for diagnosis and treatment planning of spinal metastasis.

Active Handout: Pejman Jabehdar Maralani

RC420C Target Delineation of Spinal Metastases

Participants
Kristin J. Redmond, MD, MPH, Baltimore, MD (Presenter) Research support, Elekta AB

LEARNING OBJECTIVES
1) To understand target and normal tissue delineation for patients receiving SBRT for malignant spinal metastases.

ABSTRACT
The purpose of this section will be to review principles involved with target and normal tissue delineation in patients being treated with SBRT for malignant spinal metastasis. This will include review of both current consensus guidelines as well as areas of controversy.

Active Handout: Kristin Janson Redmond
Participants
Arjun Sahgal, Toronto, ON, (arjun.sahgal@sunnybrook.ca) (Presenter) Speaker, Medtronic, Inc; Speaker, Elekta AB; Medical Advisory Board, Varian Medical Systems, Inc; Speaker, Accuray Incorporated; Research Grant, Elekta AB

LEARNING OBJECTIVES
1) To understand the challenges of post-spine SBRT response assessment. 2) To understand the current state of response criteria consensus.

ABSTRACT
The aim of this presentation is to highlight the challenges of post spine SBRT response assessment, and current consensus work to standardize imaging and evaluation.
Proton: Imaging for Treatment Guidance and Verification

Tuesday, Dec. 1 4:30PM - 6:00PM Location: S104A

RC422A
Pre- and Intra-treatment Imaging Strategies for Patient Alignment

Participants
Jon J. Kruse, PhD, Rochester, MN (Moderator) Research Grant, Varian Medical Systems, Inc

ABSTRACT
Proton therapy dose distributions are highly conformal and are often used to deliver therapeutic doses to tumors close to critical, radiosensitive normal anatomy. Precise daily reproduction and alignment of the patient anatomy is crucial, then, for successful outcome of proton radiotherapy. This course will describe modern approaches to pre- and intra-treatment imaging to align the patient for proton therapy as well as post-treatment modalities which can verify patient alignment and proton beam range. Pre-treatment image guidance for protons has evolved differently than many common approaches for standard external beam radiotherapy. One reason for this is the dissimilar impact of setup variations on the delivered proton dose distributions, while another is related to the expense of building a proton center and the need to maximize efficiency by moving as many complex processes out of the treatment room as possible. Additionally, the sensitivity of proton dose distributions to intra-fractional changes has led to the development of novel techniques to monitor patient anatomy throughout a treatment. Modest errors in patient positioning or in calculation of proton range could lead to tumor or healthy tissues receiving vastly different doses than were planned. This has led to the development of a number of approaches for post treatment verification of proton beam placement and range. Proton dose verification via positron emission tomography, prompt gamma imaging, and magnetic resonance imaging will be presented.

Sub-Events

RC422B Advanced Imaging Techniques for Range Verification

Participants
Thomas R. Bortfeld, PhD, Boston, MA (Presenter) Research Grant, Koninklijke Philips NV; Research Grant, RaySearch Laboratories AB

LEARNING OBJECTIVES
1) Explain the impact of inter- and intra-fractional variations in patient anatomy on proton dose distributions. 2) Describe proton specific approaches to pre-treatment and intra-treatment imaging for patient alignment. 3) Compare various imaging modalities for post-treatment verification of a delivered proton dose distribution.
Molecular Imaging Mini-Course: Clinical Applications of Molecular Imaging - Oncology

Tuesday, Dec. 1 4:30PM - 6:00PM Location: E352

AMRA Category I Credits: 1.50
ARRT Category A+ Credits: 1.50

FDA Discussions may include off-label uses.

Participants

Sub-Events

RC423A Diagnosis

Participants
Terence Z. Wong, MD, PhD, Chapel Hill, NC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Discuss the potential roles and limitations of PET imaging for amyloid and tau protein in evaluating patients with dementia. 2) Describe anatomic and functional MRI techniques for evaluating Alzheimer's disease. 3) Understand the clinical challenges of diagnosing and managing patients with dementia.

RC423B Staging

Participants
Dominique Delbeke, MD, PhD, Nashville, TN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The potential clinical indications of PET and PET/CT in the evaluation of patients with malignancies. 2) The impact on patient care. 3) Recommendations for PET/CT in the NCCN guidelines.

RC423C Evaluation of Treatment

Participants
David A. Mankoff, MD, PhD, Philadelphia, PA, (david.mankoff@uphs.upenn.edu) (Presenter) Speaker, Koninklijke Philips NV; Consultant, General Electric Company

LEARNING OBJECTIVES
1) List applications of quantitative imaging for clinical trials. 2) Describe the approach to the design of cancer imaging trials. 3) Discuss biomarkers applications for cancer imaging.

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

David A. Mankoff, MD, PhD - 2013 Honored Educator
Participants
Jonathan P. Knisely, MD, Lake Success, NY (Presenter) Travel support, Elekta AB; Travel support, BrainLAB AG; Speaker, BrainLAB AG; Travel support, Cyber Medical Corporation Limited
Jesty R. Abraham, DO, Philadelphia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Define normal anatomy in the CNS. 2) Define and contour the GTV/CTV for Glioma. 3) Define and contour the GTV/CTV for CNS tumors.

ABSTRACT
The safe and successful treatment of brain tumors is depending upon accurately and reliability being able to identify normal CNS anatomy, and regions of gross tumor and regions at risk. This course will teach participants to identify normal anatomy and define the GTV and CTV for brain tumors.
Hot Topic Session: Molecular Imaging and Radionuclide Therapy for Prostate Cancer

Wednesday, Dec. 2 7:15AM - 8:15AM Location: E451A

GU MI DI RO

AMA PRA Category 1 Credit™: 1.00
ARRT Category A+ Credit: 1.00
FDA

Discussions may include off-label uses.

Participants
Uwe Haberkorn, MD, Heidelberg, Germany (uwe.haberkorn@med.uni-heidelberg.de) (Moderator) Nothing to Disclose
Eric M. Rohren, MD, PhD, Houston, TX (Moderator) Nothing to Disclose
Alexander Drzezga, MD, Cologne, Germany (Moderator) Research Grant, Eli Lilly and Company; Speakers Bureau, Siemens AG; Speakers Bureau, General Electric Company; Speakers Bureau, Piramal Enterprises Limited; Research Consultant, Eli Lilly and Company; Research Consultant, Piramal Enterprises Limited; ; ; ; ;

LEARNING OBJECTIVES
1) Review the chemical and physical features of radium-223 dichloride. 2) Discuss the clinical utility of radium-223 therapy. 3) Understand the technique for radium-223 administration. 4) Review the anticipated outcomes of radium-223 therapy through case-based review.

ABSTRACT
Radium-223 is a recently approved therapy for treatment of bone metastases in patients with metastatic prostate carcinoma. As an alpha-emitting radioisotope, radium has the potential to be a powerful therapy for treatment of a variety of skeletal malignancies. In this presentation, the use of radium-223 in the treatment of prostate cancer will be reviewed through a case-based format. Future directions in radium-223 therapy will be discussed.

URL

Honored Educators

Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Eric M. Rohren, MD, PhD - 2015 Honored Educator

Participants
Carsten Kobe, Cologne, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the concept of PSMA PET-imaging in the diagnosis of prostate cancer in general and in comparison to conventional methods. 2) Learn about the currently available alternatives for radiolabeling of PSMA-tracers, e.g. 68-Gallium and 18F-Fluoride and their characteristics. 3) Gain insights from first comparative studies about the clinical value of the available tracers with regard to their sensitivity, specificity and practicability.

SPSH40B Comparison of Ga-68 and F-18 Labeled Small Molecule PSMA Tracers for Prostate Cancer Imaging

Participants
Carsten Kobe, Cologne, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the concept of PSMA PET-imaging in the diagnosis of prostate cancer in general and in comparison to conventional methods. 2) Learn about the currently available alternatives for radiolabeling of PSMA-tracers, e.g. 68-Gallium and 18F-Fluoride and their characteristics. 3) Gain insights from first comparative studies about the clinical value of the available tracers with regard to their sensitivity, specificity and practicability.

SPSH40C PSMA Ligands for Imaging and Therapy of Prostate Cancer

Participants
Uwe Haberkorn, MD, Heidelberg, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the background and pharmacokinetics of PSMA ligands for PET/CT. 2) Estimate the value of PSMA-based imaging in comparison to choline-based imaging. 3) Assess the value of PSMA-targeting for diagnosis and therapy. 4) Estimate the effects and side effects of endoradiotherapy with PSMA ligands

ABSTRACT

The prostate-specific membrane antigen (PSMA) is frequently over-expressed in prostate cancer (PCa), which led to the...
The prostate-specific membrane antigen (PSMA) is frequently over-expressed in prostate cancer (PCa), which led to the development of several PSMA-targeting molecules for the detection and therapy of metastatic castration-resistant prostate cancer (mCRPC). In a first diagnostic study, 82.8% of 319 patients investigated with 68Ga-PSMAHBED-PET/CT at least one lesion indicative for PCa was detected. Amongst lesions investigated by histology, 30 were false-negative in 68Ga-PSMAHBED-PET/CT, all other lesions (n=416) were diagnosed true-positive or -negative. Fifty of 116 patients available for follow-up received local treatment after 68Ga-PSMAHBED-PET/CT. A comparison of the 68Ga-PSMA-ligand with 18F-fluoromethylcholine PET/CT revealed 78 PC-suspicious lesions in 32 patients using 68Ga-PSMA-PET/CT and 56 lesions in 26 patients using Choline-PET/CT (significant with p=0.04). All lesions detected by 18F-fluoromethylcholine-PET/CT were also seen by 68Ga-PSMA-PET/CT. Since the ligand bound to PSMA is internalized, the target may also be used for endoradiotherapy. We used a small molecule inhibitor of PSMA MIP-1095 for therapy in 25 men with final stage mCRPC. PSA values decreased by >50% in 60.7% of the men treated. 84.6% of men with bone pain showed complete or moderate reduction in pain. Hematological toxicities were mild. 25% of men treated had a transient slight to moderate dry mouth. No adverse effects on renal function were observed. In order to increase the therapeutic flexibility, a theranostic PSMA ligand coupled to DOTA was synthesized which allows coupling to Ga-68 for diagnostic use or to Lu-177 or Ac-225 for therapy. Initial experience in 30 patients shows promising results concerning antitumor activity with mild side effects.
Participants
Jelle O. Barentsz, MD, PhD, Nijmegen, Netherlands (Presenter) Nothing to Disclose
Albert J. Chang, MD, PhD, San Francisco, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Introduce imaging anatomy relevant to prostate cancer and review imaging issues for contouring primary tumors, nodal regions, and adjacent critical structures. 2) Review how the integration of different imaging modalities can affect tumor delineation. 3) How to choose appropriate imaging methods for specific purposes and to discuss the significance of certain imaging findings.
SUB-EVENTS

**RC513-01**  
**Bone Mineral Density Changes in Survivors of Childhood Cancer**

**Participants**
- Sue C. Kaste, DO, Memphis, TN (Moderator) Nothing to Disclose
- Heike E. Daldrup-Link, MD, Palo Alto, CA (Moderator) Nothing to Disclose
- Stephan D. Voss, MD, PhD, Boston, MA (Moderator) Nothing to Disclose
- Robert Orth, MD, PhD, Houston, TX (Moderator) Research support, General Electric Company;
- Whal Lee, MD, PhD, Seoul, Korea, Republic Of (Moderator) Nothing to Disclose

**LEARNING OBJECTIVES**

1) Participants will learn risk factors for bone mineral density deficits in patients having been treated for childhood malignancies.

**PURPOSE**
Osteonecrosis (ON) is a devastating complication of pediatric cancer therapy with high dose corticosteroids, with 20% of cases progressing to bone collapse, at which point joint conservation therapy may no longer be possible. It was recently shown in adult ON patients that the presence of bone marrow edema (BME) adjacent to epiphyseal ON is correlated with the presence of micro- or macro-fractures on histopathology, and the purpose of our study is to determine whether BME correlates with eventual bone collapse in pediatric cancer patients to help identify high-risk patients who would benefit from early interventions.

**METHOD AND MATERIALS**
We retrospectively reviewed imaging studies of 18 pediatric leukemia patients who underwent high dose corticosteroid therapy and had findings of epiphyseal ON on magnetic resonance imaging (MRI). Two radiologists evaluated the presence of BME. Followup imaging was reviewed to determine lesion progression. Using Fisher's exact test, the presence of BME was compared to the patient's outcome.

**RESULTS**
Of the 18 patients, 12 were found to have pre-collapse ON lesions with sufficient follow-up imaging. A total of 36 weight-bearing and 2 non-weight-bearing lesions were identified, of which 13 progressed to collapse and 22 remained stable or improved. The presence of BME was found to be significantly correlated with eventual bone collapse, with 100% of patients who progressed to collapse demonstrating BME on initial imaging (p < 0.0001). The absence of BME initially was associated with lesion stability or even improvement (p < 0.0001). 3 lesions were identified that progressed slightly but did not collapse, of which none had BME on initial scans.

**CONCLUSION**
The absence of BME early on is an indicator of future stability or even improvement of an ON lesion, while the presence of BME appears to precede bone collapse. These results suggest that the presence or absence of BME can be used to help identify high-risk patients earlier so they may receive joint preserving therapies. This study is ongoing to evaluate our findings in a larger patient cohort.

**CLINICAL RELEVANCE/APPLICATION**
Presence or absence of edema on MRI predicts osteonecrosis progression in pediatric cancer patients and is recommended for stratifying high-risk patients for joint preservation therapy.

**RC513-02**  
**Bone Marrow Edema on MRI as an Indicator of Impending Bone Collapse in Pediatric Cancer Patients on High Dose Corticosteroid Therapy**

**Participants**
- Preeti Sukerkar, MD, PhD, Palo Alto, CA (Presenter) Nothing to Disclose
- Shanshan Bao, MD, Winston Salem, NC (Abstract Co-Author) Nothing to Disclose
- Sandhya Kharbanda, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose
- Stuart Goodman, Stanford, CA (Abstract Co-Author) Nothing to Disclose
- Heike E. Daldrup-Link, MD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
Osteonecrosis (ON) is a devastating complication of pediatric cancer therapy with high dose corticosteroids, with 20% of cases progressing to bone collapse, at which point joint conservation therapy may no longer be possible. It was recently shown in adult ON patients that the presence of bone marrow edema (BME) adjacent to epiphyseal ON is correlated with the presence of micro- or macro-fractures on histopathology, and the purpose of our study is to determine whether BME correlates with eventual bone collapse in pediatric cancer patients to help identify high-risk patients who would benefit from early interventions.

**METHOD AND MATERIALS**
We retrospectively reviewed imaging studies of 18 pediatric leukemia patients who underwent high dose corticosteroid therapy and had findings of epiphyseal ON on magnetic resonance imaging (MRI). Two radiologists evaluated the presence of BME. Followup imaging was reviewed to determine lesion progression. Using Fisher's exact test, the presence of BME was compared to the patient's outcome.

**RESULTS**
Of the 18 patients, 12 were found to have pre-collapse ON lesions with sufficient follow-up imaging. A total of 36 weight-bearing and 2 non-weight-bearing lesions were identified, of which 13 progressed to collapse and 22 remained stable or improved. The presence of BME was found to be significantly correlated with eventual bone collapse, with 100% of patients who progressed to collapse demonstrating BME on initial imaging (p < 0.0001). The absence of BME initially was associated with lesion stability or even improvement (p < 0.0001). 3 lesions were identified that progressed slightly but did not collapse, of which none had BME on initial scans.

**CONCLUSION**
The absence of BME early on is an indicator of future stability or even improvement of an ON lesion, while the presence of BME appears to precede bone collapse. These results suggest that the presence or absence of BME can be used to help identify high-risk patients earlier so they may receive joint preserving therapies. This study is ongoing to evaluate our findings in a larger patient cohort.

**CLINICAL RELEVANCE/APPLICATION**
Presence or absence of edema on MRI predicts osteonecrosis progression in pediatric cancer patients and is recommended for stratifying high-risk patients for joint preservation therapy.
Participants
Theodore T. Pierce, MD, Boston, MA (Presenter) Nothing to Disclose
Randheer Shailam, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Santiago Lozano Calderon, MD, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Pallavi Sagar, MBBS, Boston, MA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Osteosarcoma, a malignant bone tumor, is routinely evaluated using magnetic resonance imaging (MRI) with and without intravenous (IV) gadolinium prior to surgical intervention, typically both at initial staging and following neoadjuvant chemotherapy to determine tumor extent for operative planning. A paucity of data exists showing the utility of preoperative contrast enhanced MRI for operative planning and, so far, gadolinium does not reliably help in differentiating post treatment changes from residual disease. Preoperative parameters such as intramedullary tumor length and transphyseal tumor extension are best evaluated on non-contrast T1 or STIR sequences. Uncertainty remains as to the benefit of IV contrast for evaluating neurovascular bundle involvement (NBI) and intra-articular extension (IAE), key parameters for pre-surgical evaluation.

METHOD AND MATERIALS
At 2 time points, 2 pediatric radiologist independently analyzed MRI examinations of patients between the ages of 0–25 years with pathologic methods such as osteosarcoma for two parameters, NBI and IAE. Initial evaluation analyzed these parameters using non-contrast MRI images only (PRE) and, after 1 week, subsequent evaluation included both the pre and post contrast images (POST). Inter-rater discrepancies were resolved by consensus. Cohen's Kappa and McNemar's test were calculated to assess agreement between PRE and POST image interpretations of NBI and IAE.

RESULTS
56 patients with 90 preoperative MRI examinations were analyzed. PRE and POST interpretations agreed on 47 cases of NBI, 39 cases without NBI, and had 4 discordant cases. There were 63 cases with IAE, 25 without IAE, and 2 were discordant. Kappa was 0.91 for NBI and 0.95 for IAE. McNemar's test did not show a difference between PRE and POST imaging (p=0.61 NBI; p=0.48 IAE).

CONCLUSION
No statistical difference between PRE and POST image interpretation was found. A high level of agreement between PRE and POST image interpretation suggests that non-contrast enhanced MRI may be sufficient for pre-surgical planning for long bone osteosarcoma in pediatric patients.

CLINICAL RELEVANCE/APPLICATION
Avoiding unnecessary gadolinium use limits adverse reaction risk, obviates the need for intravenous access and shortens image acquisition, all of which are of particular benefit in pediatric patients.

Wednesday, Dec. 2 9:10AM - 9:20AM Location: S102AB

Participants
Guenther K. Schneider, MD, PhD, Homburg, Germany (Presenter) Research Grant, Siemens AG; Speakers Bureau, Siemens AG; Speakers Bureau, Bracco Group; Research Grant, Bracco Group; Stefan R. Rith, Homburg, Germany (Abstract Co-Author) Nothing to Disclose
Peter Fries, MD, Homburg, Germany (Abstract Co-Author) Nothing to Disclose
Alexander Massmann, MD, Homburg/Saar, Germany (Abstract Co-Author) Nothing to Disclose
Amo Bieber, MD, Homburg, Germany (Abstract Co-Author) Consultant, Medtronic, Inc Speaker, Medtronic, Inc Co-founder, Aachen Resonence GmbH Research Grant, Siemens AG

PURPOSE
In 58 pediatric pts. with malignant tumors whole body MRI was evaluated as the sole staging procedure in comparison to established methods such as FDG-PET, MIBG or bone scintigraphy, CT and ultrasound. Findings in follow-up whole body MRI were used for evaluation of tumor response and tumor recurrence, again compared against other established imaging methods. Of particular interest was the detection of late recurrence (> 18 month post initial diagnosis) at time points, at which FDG-PET or MIBG scintigraphy are routinely not available based on actual imaging recommendations.

CONCLUSION
Whole body MRI performed with the described technique can correctly stage and diagnose a variety of malignant tumors in pediatric patients and late recurrence of disease is detected with a high accuracy at time points, at which PET or scintigraphy is routinely not performed.

CLINICAL RELEVANCE/APPLICATION
Inferior accuracy of whole body MRI using only STIR sequences or just DWI was recently published, this study demonstrates the potential of whole body MRI using more advanced techniques. Detection of late recurrence only in MRI highlights the need for advanced MRI in follow-up of pediatric malignancies.

Wednesday, Dec. 2 9:20AM - 9:30AM Location: S102AB

Participants
Hee Mang Yoon, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Jin Seong Lee, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Ah Young Jung, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Young Ah Cho, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE
RC513-04 Whole Body MRI including Diffusion-weighted Imaging as the Sole Staging and Follow-up Imaging Procedure in Pediatric Tumors - Comparison with Established Imaging Modalities

Wednesday, Dec. 2 9:10AM - 9:20AM Location: S102AB
POURPOSE
Whole body MR imaging has been frequently used for the management of children with acute myeloid leukemia (AML) because it can provide additional information besides bone marrow evaluation. In this regard, we assess the use of the whole body magnetic resonance (MR) imaging in the management of the children with AML to validate its usefulness.

METHOD AND MATERIALS
Sixty nine whole body MR scans of 40 consecutive pediatric patients with AML were evaluated by two radiologists in consensus. Whole body MR imaging was acquired for the following purposes: work-up for initial diagnosis, work-up for relapsed AML, work-up for stem cell transplant, work-up for a new sign or symptom, or follow-up of pre-existing abnormality. We estimated the presence of abnormal findings including extramedullary granulocytic sarcoma (EGS), clinically occult lesions, and lesions explaining the patient’s clinical symptoms, except the bone marrow involvement by AML.

RESULTS
Total 76 EGSs were identified in eleven of 40 patients (27.5 %). Nine of eleven patients (81.8%) had multiple EGSs. Thirty eight EGSs were incidentally detected on 9 whole body MR scans in seven patients (17.5 %). Positive findings were most commonly observed on whole body MR scans performed as work-up for a new sign or symptom (14 of 15 MR scans, 93.3%). Six clinically occult non-EGS lesions found on whole body MR scans were small intracranial hemorrhage (n=1), bilateral otomastoiditis (n=1), pneumonia (n=1), knee joint inflammation with effusion (n=1) and disseminated infection/inflammation (n=2). Multiple lesions at anatomically distant regions were successfully evaluated with 18 whole body MR scans (26.1%) in a single session head-to-toe imaging.

CONCLUSION
Whole body MR imaging could be helpful to detect multiple EGSs or clinically occult lesions and be used as a problem solving tool in children with a new sign or symptom by AML in a single session study.

CLINICAL RELEVANCE/APPLICATION
Whole body MR imaging is a useful imaging modality in management of the pediatric AML patients considering tendency for multiplicity of EGSs and prevalent occult lesions as well as the intrinsic advantages of whole body MR imaging.

POURPOSE
To find optimal tracer dose regimes for pediatric whole-body 18F-FDG-PET/MRI with minimal radiation exposure and sufficient diagnostic quality.

METHOD AND MATERIALS
Whole-body PET data sets of 30 pediatric patients (14 female, mean age 12±6 [1-18] years) were retrospectively analyzed. PET data were acquired in list mode on a combined PET/MR scanner (Biograph mMR, Siemens) 65±14 min after injection of 3.1±0.5 MBq 18F-FDG per kg bw for 4 min per bed position. Based on the acquired list mode data, PET images of lower tracer doses (0.25 to 2.5 MBq/kg bw 18F-FDG) were simulated by retrospective undersampling of PET list mode data. Resulting data sets were analyzed quantitatively by measurement of standardized uptake values (SUVs) in healthy organs (liver, lungs, blood pool) and pathologic lesions by volume-of-interest (VOI) analysis. Qualitative analysis was performed independently by two readers experienced in pediatric nuclear medicine. To this end, PET-data sets were analyzed beginning with the lowest simulated tracer dose (0.25 MBq/kg bw) and gradually increasing tracer doses up to the original acquired PET image. Conspicuity of organ structures (such as brain, thymus, muscle, heart etc.) and detectability of focal PET lesions were recorded and finally compared to the original full-dose data set.

RESULTS
Image quality steadily improved with increasing simulated tracer doses. SUVs showed higher relative deviations of about 10 % at tracer doses below 1 MBq/kg bw. Conspicuity of physiologic organ structures improved steadily with increasing simulated tracer doses and was equivalent with the original acquired PET data set at simulated doses of 1-1.5 MBq/kg bw. Detectability of focal PET lesions increased continuously with increasing simulated tracer doses; all focal lesion that were detectable in the original full-dose PET were already detectable at 1.5 MBq/kg bw.

CONCLUSION
Tracer doses can be significantly reduced in pediatric PET/MRI compared to existing standard regimes. Our results suggest that doses of 1.5 MBq/kg bw FDG are sufficient for accurate diagnostic quality of PET. These results have to be validated in larger clinical studies.

CLINICAL RELEVANCE/APPLICATION
Reduced tracer doses will result in lower diagnostic radiation exposure in pediatric patients. Variation of PET acquisition times may enable further reduction of tracer doses.

POURPOSE
Whole body MR imaging has been frequently used for the management of children with acute myeloid leukemia (AML) because it can provide additional information besides bone marrow evaluation. In this regard, we assess the use of the whole body magnetic resonance (MR) imaging in the management of the children with AML to validate its usefulness.

METHOD AND MATERIALS
Sixty nine whole body MR scans of 40 consecutive pediatric patients with AML were evaluated by two radiologists in consensus. Whole body MR imaging was acquired for the following purposes: work-up for initial diagnosis, work-up for relapsed AML, work-up for stem cell transplant, work-up for a new sign or symptom, or follow-up of pre-existing abnormality. We estimated the presence of abnormal findings including extramedullary granulocytic sarcoma (EGS), clinically occult lesions, and lesions explaining the patient’s clinical symptoms, except the bone marrow involvement by AML.

RESULTS
Total 76 EGSs were identified in eleven of 40 patients (27.5 %). Nine of eleven patients (81.8%) had multiple EGSs. Thirty eight EGSs were incidentally detected on 9 whole body MR scans in seven patients (17.5 %). Positive findings were most commonly observed on whole body MR scans performed as work-up for a new sign or symptom (14 of 15 MR scans, 93.3%). Six clinically occult non-EGS lesions found on whole body MR scans were small intracranial hemorrhage (n=1), bilateral otomastoiditis (n=1), pneumonia (n=1), knee joint inflammation with effusion (n=1) and disseminated infection/inflammation (n=2). Multiple lesions at anatomically distant regions were successfully evaluated with 18 whole body MR scans (26.1%) in a single session head-to-toe imaging.

CONCLUSION
Whole body MR imaging could be helpful to detect multiple EGSs or clinically occult lesions and be used as a problem solving tool in children with a new sign or symptom by AML in a single session study.

CLINICAL RELEVANCE/APPLICATION
Whole body MR imaging is a useful imaging modality in management of the pediatric AML patients considering tendency for multiplicity of EGSs and prevalent occult lesions as well as the intrinsic advantages of whole body MR imaging.

POURPOSE
To find optimal tracer dose regimes for pediatric whole-body 18F-FDG-PET/MRI with minimal radiation exposure and sufficient diagnostic quality.

METHOD AND MATERIALS
Whole-body PET data sets of 30 pediatric patients (14 female, mean age 12±6 [1-18] years) were retrospectively analyzed. PET data were acquired in list mode on a combined PET/MR scanner (Biograph mMR, Siemens) 65±14 min after injection of 3.1±0.5 MBq 18F-FDG per kg bw for 4 min per bed position. Based on the acquired list mode data, PET images of lower tracer doses (0.25 to 2.5 MBq/kg bw 18F-FDG) were simulated by retrospective undersampling of PET list mode data. Resulting data sets were analyzed quantitatively by measurement of standardized uptake values (SUVs) in healthy organs (liver, lungs, blood pool) and pathologic lesions by volume-of-interest (VOI) analysis. Qualitative analysis was performed independently by two readers experienced in pediatric nuclear medicine. To this end, PET-data sets were analyzed beginning with the lowest simulated tracer dose (0.25 MBq/kg bw) and gradually increasing tracer doses up to the original acquired PET image. Conspicuity of organ structures (such as brain, thymus, muscle, heart etc.) and detectability of focal PET lesions were recorded and finally compared to the original full-dose data set.

RESULTS
Image quality steadily improved with increasing simulated tracer doses. SUVs showed higher relative deviations of about 10 % at tracer doses below 1 MBq/kg bw. Conspicuity of physiologic organ structures improved steadily with increasing simulated tracer doses and was equivalent with the original acquired PET data set at simulated doses of 1-1.5 MBq/kg bw. Detectability of focal PET lesions increased continuously with increasing simulated tracer doses; all focal lesion that were detectable in the original full-dose PET were already detectable at 1.5 MBq/kg bw.

CONCLUSION
Tracer doses can be significantly reduced in pediatric PET/MRI compared to existing standard regimes. Our results suggest that doses of 1.5 MBq/kg bw FDG are sufficient for accurate diagnostic quality of PET. These results have to be validated in larger clinical studies.

CLINICAL RELEVANCE/APPLICATION
Reduced tracer doses will result in lower diagnostic radiation exposure in pediatric patients. Variation of PET acquisition times may enable further reduction of tracer doses.
RC513-08 Whole Body Imaging in Pediatric Oncology

Participants
Stephan Voss, MD, PhD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The participant should understand the various whole body multi-modality imaging techniques used in Pediatric Oncology.
2) The participant should be able to discuss strategies and opportunities for radiation dose reduction when performing multi-modality whole body examinations.
3) The audience should understand the appropriate indications for whole body imaging in pediatric oncology, including the role of whole body imaging in tumor surveillance and evaluation of patients with cancer predisposition syndromes.

RC513-09 Neuroblastoma - Imaging and Therapy Update

Participants
Adina L. Alazraki, MD, Atlanta, GA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify the common indications for I-131 MIBG in pediatric patients.
2) Describe the necessary considerations for pediatric patients prior to I-131 MIBG therapy.
3) Discuss imaging protocols and typical pre and post therapy imaging appearance as part of monitoring of response to therapy.

RC513-10 PET/MR Imaging in Pediatric Sarcomas and Malignant Soft Tissue Tumors: Is There a Clinical Impact?

Participants
Juergen F. Schaefer, MD, Tuebingen, Germany (Presenter) Nothing to Disclose
Sergios Gatidis, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Ilias Tsiflikas, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Guido Seitz, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Martin Ebinger, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Christian la Fougere, Munich, Germany (Abstract Co-Author) Nothing to Disclose
Matthias Reimold, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Nina Schwenzer, MD, Tuebingen, Germany (Abstract Co-Author) Nothing to Disclose
Konstantin Nikolau, MD, Tuebingen, Germany (Abstract Co-Author) Speakers Bureau, Siemens AG Speakers Bureau, Bracco Group Speakers Bureau, Bayer AG

PURPOSE
To evaluate the clinical impact of PET/MRI in pediatric sarcomas and malignant soft tissue tumors.

METHOD AND MATERIALS
43 examinations in 30 patients (11 female, mean age 11.1 y ± 5.4 y) with diagnoses of Ewing sarcoma (n=6), osteosarcoma (n=4), rhabdomyosarcoma (n=6), NF 1 suspected for MPNST (n=9), others (n=5) were included. Written informed consent was obtained. Two protocols were performed: In group A, 11 examinations were carried out using PET/CT (Biograph mCT, Siemens) and PET/MRI (Biograph mMR, Siemens). Data were acquired on the same day after administration of 161±88 MBq 18F-FDG. In group B, 32 examinations were performed using PET/MRI only, after administration of 114±67 MBq 18F-FDG. Additionally, if indicated an additional low dose chest CT was carried out. In Group A, image analysis was performed by two experienced rater teams blinded for the respective different modality. In group B, image analysis was performed by an experienced rater team: first MRI followed by PET-MRI. Histopathology and follow-up served as reference standard. Findings of PET/MRI were reevaluated by the institutional pediatric tumor board regarding further clinical management (e.g. change of diagnostic or therapeutic regime).

RESULTS
Group A: The rate of focal uptake on PET/MRI was equivalent to PET/CT (52 vs. 53). Local staging (4/11), anatomic allocation (2/11) and relevant additional findings were improved by MRI. Group B: Findings of PET/MRI affecting clinical management were found in 8/32 examinations (e.g. change of surgical approach or no additional radiation). Compared to chest CT, PET/MRI detected equal numbers of metastases in 5 patients and lower numbers in 5 patients. MRI was negative in 4 patients with nodules smaller than 4 mm who had no evidence of metastases in follow-up. There was no evidence of pulmonary metastasis in 16 patients.

CONCLUSION
Simultaneous PET/MRI in pediatric sarcomas allows a comprehensive diagnostic for both, local and systemic tumor spread. PET/MR substantially affected the clinical management. The lower detection rate of small pulmonary nodules by MRI needs to be discussed with respect to clinical importance.

CLINICAL RELEVANCE/APPLICATION
PET/MRI improves the clinical management in pediatric soft tissue tumors and both, local and systemic staging is possible in a single approach.

RCS13-11  Brain Exams in Pediatric Epilepsy: PET/MRI Compared to PET/CT

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S102AB

Participants
Matthew Goette, PhD, Houston, TX (Presenter) Support, Koninklijke Philips NV
Erica Yang, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Nadia F. Mahmood, MD, Sugar Land, TX (Abstract Co-Author) Nothing to Disclose
Jeremy Y. Jones, MD, Bellaire, TX (Abstract Co-Author) Nothing to Disclose
Wei Zhang, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Victor J. Seghers, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Andrew Sher, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Michael J. Paldino, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE
PET/MR offers the potential for diverse image contrasts in a single examination. To reach its full potential, this technology will require robust attenuation correction (AC) algorithms. The goal of this study was to compare the diagnostic accuracy of FDG-PET images of the brain processed according to MR-based AC (MRAC) with that of images obtained using traditional CT-based AC (CTAC).

METHOD AND MATERIALS
IRB approval and informed consent were obtained for this study. All patients referred for clinical FDG-PET/CT exams of the brain were prospectively recruited to undergo an additional FDG-PET acquisition on a Philips Ingenuity PET/MR system. A bootstrap power calculation was used to determine the number of patients required to detect a 10% difference in diagnostic accuracy (power: 0.8). Raw FDG-PET images were processed according to vendor-provided MRAC or CTAC algorithms. Five expert readers were blinded to the method of AC and all other clinical/imaging data. Consensus between readers at unblinded re-review of all data was considered the gold standard. Any potential difference in the accuracy of PET/MR compared to PET/CT was assessed using McNemar's test. Cohen's kappa was calculated to measure agreement between each reader's interpretation of MRAC and CTAC.

RESULTS
The study population comprised 35 patients referred for a diagnosis of epilepsy (mean age: 11y; range: 2-18y), with a paired PET/CT and PET/MR exam. Compared to the reference gold standard, the overall sensitivity (71.6% and 70.2%, p>0.05) and specificity (74.7% and 85.1%, p>0.05) of the blinded interpretation of the PET/MR and PET/CT images, respectively, demonstrated no significant difference. The accuracy of MRAC-processed images did not differ significantly from those obtained using CTAC (74.7% and 76.6%, respectively, p>0.3). Overall, there was good intra-reader agreement between the interpretation of PET/MR and PET/CT (κ range: 0.55-0.78).

CONCLUSION
The accuracy of FDG-PET images generated by an MRAC algorithm was comparable to that of FDG-PET images processed by traditional CTAC. These results further support the use of integrated PET/MR systems in clinical practice.
**CLINICAL RELEVANCE/APPLICATION**
The evaluation of pediatric brain exams for the diagnosis of epilepsy using PET/MR demonstrated no statistical difference in sensitivity, specificity, or accuracy compared to PET/CT, and support the use of PET/MR in patient management with lower radiation dose.

**RC513-12 What is the Optimal Way to Measure Neuroblastoma Response to Chemotherapy?**

**Participants**
Lindsey R. Klingbeil, MD, Cincinnati, OH (Presenter) Nothing to Disclose
Andrew T. Trout, MD, Cincinnati, OH (Abstract Co-Author) Advisory Board, Koninklijke Philips NV
Alex Towbin, MD, Cincinnati, OH (Abstract Co-Author) Author, Reed Elsevier; Consultant, Reed Elsevier; Shareholder, Merge Healthcare Incorporated; Consultant, Guerbet SA; Grant, Guerbet SA
Daniel von Allmen, MD, Cincinnati, OH (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The current recommendation for determining primary neuroblastoma tumor size and response to chemotherapy is to use 3D (anteroposterior, transverse, craniocaudal) measurements. This is in contrast to the 1D measurements recommended in RECIST 1.1 and the 2D measurements recommended for Hodgkin lymphoma. There is little evidence specific to neuroblastoma to show superiority of one measurement technique. The purpose of this study was to assess the correlation between the various measurement methods and actual tumor volume in terms of response assessment.

**METHOD AND MATERIALS**
We retrospectively analyzed the radiographic data of intermediate and high-risk neuroblastoma patients with either Stage 3 or 4 disease who were diagnosed between 2003 and 2012. Primary tumors were measured in 1D, 2D and 3D at the time of diagnosis and following chemotherapy with 2D and 3D measurements expressed as a product. True tumor volume at each time point was also measured using manual segmentation of the tumor. Tumor response for each measurement method was expressed in terms of a fraction of tumor size at diagnosis. Comparisons were based on Bland-Altman analyses with agreement expressed in terms of correlation coefficients.

**RESULTS**
Imaging from 34 patients was included in the study with comparison of tumor response to true volumes for 50 1D, 50 2D, and 39 3D measurements. A statistically significant correlation was seen between both the 2D (p<0.05) and the 3D (p<0.01) measurements and the volumetric method of tumor response assessments with the best correlation (r=0.47 versus 0.31) for the 3D measurements. 1D measurements had poor correlation with the volumetric response assessment (r=0.04). The mean difference in tumor response relative to volumetric assessment was higher for 2D measurements than 3D measurements (19% ±16% versus 10%±15%).

**CONCLUSION**
Correlation between single and multiplanar measurements and true tumor volume for assessment of neuroblastoma response to therapy is moderate at best likely reflecting the irregular shape and infiltrative character of these tumors. 3D measurements had the highest correlation with volumetric assessments but may over- or underestimate tumor response by 40%.

**CLINICAL RELEVANCE/APPLICATION**
Accurately determining the primary tumor response to chemotherapy using imaging is critical for making therapeutic decisions and surgical planning for neuroblastoma patients.

**Honored Educators**
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Alex Towbin, MD - 2014 Honored Educator

**RC513-13 Evaluation of the Predictive Value of Doppler Ultrasonography in Children with Clinically Suspicious Hepatic Veno-occlusive Disease after Hematopoietic Stem Cell Transplantation**

**Participants**
Ji-Eun Park, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Young Hun Choi, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyun Suk Cho, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yu Jin Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Jung-Eun Cheon, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Woo Sun Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
In-One Kim, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To evaluate the predictive value of Doppler ultrasonography in children with clinically suspicious hepatic veno-occlusive disease (VOD) after hematopoietic stem cell transplantation (HSCT).

**METHOD AND MATERIALS**
From January 2012 to January 2015, among 216 children who underwent HSCT, 56 children underwent Doppler ultrasonography for clinical suspicion of hepatic VOD (M:F = 22:34; mean age, 8.3years; age range 8months-20years). Among 56 patients, fifteen patients were confirmed as having VOD later (VOD group), while 41 patients turned out to have other conditions (acute graft-
versus-host disease, n=10; cytomegalovirus hepatitis, n=4; other virus hepatitis, n=6; aspergillosis, n=3; unrevealed cause, n=18; non-VOD group). Doppler ultrasonography was retrospectively reviewed for the following findings: hepatomegaly, splenomegaly, gall bladder(GB) wall edema, ascites, Doppler spectral parameters of the left portal vein (peak velocity, trough velocity, pulsatile index, flow inversion), Doppler spectral parameters of the left hepatic artery (peak systolic velocity, end systolic velocity, resistance index) and phasicity of the middle hepatic vein. The Doppler US findings were compared between two groups using Student t-test, Chi square test. Multivariate logistic regression was performed to reveal the significant predictor of VOD.

**RESULTS**

The VOD group showed significantly higher incidences of hepatomegaly (9/15, 60% vs. 10/41, 24%, p=0.016), GB wall edema (9/12, 80% vs. 9/41, 22%, p < 0.001) and ascites (12/15, 80% vs. 9/41, 22%, p < 0.001), relative to the non-VOD group. The peak systolic velocity of the left hepatic artery was significantly higher in VOD patients compared with non-VOD patients (73±33cm/sec vs. 49±21cm/sec, p=0.002). Other findings showed no statistically significant difference between the two groups. Multivariate analysis revealed that only ascites was significantly associated with VOD (ß=0.345).

**CONCLUSION**

The presence of hepatomegaly, GB wall edema, ascites and increased peak systolic velocity of the hepatic artery were significantly associated with progression to definite VOD in pediatric HSCT patients with clinically suspicious VOD.

**CLINICAL RELEVANCE/APPLICATION**

Hepatic VOD is one of the most feared complications of HSCT. Our study identified Doppler ultrasonographic findings that could be helpful in predicting progression to definite VOD.

**PURPOSE**

to evaluate the diagnostic accuracy of conventional MR imaging in detecting tumor invasion of intraocular retinoblastoma and to correlate ADC values with high-risk pathological prognostic parameters of retinoblastoma.

**METHOD AND MATERIALS**

The accuracy of MR imaging in detecting invasion extent of 63 tumors were determined. Furthermore, ADC value with b factors of 0 and 1000 seconds/mm2 were calculated and correlated with high risk pathological prognostic parameters. Additionally, the correlation of Ki-67 expression with ADC value were analysed.

**RESULTS**

The accuracy of conventional MRI in detecting prelaminar and postlaminar optic nerve invasion was 85.7%, focal and massive choroidal invasion 61.9%, scleral invasion 98.4% and ciliary body invasion was 95.2%. The ADC value of well-differentiated retinoblastoma were significantly different from poorly or undifferentiated tumors (p < 0.002). There was no significant difference in the ADC value between bilateral and unilateral retinoblastomas (P=0.09) and different growth pattern (P=0.74). The ADC value of postlaminar optic nerve invasion has significantly different with no optic nerve invasion (P=0.04). There was significant difference in the ADC of retinoblastoma with or without scleral invasion (P=0.007), but has no difference in choroidal invasion (P=0.629) or ciliary body invasion (P=0.532). Additionally, the ki-67 index was inversely correlated with the ADC value (p < 0.002).

**CONCLUSION**

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, where ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

**CLINICAL RELEVANCE/APPLICATION**

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, whereas ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

**ABSTRACT**

**RC513-14 Correlation between Diffusion-weighted Imaging Combined with Conventional Magnetic Resonance Imaging Parameters and Histopathologic Findings in Eyes Primarily Enucleated for Advanced Retinoblastoma: A Retrospective Study**

**Wednesday, Dec. 2 11:30AM - 11:40AM Location: S102AB**

**Awards**

**Trainee Research Prize - Medical Student**

**Participants**

Yanfen Cui, Shanghai, China (**Presenter**) Nothing to Disclose
Dengbin Wang, Shanghai, China (**Abstract Co-Author**) Nothing to Disclose
Huanhuan Liu, Shanghai, China (**Abstract Co-Author**) Nothing to Disclose
Caiyuan Zhang, MD, Shanghai, China (**Abstract Co-Author**) Nothing to Disclose

**ABSTRACT**

**PURPOSE**

to evaluate the diagnostic accuracy of conventional MR imaging in detecting tumor invasion of intraocular retinoblastoma and to correlate ADC values with high-risk pathological prognostic parameters of retinoblastoma.

**METHOD AND MATERIALS**

The accuracy of MR imaging in detecting invasion extent of 63 tumors were determined. Furthermore, ADC value with b factors of 0 and 1000 seconds/mm2 were calculated and correlated with high risk pathological prognostic parameters. Additionally, the correlation of Ki-67 expression with ADC value were analysed.

**RESULTS**

The accuracy of conventional MRI in detecting prelaminar and postlaminar optic nerve invasion was 85.7%, focal and massive choroidal invasion 61.9%, scleral invasion 98.4% and ciliary body invasion was 95.2%. The ADC value of well-differentiated retinoblastoma were significantly different from poorly or undifferentiated tumors (p < 0.002). There was no significant difference in the ADC value between bilateral and unilateral retinoblastomas (P=0.09) and different growth pattern (P=0.74). The ADC value of postlaminar optic nerve invasion has significantly different with no optic nerve invasion (P=0.04). There was significant difference in the ADC of retinoblastoma with or without scleral invasion (P=0.007), but has no difference in choroidal invasion (P=0.629) or ciliary body invasion (P=0.532). Additionally, the ki-67 index was inversely correlated with the ADC value (p < 0.002).

**CONCLUSION**

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, where ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

**CLINICAL RELEVANCE/APPLICATION**

Routine MRI has limitations in reliably predicting microscopic infiltration of the retinoblastoma, whereas ADC correlated well with high-risk pathological prognostic parameters and Ki-67 index for retinoblastoma and may serve as a noninvasive prognostic parameter for assessment of newly diagnosed retinoblastoma.

**ABSTRACT**

**RC513-15 Imaging of Tumor Syndromes**

**Wednesday, Dec. 2 11:40AM - 12:00PM Location: S102AB**

**Participants**

Andrew T. Trout, MD, Cincinnati, OH, (andrew.trout@cchmc.org) (**Presenter**) Advisory Board, Koninklijke Philips NV

**LEARNING OBJECTIVES**

1) Recognize some of the tumor predisposition syndromes that present in children/young adults. 2) Name the relevant tumors for the discussed syndromes. 3) Implement currently accepted imaging protocols for the discussed syndromes.
Participants
Anca L. Grosu, MD, Freiburg, Germany (Moderator) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand challenges of morphological radiological investigations for the detection and characterization of tumor biology and the timely assessment of tumor response in clinical cancer therapy and in clinical trials testing new therapy regimens. 2) To understand the role and the potential of functional and molecular imaging modalities and techniques used a. prior to therapy for tumor delineation and targeting, b. during cytotoxic therapy, such as radiation and chemotherapy for intra-treatment tumor response monitoring, and c.) after cytotoxic therapy for response assessment. 3) To apply and integrate imaging modalities into the therapeutic management of cancer. 4) To review the role of imaging as predictors of tumor control and survival and their emerging role as short-term surrogate markers for long-term therapeutic outcome of cancer treatment regimens and its potential for adaptive therapy.

Sub-Events

RCS20A Imaging Surrogate Markers in CNS Tumors

Participants
Anca L. Grosu, MD, Freiburg, Germany (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

ABSTRACT

RCS20B Imaging Surrogate Markers in Pelvic Tumors

Participants
Nina A. Mayr, MD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCS20C Imaging Surrogate Markers in Lung Tumors

Participants
Meng X. Welliver, MD, Columbus, OH (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
View learning objectives under main course title.

RCS20D Imaging Surrogate Markers in Head and Neck Cancer

Participants
Min Yao, MD, PhD, Cleveland, OH (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Prognostic indications of FDG PET in head and neck cancer. 2) How to use FDG PET in radiation treatment planning in head and neck cancer. 3) Further treatment decision based on PET. 4) Future prospectives including potential new tracers.
Personalized Medicine: Head and Neck
Wednesday, Dec. 2 8:30AM - 10:00AM Location: S102D

Participants
Kristy K. Brock, PhD, Ann Arbor, MI (Moderator) License agreement, RaySearch Laboratories AB;

LEARNING OBJECTIVES
1) Describe the evolution of adaptive radiotherapy and relevant technological advances as they pertain to head and neck radiotherapy. 2) Understand the clinical rational for of plan adaptation in the head and neck patient population. 3) Describe possible routes to clinical implementation. 4) Discuss risks associated with adaptive planning workflows and appropriate quality assurance.

ABSTRACT
This session will focus on the practical implementation of adaptive radiotherapy for head and neck cancer. Although the concept of adaptive radiation therapy (ART) has been around for more than two decades, routine plan adaptation has not become standard practice in the management of head and neck cancer despite huge technological advances in imaging, image registration software, and dose calculation speed. The remaining challenges in implementing ART for head and neck cancer in 2015 as well as an update of the demonstrated clinical need will be discussed. Features of successful adaptive radiotherapy implementations will be highlighted as well as a summary of useful clinical tools and required quality assurance.

Participants
Emilie Soisson, PhD, Montreal, QC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To learn about appropriate anatomical and imaging modalities for selection and delineation of target volumes in HN. 2) To learn about biologically conformal approaches (dose painting) in HN. 3) To learn about quantitative imaging requirements for RT in HN.

ABSTRACT
Anatomical and molecular imaging is used to tailor radiation treatment by enabling proper selection and delineation of target volumes and organs, which in turn lead to dose prescriptions that take into account the underlying tumor biology. Dose modulation to different parts of target volume may also be used to match variable tumor radiosensitivity (so-called biologically conformal radiotherapy or dose-painting). For accurate implementation of targeted and adaptive IMRT, tools and procedures, such as accurate image acquisition and reconstruction, automatic segmentation of target volumes and organs at risk, non-rigid image and dose registration, and dose summation methods, need to be developed and properly validated.
Purpose/Objective(s): The optimal radiation schedule for the curative treatment of prostate cancer remains unknown. Prostate cancer patients receiving definitive external beam radiation therapy (EBRT) are typically treated 5 days per week for 7-9 weeks. This prolongation of treatment time increases healthcare costs and is less convenient for patients. There is data supporting the notion that the a/ß ratio for prostate cancer cells is between 1 and 3, suggesting a clinical benefit to hypofractionation. We therefore conducted a Phase I dose escalation trial in men with low to low-intermediate risk prostate adenocarcinoma.

Materials/Methods: All men with clinical T1-2c, Gleason Score (GS) 6, prostate cancer with a prostatic specific antigen (PSA) less than 10 ng/dL were eligible for this trial. Men with clinical T1-2c, GS 7 prostate cancer and/or PSA 10 - 20 ng/dL were included provided the biopsy demonstrated low volume disease (Results: From June, 2012 to December, 2014, 9 patients were accrued to the three dose cohorts with a median follow-up of 11 months (range: 2 – 30). Patients had a median age of 63, pre-treatment PSA of 4.9 ng/dL, and pre-treatment AUA score of 10. Four patients had a GS of 7. The maximum tolerated dose (MTD) was 57.6 Gy with all patients completing treatment with less than or equal to grade 2 maximum gastrointestinal, genitourinary, dermatologic or fatigue related toxicity (Table 1). Six patients have at least 1 PSA post-treatment (3 months after completion) with a median PSA decrease of 65%. One patient of the six with > 11 month follow-up had grade 2 rectal telangiectasia requiring minor endoscopic cautery. The remaining 5 patients had no grade 2 toxicity thus far. Conclusion: All three dose levels were well tolerated with no MTD identified. Further follow-up is warranted for long term toxicity and efficacy. Table 1: Acute toxicity in patients undergoing hypofractionated radiation. Grade of Toxicity: CTCAE v. 4.0Dose Level 154 Gy/ 18 Fxn = 3Dose Level 255.8 Gy/ 18 Fxn = 3Dose Level 357.6 Gy/ 18 Fxn = 3Dose

ABSTRACT
Purpose/Objective(s): The unique radiobiology of prostate cancer supports a hypofractionated as opposed to a conventionally fractionated dose regimen with a potential for improved outcomes and reduced toxicities. We report on our continued experience using a robotic linear accelerator to deliver stereotactic body radiation therapy for localized prostate cancer.

Materials/Methods: From April 2006 through December 2014, a total of 1207 patients with localized carcinoma of the prostate were treated with robotic stereotactic body radiation therapy at a single institution. All patients had T1c to T2b disease. 493 patients had low risk disease. 548 patients had intermediate risk disease. 166 patients had high risk disease. Pretreatment PSA ranged from .77 to 205. 126 patients received hormonal therapy prior to treatment at the discretion of their urologist. Treatment planning was done with CT scans fused with an MRI scan except in 31 cases where an MRI scan could not be done for medical reasons such as a pacemaker. Dose was prescribed to the 83% to 87% line, 5 mm beyond the capsule except posteriorly 3 mm. 1037 patients with low and intermediate risk disease received CyberKnife only to a dose of 3500 to 3625 cGy over 5 fractions. All patients received 1500 mg of amifostine intrarectally 50 minutes prior to each treatment fraction.Results: The median initial PSA was 6.2. The median follow-up was 33 months. The median post treatment PSA is 0.35. At the time of last follow-up, 12 patients have had a PSA failure by Phoenix biochemical definition. 1 patient with low risk disease failed. 7 patients with intermediate risk disease failed and 4 patients with high risk disease failed. There were 136 patients with a minimum follow up of at least 36 months and 56 patients with a minimum follow up of at least 48 months. There are 26 patients with a minimum follow up of 60 months. 272 patients achieved a PSA below 0.2 and 413 patients reached a PSA below 0.4. The median treatment PSA at 12 months is 0.90. The median PSA at 24 months is 0.45. The median PSA at 36 months is 0.40. the median PSA at 48 months is 0.25. The median treatment PSA at 60 months is 0.20. With a median follow up of 33 months, the biochemical disease free survival for low risk, intermediate risk, and high risk was 99.7%, 98.7%, and 97.5% respectively. 2 patients had symptomatic hematuria which resolved with hyperbaric oxygen. 2 patients required green light laser for urinary retention. 1 patient has required catheterization. 3 patients had rectal bleeding which resolved with rowasa enemas and hyperbaric oxygen.Conclusion: Stereotactic body radiation therapy using a robotic linear accelerator continues to be extremely well tolerated and efficacious in the management of localized prostate cancer. High rates of local control can be achieved while also achieving low rates of bladder and rectal toxicity. This study confirms prior reported series with a larger number of patients.

**MSRO42-04 The Effect of Radiation Timing on PSA Reduction in High Risk Prostate Cancer Patients Treated with Definitive Radiation Therapy**

Wednesday, Dec. 2 11:00AM - 11:10AM Location: S103CD

Participants
- Apar Gupta, Boston, MA (Presenter) Nothing to Disclose
- Steven Vemali, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Ankit Agarwal, BS, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Muhammad M. Qureshi, MBBS, MPH, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Alexander E. Rand, BA, Boston, MA (Abstract Co-Author) Nothing to Disclose
- Ariel E. Hirsch, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): We previously found that neither time to treatment (TTT) nor elapsed time of treatment (ETT) had any effect on PSA velocity in patients with low- and intermediate-risk prostate cancer. In this analysis, we sought to examine the effects of TTT and ETT on PSA change in patients with high-risk prostate cancer.

Materials/Methods: We performed a retrospective review of 1,584 patients who were diagnosed with prostate cancer at our institution between January 2005 and December 2013, and found 412 patients with non-metastatic disease who completed treatment with definitive external beam radiation therapy (EBRT). A total of 146 patients who also received concurrent androgen-deprivation therapy (ADT) were included in the analysis. TTT was calculated as days between positive prostate biopsy and EBRT start date, and ETT was calculated as days between EBRT start and stop date. Demographic data on race/ethnicity, primary language spoken, insurance status, marital status, and age were also collected. Analysis of variance was performed to analyze the relationship of these factors with absolute and percentage change in pre- and post-EBRT PSA levels. Data were analyzed using a 0.05 level of significance.

Results: Median age at diagnosis was 67 years (range 50-85 years); 11% had a Gleason score (GS) of 6, 49% GS 7, and 40% GS 8-10. Median TTT was 134 days and median ETT was 62 days. No demographic variable was found to be significantly related to absolute or percentage change in PSA. No optimal threshold of days from diagnosis to treatment (TTT) was identified to predict change in PSA level. ETT was significantly related to PSA change, after adjusting for demographic variables. Those who fell in the upper quartile of ETT (>64 days) were found to have a 94.2% decline in PSA, compared to 98.0% for those who fell in the lower three quartiles (p=0.03). Conclusion: A delay in treatment prior to starting EBRT did not have an effect on post-EBRT PSA level, relative to initial PSA level. However, a delay during EBRT was related to a lesser reduction in PSA decline. Further research is warranted in this area to elucidate the clinical significance of differences in PSA reduction.

**MSRO42-05 Patient Inversion Therapy for Bowl (PI TB) to Achieve Maximum Displacement in Radiotherapy for Prostate Cancer**

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S103CD

Participants
- Gordon L. Grado, MD, PhD, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
- David Constantinescu, Charleston, IL (Presenter) Nothing to Disclose
- Scott Thompson, CMD, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
- Carrie S. Petrone, RN, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
- Mary M. Grado, BSN, MS, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
- Michael C. Grado, BA, Scottsdale, AZ (Abstract Co-Author) Nothing to Disclose
- Thayne Larson, MD, Scottsdale, AZ (Abstract Co-Author) Research Consultant, NxThera, Inc

**PURPOSE**

The purpose of this study was to evaluate a new and novel approach to the valuation and reduction of small bowel volume from the irradiated fields in the treatment of prostate cancer. This technique utilizes inversion therapy to either completely displace small or large bowel from the irradiated field or to significantly reduce the volume of bowel irradiated in the PTV. This procedure has potential application in multiple areas of abdominal and pelvic radiation therapy.

**METHOD AND MATERIALS**
Between January 2014 and March 2015, 14 consecutive patients were identified where small or large bowel was directly within the irradiated PTV. Patients were evaluated with bladder distention, patient positioning, and inversion therapy to displace bowel from the irradiated PTV. Inversion therapy had the greatest effect in displacing and maintaining displacement of bowel from the irradiated volume. Several inversion tables were evaluated prior to the procedure and the two safest devices with the most clinical experience for inversion therapy were selected for this trial. Dose volume histograms were compared with and without inversion.

RESULTS

Patients were identified with loops of bowel directly within the radiated field due to previous surgery or anatomy. Standard techniques for bowel displacement (patient positioning, bladder distention, belly-board), were ineffective at displacing sufficient bowel from the irradiated volume to affect greater radiation dose delivery. Inversion therapy was selected for bowel displacement which when combined with bladder distention maintained the displacement during the course of radiation therapy. 13/14 patients were found to have sufficient bowel displacement to allow greater radiation dose delivery to the PTV without compromising field size or prescribed dose. 1/14 patients did not benefit from this technique.

CONCLUSION

Patient inversion therapy for bowel (PITB) achieved excellent bowel displacement for radiation therapy to the pelvis. In these patients, neither the radiation therapy field nor the prescribed dose had to be compromised. Patients also had fewer bowel and bladder symptoms during the pelvic radiation therapy. This technique is determined to be useful, easily applicable, and well tolerated by patients.

CLINICAL RELEVANCE/APPLICATION

This procedure permits higher radiation therapy dose delivery to the PTV with fewer side effects and morbidity due to less small/large bowel volume irradiated.

MSRO42-06 Institutional Experience of Long-term (10-15 Years) Results with High Dose Rate (HDR) Salvage Therapy for Recurrent Prostate Cancer

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S103CD

Participants

Nevinne M. Hanna, MD, Sandy, UT (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Limited treatments are available for recurrent prostate cancer patients. Modality selection can be challenging for both the patient and their physicians. HDR brachytherapy has been used extensively as a boost after external beam radiation therapy, but is increasingly being tested as salvage treatment for locally recurrent prostate cancer. We report our long-term results for HDR salvage brachytherapy in patients with initially low, intermediate, and high-risk prostate cancer.

Materials/Methods: Patients (n=27) with a median age of 71 (37-84) years at recurrence with low- (n=10), intermediate- (n=8), and high-risk prostate cancer (n=9) treated at the California Endocurietherapy (CET now at UCLA) between 1991 and 2009 were analyzed. Median HDR brachytherapy dose prescription was 36 (22-46) Gy in 6 (3-8) fractions. Five patients did receive additional external beam radiation therapy (EBRT) after HDR brachytherapy to an EBRT dose of 36 (36-50) Gy. Presenting disease characteristics were median recurrent PSA 8.1 (1.4-86.7) ng/mL, Gleason Score 7 (5-10), median prostate volume 23.2 (0-80) cc. Androgen deprivation therapy (ADT) was administered in 68% for a median of 6 (3-96) months. Risk groups were defined according to the NCCN guidelines. Sustained PSA nadir+2 was used to define biochemical relapse. Statistical analyses being performed are to include Kaplan-Meier analyses and univariate and multivariate Cox proportional analyses.

Results: Preliminary analysis shows that the median overall follow-up time was 6.90 (0.30-15.92) years. The 5, 10 and 15 year overall survival (OS) rates were 86%, 36% and 11%, respectively. The 5, 10 and 15 year distant metastases-free survival (DMFS) rates were 68%, 29% and 11%, respectively. Biochemical progression free survival (BPFS) for the initially presenting low, intermediate and high grade patients is 122, 59, and 41 months, respectively. On univariate analyses, BPFS after salvage HDR was most significantly impacted by PSA at recurrent disease (p=0.007) but not significantly affected by risk group at initial diagnosis (P>0.05). Univariate Cox analyses and multivariate analyses are currently underway to determine the impact of ADT on these parameters. Conclusion: Our long-term results validate HDR salvage brachytherapy in recurrent prostate cancer patients as a standard treatment option which offers excellent rates of disease control.

MSRO42-07 Designing and Implementing an Innovative Phantom-Based Simulator Training Program for Prostate Brachytherapy Using Advanced Magnetic Resonance Imaging

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S103CD

Awards

Trainee Research Prize - Resident

Participants

Nikhil G. Thaker, MD, Houston, TX (Presenter) Nothing to Disclose
Tze Yee Lim, Houston, TX (Abstract Co-Author) Nothing to Disclose
Rajat Kudchadker, Houston, TX (Abstract Co-Author) Nothing to Disclose
Tharakeswara K. Bathala, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Thomas Pugh, Houston, TX (Abstract Co-Author) Nothing to Disclose
Usama Mahmoud, Houston, TX (Abstract Co-Author) Nothing to Disclose
Deborah A. Kuhan, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Teresa Bruno, Houston, TX (Abstract Co-Author) Nothing to Disclose
Jihong Wang, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
R. Jason Stafford, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Thomas A. Buchholz, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
S J. Frank, MD, Houston, TX (Abstract Co-Author) Board Member, C4 Imaging LLC; Stockholder, C4 Imaging LLC; Advisory Board, Elekta AB

PURPOSE

Prostate brachytherapy (PB) is a well-established treatment for localized prostate cancer and has the potential to deliver excellent
outcomes at low cost. However, high-quality PB requires hands-on training and expertise in image-guidance, which is minimally emphasized in current radiation oncology training. Additionally, MRI holds promise of improving target delineation over CT imaging. Our objective was to design and implement a unique pilot training program that utilizes advanced MRI and a phantom simulator approach to improve the quality of PB education.

**METHOD AND MATERIALS**

Our existing PB phantom simulator program was adapted to introduce MRI treatment planning and post-implant evaluation. The simulator program emphasized six core areas: patient selection, simulation, treatment planning, implantation, treatment evaluation, and outcome assessment. Trainees in the simulator program were residents, fellows, or physicists. The program utilized the Iodine-125 pre-operative planning technique and a transrectal ultrasound device to implant prostate phantoms. MRI markers were substituted for spacers to allow for visualization.

**RESULTS**

Forty one trainees have completed the phantom simulator program to date. Ten implants were successfully conducted during the MRI-phantom simulator pilot program. MRI 3DT2 CUBE sequence could adequately delineate the prostate, seminal vesicles, rectum and bladder in the CIRS 053MM phantom. Dummy seeds could be well-visualized with post-implant CT scans. However, seed identification on MRI required a learning curve due to the need to identify MRI markers, which flanked each dummy seed (Figure). The MRI markers facilitated detection of up to 97% of seeds in implanted phantoms by identifying the signal voids between MRI markers.

**CONCLUSION**

This proof-of-principle educational curriculum successfully adapted a phantom simulator training program to implement advanced MRI simulation, treatment planning, and post-implant dosimetry. Analysis of implants showed that most organs could be adequately visualized with MRI and that most seeds could be identified with the aid of MRI markers. Phantom-based simulator training programs can provide a valuable educational opportunity to learn the PB process and to learn how to implement advanced image-guidance.

**CLINICAL RELEVANCE/APPLICATION**

Phantom-based simulator training can enhance practical expertise with advanced imaging technology and image-guide therapies.

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**MRSO42-09 Stereotactic Body Radiation Therapy for Primary Lesion of Renal Cell Carcinoma**

**Participants**
Hotaka Nonaka, Chuo, Yamanashi, Japan (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): We assessed the efficacy and toxicity of stereotactic body radiation therapy (SBRT) for primary lesion of renal cell carcinoma (RCC). Materials/Methods: We retrospectively reviewed 9 patients (7 male and 2 female) with stage I RCC treated with SBRT between 2007 and 2014. The diagnosis of RCC was judged according to imaging. The median age was 73 years old (range, 59-79). Three patients had high serum creatinine level before SBRT. Four patients had history of prior contralateral nephrectomy. The median diameter of tumor was 18 mm (range, 9-26). A total dose of 60-70 Gy in 10 fractions was administered at the 95% of planning target volume or internal target volume. Median biologically effective dose was 119 Gy (range 96-119), using an a/ß value of 10 Gy. Overall survival (OS) and local progression-free survival (LPFS) were based on Kaplan Meier estimates. Toxicity was scored according to NCI-CTCAE, version 4.0. Renal disorder was graded by referring to pretreatment renal function. Results: The median follow-up duration after SBRT was 28 months (range, 11-89). Clinical response was partial response (PR) in 5 tumors, stable disease (SD) in 4 tumors. Five tumors with PR has decreased gradually in size for 11-56 months (median, 42) after SBRT. Three patients developed distant metastases. The 2- and 3-year OS rate were 85.7% and 64.3%, respectively (median survival time, 44 months). The 3-year LPFS rate was 100%. In a case of a patient with SD tumor, autopsy was performed at 29 months after SBRT, and it showed almost complete necrosis of tumor tissues with a small amount of viable renal carcinoma cells. Three patients developed Grade 3 chronic kidney disease (CKD), 1 had Grade 2 CKD. All patients with Grade 3 CKD had high serum creatinine level before SBRT. Severe toxicity for other organs at risk was not observed. Conclusion: SBRT for primary lesion of RCC resulted in acceptable LPFS and toxicity. Because of slow tumor response, we need long-term follow up to observe the effect of SBRT for RCC. Multicenter prospective study is mandatory to evaluate true local effect and toxicity and to compare SBRT versus other local treatment modalities for RCC.
SSK17
ISP: Radiation Oncology (Outcomes/Quality of Life I)
Wednesday, Dec. 2 10:30AM - 12:00PM Location: S104A

RO SQ
AMA PRA Category 1 Credits ™: 1.50
ARRT Category A+ Credits: 1.50

Participants
Martin Colman, MD, Houston, TX (Moderator) Nothing to Disclose
James S. Welsh, MD, MS, Batavia, IL (Moderator) Nothing to Disclose

Sub-Events
SSK17-01 Radiation Oncology Keynote Speaker: Perspectives in Breast Cancer
Wednesday, Dec. 2 10:30AM - 10:40AM Location: S104A

Participants
Anna Shapiro, MD, Syracuse, NY (Presenter) Nothing to Disclose

SSK17-02 An Institutional Review of Radiation Doses from Radiological Imaging Procedures in Image-guided Radiotherapy of Cancers
Wednesday, Dec. 2 10:40AM - 10:50AM Location: S104A

Participants
Li Zhou, PhD, Chengdu, China (Abstract Co-Author) Nothing to Disclose
Yibao Zhang, Beijing, China (Abstract Co-Author) Nothing to Disclose
Jun Deng, PhD, New Haven, CT (Presenter) Nothing to Disclose

PURPOSE
To systematically compare radiation doses to organs-at-risk (OARs) between planning CTs and image-guided procedures during image-guided radiotherapy (IGRT) of cancers.

METHOD AND MATERIALS
With IRB approval, 4832 cancer patients who underwent IGRT at our institution between Sep. 2009 and Apr. 2014 were included in this retrospective study. Their gender, age, circumference were collected as well as all the radiological imaging procedures performed, including computed tomography (CT), kilo-voltage portal imaging (kVPI), megavoltage portal imaging (MVPI) and kilo-voltage cone-beam computed tomography (kVCBCT). Correlations between patient's size and organ dose were first established via Monte Carlo dose calculations in patient anatomy, and then used for patient-specific organ dose estimation. The imaging doses to brain, lungs and red bone marrow (RBM) were analyzed.

RESULTS
A total of 142017 imaging procedures were performed on 4832 patients, 5113 of which were CT scans. Regardless of age, average CT doses to brain, lungs and RBM were 0.5, 0.6, 0.6 cGy for males, and 0.5, 0.6, 0.6 cGy for females, accounting for 1.6%, 3.5%, 2.0%, 1.6%, 4.0% and 3.3% of combined dose, respectively. Peaking at 45 cGy, kVPI contributed largest doses to brain, about 47 times of CT doses. In lungs and RBM, average kVPI dose remained higher for most children but decreased below 14 cGy in adults. Unlike kVPI, average MVPI doses to OARs were less than 10 cGy, peaking at 16 cGy in RBM for eldest males. kVCBCT doses were generally 0-8 cGy except for males of 51 years and older who received largest number of scans in pelvis.

CONCLUSION
While CT scans deposited a small portion of radiation doses to cancer patients, image-guided procedures employed in IGRT can contribute up to 50 cGy of cumulative imaging doses to brain, 30 cGy to lungs and 40 cGy to RBM in pediatric patients. This study indicated a pressing need for personalized imaging protocol to maximize clinical benefits of imaging procedures while reducing imaging doses and associated cancer risks.

CLINICAL RELEVANCE/APPLICATION
(dose comparison among imaging procedures) This study reveals a strong need for personalized imaging protocol to maximize clinical benefits of imaging procedures while reducing imaging doses and associated cancer risks.

SSK17-03 Impact of Single Day Multidisciplinary Clinics on the Lead Time from Diagnosis to Initiation of Treatment in Head and Neck Cancers
Wednesday, Dec. 2 10:50AM - 11:00AM Location: S104A

Participants
Raju Vaddepally, Oak Brook, IL (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): We evaluated the impact of single day multidisciplinary clinics (MDC) on the lead time from diagnosis to treatment in head and neck cancers compared with matching patients prior to the implementation of MDC. We also wanted to investigate the relationship of demographic factors to the lead time.

Materials/Methods: We retrospectively analyzed clinical and demographic variables of 310 patient's records collected from head and neck cancer tumor registry at St. Joseph Mercy Hospital, Ann Arbor, from 2007 to 2013. We had 170 cases with in the MDC period compared to 140 prior to the MDC. Results: We excluded 60 cases from our analysis because of missing data; no date of biopsy (N=5), no documentation of first treatment date (N=42)
and tumor resected on the same day of biopsy (N=22). This left 129 cases (76%) in the MDC period and 112 cases (80%) in the Pre-MDC period. Mean age was 63 in both the groups. Frequencies of other demographic factors include males (76% vs 79%), Caucasians (91% vs 88%), married (66% vs 62%) and insurance as Medicare (57% vs 50%), median distance from clinic (22 miles vs 17), in the MDC vs Pre-MDC groups respectively. Most of the cancers were squamous cell carcinomas (88% vs 83%), however, we had more stage 4 disease in MDC (56%) when compared to the Pre-MDC group (41%). To compare the two groups, after adjusting for demographic variables and an interaction between stage and site, we fit a generalized linear regression model. There was no difference in the median number of days from biopsy to definitive treatment between the two groups, (35 MDC vs 33.5 in pre-MDC, p = 0.14). The average number of days from biopsy to definitive treatment was 1.13 times longer, for the MDC group (95% CI: 0.96 to 1.32). Marital status was the only variable statistically significantly related to lead time (p = 0.04). Time to definitive treatment was 0.83 (95% CI: 0.70 to 0.99) times shorter, on average for married vs unmarried patients in both the groups. Post hoc analysis was also done to investigate the association between MDC and time to first radiation dose, where radiation was the first treatment. There were only 78 cases that met these criteria, Pre-MDC (N=37) and MDC (N=41). The negative binomial regression model showed no association of MDC with time to first radiation treatment (median time in days was, 40 in pre-MDC vs 36 in MDC). Time to radiation treatment was 0.91 (95% CI: 0.74 to 1.10) times shorter in the MDC when compared to the pre-MDC group. Conclusion: There was no significant difference in lead time with single day MDC compared to patients Pre-MDC in head & neck cancer patients. However, patients in the MDC group had more advanced cancer, which could reflect more complex work-up and management, resulting in longer lead time. Interestingly, marital status was associated with decrease in lead time in married compared to unmarried patients, in both the groups.

**SSK17-05** A Review of Studies Using Self-reported Measures of Sexual Function among Female Cancer Patients Treated with Radiation Therapy, 2008-2014

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S104A

**Participants**
Anuja Jhingran, MD, Houston, TX (Presenter) Nothing to Disclose

**ABSTRACT**
Purpose/Objective(s): A systematic review was conducted to identify and characterize self-reported sexual function (SF) measures administered to women who had received radiation therapy (RT) for cancer.Materials/Methods: Using 2009 PRISMA guidelines, we searched electronic bibliographic databases for quantitative studies published January 2008-September 2014 that used a self-reported measure of SF, or a quality of life (QOL) measure that contained at least one item pertaining to SF. Of these studies, we selected articles that reported the percentage of females who had received any form of RT. Results: Of 1,487 articles initially identified, 83 met inclusion criteria. The studies originated in 28 different countries with 23% from the U.S.A. Most studies focused on women treated for breast, gynecologic, or colorectal cancer, with the percent of women who had received RT ranging from 7% to 100%. Only 19 articles (23%) provided information about radiation dose, number of fractions, field, or type of RT equipment. SF was assessed with 27 unique self-reported measure, the most common being the EORTC QLQ modules (considered as one measure), the Female Sexual Function Inventory, and the Sexual Function Vaginal Changes Questionnaire. Of the 32 studies designed to compare SF by treatment modality, one-third found no statistically significant difference between RT and other modalities, and 28% found worse SF associated with RT. Only 4 studies reported on interventions to improve SF. Conclusion: The paucity of RT information in the reviewed articles, and the large number of measures used to assess SF limit comparative analysis. Needed are intervention studies with common metrics, preferably dedicated SF measures developed with cancer patients treated with RT. This systematic review will assist radiation oncologists select SF measures and encourage assessment of this quality of life domain in patient care.

**SSK17-06** The Impact of Weight Loss on Set-up Accuracy with Patients Receiving Head and Neck Cancer Radiation Therapy

Wednesday, Dec. 2 11:20AM - 11:30AM Location: S104A

**Participants**
Saydy Y. Zia, MA, MD, New York, NY (Presenter) Nothing to Disclose
Awais Mirza, Mineola, NY (Abstract Co-Author) Nothing to Disclose
Umut Ozbek, New York, NY (Abstract Co-Author) Nothing to Disclose
Ren-Dih Sheu, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Vishal Gupta, MD, Sacramento, CA (Abstract Co-Author) Nothing to Disclose
Richard L. Bakst, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

**ABSTRACT**
Purpose/Objective(s): Patients receiving radiation therapy for head and neck cancers often experience severe weight loss and in some cases require re-planning. The purpose of this study was to evaluate whether we can determine at what point patients daily shifts vary greatly in relation to their specific weight loss to ensure the safe delivery of radiation therapy to our patients.

Materials/Methods: 99 consecutive patients with head and neck cancers were treated with radiation therapy (+/- chemotherapy) at our institution. Patient and disease characteristics: median age 59 (41-94), 14% female, 86% male, 3% Stage 0, 10% Stage I, 12% Stage II, 15% Stage III, 60% Stage IV. Weight loss was measured and recorded during weekly on treatment visits. KV imaging was performed daily to ensure setup accuracy. All shifts were recorded on a daily basis to include AP, LR, and SI shift. Spearman correlation coefficients were used in statistical analysis.

Results: The mean weight loss during treatment in our cohort was 13.6kgs (+2.4kgs to - 24.9kgs). Stage of disease was found to correlate with percent weight loss (p=0.04). Mean weight loss was found to increase with advanced stage disease (Table 1). MEAN WEIGHT LOSS StageMean Weight Loss(kg)0.8114.2616.8116.2817.75In regards to treatment, there was no statistical correlation between treatment being adjuvant or definitive with regards to percentage weight change (p=0.56). The largest PA (posterior-anterior) shift (p=0.309), SI (superior-inferior) shift (p=0.517), LR (left-right) shift (p=0.303) compared to the largest shift (p=0.247) were trended against weight loss and found not to be statistically significant. Conclusion: Our study demonstrates that despite weight loss of head and neck cancer patients, there was no significant correlation with setup inaccuracy. Increasing stage was found to be predictive of an increase in percent weight change. This study suggests that most patients undergoing head and neck radiation therapy will have a reliable set-up when properly immobilized despite significant weight loss. Further, this study highlights the importance of daily KV imaging and close monitoring of patients weight in head and neck cancer patients.

**SSK17-07** Technology Meets Quality for Physician Collaboration in Oncology Peer Review

Wednesday, Dec. 2 11:30AM - 11:40AM Location: S104A

**Participants**
Jhingran, MD, Houston, TX (Presenter) Nothing to Disclose

**ABSTRACT**
Purpose/Objective(s): Technology Meets Quality for Physician Collaboration in Oncology Peer Review

Wednesday, Dec. 2 11:10AM - 11:20AM Location: S104A

**Participants**
Shetty, PhD, New York, NY (Presenter) Nothing to Disclose

**ABSTRACT**
Purpose/Objective(s): A systematic review was conducted to identify and characterize self-reported sexual function (SF) measures administered to women who had received radiation therapy (RT) for cancer.Materials/Methods: Using 2009 PRISMA guidelines, we searched electronic bibliographic databases for quantitative studies published January 2008-September 2014 that used a self-reported measure of SF, or a quality of life (QOL) measure that contained at least one item pertaining to SF. Of these studies, we selected articles that reported the percentage of females who had received any form of RT. Results: Of 1,487 articles initially identified, 83 met inclusion criteria. The studies originated in 28 different countries with 23% from the U.S.A. Most studies focused on women treated for breast, gynecologic, or colorectal cancer, with the percent of women who had received RT ranging from 7% to 100%. Only 19 articles (23%) provided information about radiation dose, number of fractions, field, or type of RT equipment. SF was assessed with 27 unique self-reported measure, the most common being the EORTC QLQ modules (considered as one measure), the Female Sexual Function Inventory, and the Sexual Function Vaginal Changes Questionnaire. Of the 32 studies designed to compare SF by treatment modality, one-third found no statistically significant difference between RT and other modalities, and 28% found worse SF associated with RT. Only 4 studies reported on interventions to improve SF. Conclusion: The paucity of RT information in the reviewed articles, and the large number of measures used to assess SF limit comparative analysis. Needed are intervention studies with common metrics, preferably dedicated SF measures developed with cancer patients treated with RT. This systematic review will assist radiation oncologists select SF measures and encourage assessment of this quality of life domain in patient care.
The role of adjuvant radiation therapy (ART) after lymph node dissection (LND) in pts with Stage III melanoma is controversial.

Purpose/Objective(s): To report our institutional experience of palliative proton radiotherapy (RT) for cancers in the head and neck with the QUAD SHOT regimen.

Materials/Methods: Seventeen patients completed at least 1 cycle of palliative RT to the head and neck with proton therapy for incurable primary or metastatic disease based on the RTOG 85-02 QUAD SHOT regimen (370 CGE twice daily over 2 consecutive days at 2 to 3 week intervals up to a total dose of 4400 CGE) between July 2013 and January 2015 at our center; two were lost to follow-up. In the remaining fifteen patients, we defined palliation as relief of the presenting symptom(s) or tumor response by clinical exam or imaging. Overall survival (OS) was estimated by the Kaplan-Meier (KM) method. The Spearman rho test was used to examine the correlation between various clinical factors and palliative response. Toxicity was scored using the NCI CTCAE v4.0.

Results: Median patient age was 70 years (range 54 to 89). 66% were male and 34% were female. The most common histology was squamous cell carcinoma (66%), followed by adenocarcinoma of the lung metastatic to the head and neck (13%), non-anaplastic thyroid carcinoma (7%), mucosal melanoma (7%), and adenocarcinoma (7%). Primary or recurrent AJCC stage was I (7%), II (13%), III (9%), IV (67%), and unknown (13%). The stage I patient also had metastatic SCLC. Five patients (33%) had a history of surgical resection at the primary disease site, eleven patients (73%) had previously received systemic chemotherapy, and ten patients (66%) had received significant prior RT at the palliative site (median dose 66 Gy; range, 21 to 75 Gy). Three patients had received two prior courses of RT to the site. KPS was =70 in all patients. The most common presenting symptoms were visual changes (16%), dysphagia/odynophagia (16%), pain (12%), and/or epistaxis (12%). Seven patients (47%) completed three QUAD SHOT cycles, and six patients (40%) received systemic therapy, typically targeted agents, concurrently. Palliative response was observed in 73% of patients. Median OS was 4.17 months (range, 0.57-17.0). No Grade 3 or higher acute toxicities were observed. One patient, who had received two prior courses of RT to the site, developed a Grade 2 dermatitis. The most common toxicity was Grade 2 fatigue (27%). By the log-rank test, palliative response (p=0.018) was associated with improved OS. Using bivariate analysis, palliative response was correlated with increasing number of QUAD SHOT cycles (p=0.017) but not with KPS, histology, or concurrent chemotherapy. Conclusion: Delivery of the QUAD SHOT regimen by proton radiotherapy for patients with loco-regionally advanced or metastatic disease in the head and neck provides excellent rates of palliative response with no Grade 3 or higher acute toxicity. The minimal toxicity profile in these heavily pre-irradiated patients is encouraging and warrants further study.

SSK17-09 Patterns of Local and Distant Recurrence Based on MAP Kinase Pathway Mutations in Patients with Stage III Melanoma Treated with Lymph Node Dissection and Adjuvant Radiation Therapy

Wednesday, Dec. 2 11:50AM - 12:00PM Location: S104A

Participants
Priniya Chablaini, BA, MS, Columbus, OH (Presenter) Nothing to Disclose
Steve Walston, DO, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Erik windows, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Sara Peters, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Terence M. Williams, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
Evon J. Wuthrick, MD, Columbus, OH (Abstract Co-Author) Nothing to Disclose

Purpose
The role of adjuvant radiation therapy (ART) after lymph node dissection (LND) in pts with Stage III melanoma is controversial.
Recently, different sub-groups of melanoma have emerged based on the presence of BRAF and NRAS driver mutations in the MAP Kinase pathway. We sought to determine clinical outcomes after LND and ART on the basis of BRAF-, NRAS-, and MAPK-wild-type (wt) status.

**METHOD AND MATERIALS**

We reviewed the records of patients (pts) treated with LND followed by ART at our institution from 2006 to mid-2014. 65 pts met our study criteria. We collected information on demographic, pathologic, and treatment-related variables from medical records. We tested melanoma tissue samples from all pts for BRAF/NRAS mutations using PCR-based genetic assays. Loco-regional and distant recurrences were assessed using follow-up imaging and exam findings. We examined the association of variables collected with clinical outcomes using Kaplan and Meier methods and Cox proportional hazards models.

**RESULTS**

Of the 65 pts, 42 (65%) were male and the median age was 57 yrs (range 22 - 87). 19 pts (29%) received LND and ART to the head and neck, 28 (43%) to the axilla, and 18 (28%) to the groin. Pts received external beam RT with the majority receiving 30 Gy/5 fractions (61%) or 48 Gy/20 fractions (26%). 32 pts (49%) were BRAF-positive, 33 pts (51%) were BRAF-negative. Of the 33 BRAF-negative pts, 15 pts (23%) had NRAS mutations, 18 pts (28%) were MAPK-wt. Median follow up time was 1.6 years (0.2-7.8). Presence of BRAF mutation was significantly associated with local-regional recurrence (HR: 4.3; 95% CI 0.9-20.0; p = 0.06). At 2-yr follow-up, 33% of BRAF+ pts failed loco-regionally, compared to 7% of BRAF- pts. There were a total of 11 loco-regional failures. Presence of BRAF mutation was not significantly associated with distant failure (aHR: 0.75; 95% CI 0.4-1.4; p = 0.34). At 2-yr follow-up, 54% of BRAF+ pts had distant failure, compared to 65% of BRAF- pts. There were a total of 37 distant failures.

**CONCLUSION**

BRAF-positive pts had significantly increased rates of loco-regional failure but similar rates of distant failure compared to BRAF-negative pts after LND and ART for Stage III Melanoma.

**CLINICAL RELEVANCE/APPLICATION**

BRAF-positive pts may derive less loco-regional control than BRAF-negative pts from ART after LND for Stage III melanoma; adjuvant immunotherapy or targeted therapy may be better options for these pts.
Radiation Oncology Wednesday Poster Discussions

Wednesday, Dec. 2 12:15PM - 12:45PM Location: RO Community, Learning Center

AMA PRA Category 1 Credit ™: .50

Participants
Jun Deng, PhD, New Haven, CT (Moderator) Nothing to Disclose
Meng X. Welliver, MD, Columbus, OH (Moderator) Nothing to Disclose

Sub-Events

RO247-SD-WEA2 Quantitative Assessment of Tumor Response to Celastrol and Radiation Therapy Using Diffusion-weighted MRI in Lung Cancer Mouse Model

PURPOSE
Diffusion-weighted MRI (DWI) has been suggested as a measure of therapy-induced changes at the cellular level such as necrosis, apoptosis and cytotoxic edema because viable cells act as a diffusion barrier in tissue. Celastrol had the greatest enhancing effect on ionizing radiation-induced cell death. Thus, this study was to assess the potential of noninvasive MRI techniques for the assessment of tumor response to celastrol with radiotherapy (RT).

RESULTS
Mean ADC value of combined celastrol with RT group significantly increased at 3 days (P < 0.01). At 6 days treatment, the ADC value increased in both the celastrol group and combined celastrol with RT groups as compared to RT group (P < 0.01). ADC value of combined celastrol with RT group in change of tumoral cellularity is increased than those of the single therapy as RT group and celastrol group (P < 0.01). The area of necrosis within the tumor was 29.46 ± 9.12 % in RT group, 52.15 ± 12.43 % in the celastrol group, and 70.16 ± 8.30 % in the combined celastrol and RT group (p < 0.001).

CONCLUSION
DWI was found to provide useful noninvasive indicator for assessment of tumor response to therapy with combined celastrol and irradiation in the human lung cancer murine model.

CLINICAL RELEVANCE/APPLICATION
DWI was possible imaging tool to provide useful noninvasive indicator for assessment of tumor response to therapy in the human cancer.

RO248-SD-WEA3 Fogging Artifact in Postoperative Radiographs in Lung Cancer Patients Post Sublobar Resection and Brachytherapy: Recognition and Prevention

PURPOSE
Brachytherapy seed implantation after sublobar resection is an important means of reducing local recurrence in lung cancer patients who cannot undergo standard lobar resection. Fogging artifact has been observed on Computed Radiography (CR) imaging in the immediate postoperative setting following seed implantation, which causes significant degradation of image quality. We review the deterministic factors and propose protocol modifications when imaging these patients.

METHOD AND MATERIALS
Postoperative chest radiographs of patients who received brachytherapy seeds between 2004 and 2014 were reviewed. Variseed brachytherapy planning system was used to determine the dose rate at the patient's skin surface and distance from the implant. Phantom measurements were performed to determine the relationship between dose from the brachytherapy implant and the response of the CR plate.

RESULTS
21/60 patients demonstrated the artifact, 2 of whom had clinically significant findings (e.g., pneumothorax) which were obscured.
We reviewed medical records of patients who received radiation with androgen deprivation therapy (ADT). The dose rate at the skin surface ranged from 1.17 to 117 µGy/min. Logistical regression demonstrated that dose rate and distance are statistically significant predictors of the presence of an artifact. ROC curve analysis resulted in a predictive value of 15 µGy/min at the skin surface or 6 cm distance from the implant for an artifact to be present. Phantom measurements demonstrated a deterministic response between dose and pixel value on CR plates, with saturation occurring at 100 µGy. Digital Radiographic (DR) imaging showed no artifacts.

CONCLUSION

Exposure of a CR plate to brachytherapy seeds is associated with the presence of a fogging artifact. The deterministic factors include distance of the seeds from the skin surface, time of exposure, and the use of a passive detector such as a CR plate. These findings call for protocol modifications when imaging these patients including appropriate positioning (PA/AP) based on seed location to minimize dose rate to the detector, immediate placement and removal of the CR plate to minimize the time that the detector is exposed, and using DR detectors if available as images are captured nearly instantaneously, minimizing exposure from the seeds.

CLINICAL RELEVANCE/APPLICATION

We have reviewed the deterministic factors underlying the fogging artifact in patients with brachytherapy seeds and suggest practice protocols to minimize its occurrence.

RO244-SD-WEA6  
Is Radiation Therapy Oncology Group Atlas for Upper Abdominal Normal Organ Contouring Applicable for Postoperative Klatskin Patients?

Participants
Gulbiz M. Kartal, MD, Istanbul, Turkey (Presenter) Nothing to Disclose
Rabia Nergiz Dogoglu, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Sule Karaman, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Dilek Sahin, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Baris Bakir, Dipl Phys, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Gulgun Engin, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Ilgin Ozden, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Esra Saglam, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Arzu Poyanli, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Bulent Acunbas, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Ahmet Kizir, MD, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose
Ethem N. Oral, Istanbul, Turkey (Abstract Co-Author) Nothing to Disclose

PURPOSE

Highly conformal radiotherapy (RT) techniques require precise target and organs at risk volumes utilizing CT-derived images and anatomy. To serve for this Radiation Therapy Oncology Group (RTOG) developed an atlas for upper abdominal normal organ contouring. Yet, RT is used not only in definitive or neoadjuvant setting but also in postoperative period where the normal anatomy might change. In preparation for our adjuvant RT protocol in postoperative klatskin patients, we aimed to validate the use RTOG atlas for this group of patients.

METHOD AND MATERIALS

Two radiation oncologists using RTOG Atlas and two radiologists experienced in hepatobiliary tumors participated in the study evaluating five CT. Individual contours were overlaid and compared for stomach, duodenum, liver, adrenals, kidneys, major vessels [portal vein (PV), superior mesenteric artery (SMA), superior mesenteric vein (SMV), hepatic vein (HV)]. The agreement was evaluated using volume ranges and intersection and union volumes first the average volumes among radiation oncologists and radiologist separately and then among these groups.

RESULTS

There was excellent consistency and agreement of liver, stomach, kidney, adrenals, SMA and SMV; substantial of duodenum and moderate of PV and HV.

CONCLUSION

RTOG atlas for upper abdominal normal organ contouring is an efficient tool to guide radiation oncologists to set normal structures for klatskin patients in postoperative setting.

CLINICAL RELEVANCE/APPLICATION

RTOG atlas for upper abdominal normal organ contouring is an efficient tool to guide radiation oncologists.

RO245-SD-WEA7  
Testosterone Recovery in Men Following Radiation and Androgen Deprivation Therapy

Participants
Ray Y. Zhang, Los Angeles, CA (Presenter) Nothing to Disclose
Lingyun Ji, MS, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Susan Groshen, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Tanya Dorff, MD, Los Angeles, CA (Abstract Co-Author) Consultant, Bayer AG Consultant, Dendreon Corporation Consultant, Novartis AG Speaker, Bayer AG Speaker, Pfizer Inc Speaker, sanofi-aventis Group
David I. Quinn, MD, PhD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Leslie Ballas, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): To determine patient and tumor characteristics that affect testosterone recovery in men who undergo radiation with androgen deprivation therapy (ADT). Materials/Methods: We reviewed medical records of patients who received testosterone...
radiation therapy (RT) in combination with ADT in either the definitive or post-operative setting at Los Angeles County Hospital or Norris Cancer Center between 2008 - 2012. Patients with at least one testosterone measurement after ADT administration (and before re-starting ADT, if applicable) were included in the analysis. Time to recovery of testosterone was defined as the duration between the end of ADT and when the serum testosterone became greater than lower limit of normal in our lab. Patients that had at least one follow-up testosterone checked, but who never achieved a normal testosterone, were censored at 4 years. Patient and disease characteristics that we evaluated were age, body mass index (BMI), race, surgery, duration of ADT, and Gleason score.

Results: Fifty-seven patients had at least one testosterone measurement following RT and ADT administration. 41 patients (72%) had testosterone levels that returned to the normal range following ADT and RT; the remaining 16 patients (28%) had testosterone levels below the normal range at the last measurement. Of the 41 patients who recovered testosterone into the normal range, the median duration between end of ADT and testosterone recovery was 262 days (range 104-1219 days). The mean age of patients was 64 years. The median time on ADT was 185 days (range 95-1035 days). Patients exposed to 185 days or less of ADT had a shorter time to testosterone recovery than those who were exposed to >185 days of ADT (p=0.006). The association of age, race, BMI, surgery and Gleason score was examined for all patients and then for the subsets of patients with short or long term ADT (=185 days vs >185 days). A trend was observed between time to testosterone recovery and patient’s BMI category (normal, overweight or obese): obese patients showed longer time to recovery of testosterone and patients with normal BMI showed a shorter time (p=0.057). No significant association was seen between time of recovery and age, race, surgery or Gleason score. Likely the small sample size affected the power of these tests. Conclusion: Duration of ADT affects time to testosterone recovery in patients who undergo both ADT and RT. It appears from this small sample that BMI also influences testosterone recovery.
Purpose/Objective(s): In the era of image-guided radiotherapy (IGRT), existing evidence demonstrate that PET may play a significant role in tumor delineation for several tumours. However limited data are available about the use of 11C-Choline PET in radiotherapy (RT) planning for prostate cancer patients. Aim of this study was to verify the impact of this imaging modality in treatment planning of patients eligible for RT. Materials/Methods: We prospectively enrolled 37 consecutive patients (mean age 70 years, range 53-85) referred to our Department for radiation therapy planning with a radical intent (n=7), as salvage therapy (n=15) or in order to plan a re-irradiation (n=15). Patients were submitted to a single-day protocol, including dedicated CT scan of the pelvis and 11C-Choline PET/CT scan. Clinical-tumor volumes (CTV), planning-tumor volumes (PTV) and organs at risk (OAR) were contoured on CT slices with Eclipse Varian Medical System software, whereas Gross tumor volume (GTV)-PET was defined as the area of pathologic uptake and contoured with PETVCAR software on Advantage GE workstation. Results: Among the 7 patients undergoing 11C-Choline PET for a radical radiation treatment, 5 (72%) pts received the planned RT, including 1 pt (14%) with a negative PET. Two (28%) pts showed evidence of positive nodes therefore a boost of dose on pathologic lymphnodes was also selected. Results: Local disease progression within the RT field of a treatment site was 23% (n=14). Six sites (10%) and 4 patients received reirradiation. Average cumulative dose for local reirradiation was 47 Gy (range 42-51Gy). Reirradiation dose schemes were 20Gy in 10 fractions (2 sites) and 21Gy in 7 fractions (4 sites). Initial treatment delivered was 21 Gy in 7 fractions for 3 sites, and 30 Gy in 10 fractions with 6-8 week break between first and last 5 fractions for 4 sites. Median time to follow-up patient survey was 38 months (range 18-52) for patients that completed reirradiation. Median time to re-irradiation was 12 months (range 6-20 months). Four reirradiated sites and 3 patients reported disease control at time surveyed. The one patient that progressed despite reirradiation had had previous hand surgery and positive family history. After reirradiation, patient-reported acute toxicities included erythema (5 sites), edema (1 site) and fatigue (1 site) and there were no reported late toxicity. All reirradiated patients reported that their RT was successful. The one patient with failure within reirradiation field cited RT was successful as it delayed the disease progression and preserved his hand function better compared to his family members with PFF. Conclusion: PPF is often a progressive disease and despite improved local disease control with radiation some patients experience in field progression. This report shows feasibility and preliminary data suggesting low toxicity and good disease control for en face electron reirradiation therapy for early stage PPF. Repeat courses of RT may be an alternative to more invasive therapies and warrants further investigation.

Purpose/Objective(s): Orthovoltage and electron radiation therapy (RT) has been demonstrated to provide long-term local disease control in about seventy percent of treatment sites for patients with palmar and plantar fibromatosis (PPF). Disease progression can be extremely debilitating disease due to functional impairment of patients' hands and/or feet and often requires invasive procedure(s). This report reviews single institution experience with re-irradiation for early-stage PPF. Materials/Methods: Between 2008 and 2013, 33 patients with early-stage PPF participated in an IRB-approved follow-up questionnaire. The questionnaire queried patients' past medical history, pre/post radiation symptoms, toxicity and disease progression. Patients had received 66 radiation treatments (51 hands and 15 feet) at a single institution. Treatment target was clinically defined as field encompassing at-risk areas (skin changes, cords, and nodules) with 1.5 cm margins and CT simulation was used to measure disease thickness and depth to palmar or plantar fascia allowing for appropriate en face electron energy (range 6-12MeV) and bolus (range 0.5 – 1cm) selection. Results: Local disease progression within the RT field of a treatment site was 23% (n=14). Six sites (10%) and 4 patients received reirradiation. Average cumulative dose for local reirradiation was 47 Gy (range 42-51Gy). Reirradiation dose schemes were 20Gy in 10 fractions (2 sites) and 21Gy in 7 fractions (4 sites). Initial treatment delivered was 21 Gy in 7 fractions for 3 sites, and 30 Gy in 10 fractions with 6-8 week break between first and last 5 fractions for 4 sites. Median time to follow-up patient survey was 38 months (range 18-52) for patients that completed reirradiation. Median time to re-irradiation was 12 months (range 6-20 months). Four reirradiated sites and 3 patients reported disease control at time surveyed. The one patient that progressed despite reirradiation had had previous hand surgery and positive family history. After reirradiation, patient-reported acute toxicities included erythema (5 sites), edema (1 site) and fatigue (1 site) and there were no reported late toxicity. All reirradiated patients reported that their RT was successful. The one patient with failure within reirradiation field cited RT was successful as it delayed the disease progression and preserved his hand function better compared to his family members with PPF. Conclusion: PPF is often a progressive disease and despite improved local disease control with radiation some patients experience in field progression. This report shows feasibility and preliminary data suggesting low toxicity and good disease control for en face electron reirradiation therapy for early stage PPF. Repeat courses of RT may be an alternative to more invasive therapies and warrants further investigation.

Purpose/Objective(s): In the era of image-guided radiotherapy (IGRT), existing evidence demonstrate that PET may play a significant role in tumor delineation for several tumours. However limited data are available about the use of 11C-Choline PET in radiotherapy (RT) planning for prostate cancer patients. Aim of this study was to verify the impact of this imaging modality in treatment planning of patients eligible for RT. Materials/Methods: We prospectively enrolled 37 consecutive patients (mean age 70 years, range 53-85) referred to our Department for radiation therapy planning with a radical intent (n=7), as salvage therapy (n=15) or in order to plan a re-irradiation (n=15). Patients were submitted to a single-day protocol, including dedicated CT scan of the pelvis and 11C-Choline PET/CT scan. Clinical-tumor volumes (CTV), planning-tumor volumes (PTV) and organs at risk (OAR) were contoured on CT slices with Eclipse Varian Medical System software, whereas Gross tumor volume (GTV)-PET was defined as the area of pathologic uptake and contoured with PETVCAR software on Advantage GE workstation. Results: Among the 7 patients undergoing 11C-Choline PET for a radical radiation treatment, 5 (72%) pts received the planned RT, including 1 pt (14%) with a negative PET. Two (28%) pts showed evidence of positive nodes therefore a boost of dose on pathologic lymphnodes was also delivered. Of the 15 pts candidated to a salvage RT, 4 (26%) had a negative PET and were irradiated on the prostatic bed as planned. Among the 11 pts with positive PET, 1 (9%) was irradiated only on prostatic bed as planned, 7 (64%) received also a boost on positive nodes, 3 (27%) were not submitted to RT because of the evidence of metastatic disease (2 lungs, 1 bone). Of 15
pts already submitted to RT, and undergoing 11C-Choline PET with a re-irradiation intent, 9 (60%) had a confirmed indication to
the planned RT, 1 pt (7%) did not receive RT as planned, having the PET scan showed evidence of lung metastases, 5 (33%)
because of a negative exam. Conclusion: In our experience 11C-Choline PET proved to have a significant impact on RT planning of
prostate cancer patients, by determining a change in the therapeutic decision in up to 48% of cases, in all the therapeutic
settings.
**Wednesday Plenary Session**

**Wednesday, Dec. 2 1:30PM - 2:45PM Location: Arie Crown Theater**

**Announcement of Education Exhibit Awards**

**Participants**
Ronald L. Arenson, MD, San Francisco, CA (Presenter) Nothing to Disclose

**Annual Oration in Radiation Oncology: NRG Oncology and the National Cancer Institute's National Clinical Trials Network: A Case Study for Innovation in Multi-Disciplinary Cancer Research**

**Participants**
Walter J. Curran JR, MD, Atlanta, GA (Presenter) Committee member, Bristol-Myers Squibb Company; Committee member, AstraZeneca PLC
Nina A. Mayr, MD, Seattle, WA (Presenter) Nothing to Disclose

**Abstract**
The National Cancer Institute (NCI) modified its publicly funded cancer research program from a system of ten groups with cooperative agreements, some of which dated back to the 1950's, to a network of five groups beginning in March 2014. The new network, known as the National Clinical Trials Network (NCTN), builds on the decades of practice-defining success of the cooperative groups and also seeks to be responsive to issues raised by the Institute of Medicine (IOM) in 2010. The IOM raised concerns that the cooperative groups were too slow to respond to new scientific discoveries, too cumbersome as an infrastructure, and too underfunded. The IOM also praised the groups for their remarkable accomplishments despite these obstacles. NRG Oncology is one of the five new NCTN groups and arose from the cooperation between three legacy cooperative groups: the National Surgical Adjuvant Breast and Bowel Project (NSABP), the Radiation Therapy Oncology Group (RTOG), and the Gynecologic Oncology Group (GOG). NRG Oncology focuses its clinical and translational research efforts on patients afflicted with malignancies in one of these seven cancer disease site categories: brain tumors, head and neck cancers, lung cancers, breast cancers, gastrointestinal cancers, and genitourinary cancers, and gynecologic cancers. The means by which NRG Oncology develops and executes practice-defining research for such patients on a global basis will be discussed.
LEARNING OBJECTIVES

1) Gain an appreciation of the basic scientific underpinnings of interventional oncology. 2) Understand how and why these mechanistic studies can have an impact on both daily clinical practice and future therapeutic paradigms. 3) Characterize the most important advances of tumor ablation over the last two decades. 4) Gain a better understanding of the cutting edge imaging techniques that facilitate successful state of the art interventional oncologic practice.

ABSTRACT

The first half of the session has been organized into a thematic unit entitled: "Mechanisms Matter: Basic science every IO should know" and will be dedicated to gaining an appreciation of the basic scientific underpinnings of interventional oncology and understanding how and why such studies can have an impact on both daily clinical practice and future therapeutic paradigms. This will include an initial lecture outlining the many insights and lessons that can be directly applied from radiation therapy and hyperthermia, followed by lectures that center upon key mechanistic pathways that are being used to improve transcatheter embolization and tumor ablation. Two presentations will outline our current understanding of the potential systemic effects of post-procedural, cytokine-mediated inflammation - the negative effects leading to tumorigenesis and the potential beneficial immune (abscopic) effects of IO therapies. A highlight of the session will be a keynote address ’20 years of thermal ablation: Progress, Challenges and Opportunities’. Dr. Solomon, a noted thought leader in the field will not only characterize the most important advances of tumor ablation over the last two decades and place them in their proper historical and developmental context, but will also identify key areas of research in device and technique development that hold the potential to propel the field forward in the upcoming decade. The second half of the session “Advancing IO with cutting-edge imaging techniques” will be dedicated to the cutting edge imaging modalities that facilitate successful state of the art IO practice. Leading authorities will provide an in depth look at advances and adaptation of 5 of the main technologies as they relate to enhancing interventional oncology including: advanced ultrasound and fusion techniques; state-of-the-art angiographic imaging (including Cone beam CT and subtraction reconstruction); tailoring MR for IO; the the role of PET/CT; and molecular imaging.

LEARNING OBJECTIVES

View learning objectives under main course title.

LEARNING OBJECTIVES

View learning objectives under main course title.
Hypoxia is a common physiological alteration of solid tumors and has been correlated with treatment failure. Hypoxia resulting from embolization also contributes to chemoresistance after TACE. Evofosfamide (Evo) [previously called TH-302] is administered as a nontoxic prodrug which is selectively activated by hypoxia resulting in DNA damage and tumor cell death. The purpose of this study was to investigate the feasibility, safety and antitumor efficacy of hepatic hypoxia-activated intra-arterial therapy (HAIAT) in a rabbit model.

**METHOD AND MATERIALS**

Twenty-eight VX2 tumor-bearing rabbits were assigned to 4 intraarterial therapy (IAT) regimens: 1) saline (control group); 2) Evo; 3) doxorubicin;Lipiodol emulsion followed by embolization with 100;300μm beads (conventional, cTACE); or 4) a combination of Evo and cTACE (Evo;cTACE). Blood samples were collected pre;IAT, 24/48h and 7/14 days post;IAT. Efficacy was assessed quantitatively on MDCT (24h pre; 7/14 days post;IAT). Necrotic fraction (NF) was quantified on HandE by slide;by;slide segmentation. Hypoxic fraction (HF) and compartment (HC) were determined by pimonidazole staining. Markers of tumor DNA damage, apoptosis, cell proliferation, endogenous hypoxia and metabolism were quantified (γ-H2AX, annexin V, caspase-3, Ki-67, HIF1α, MCT4, LDH).

**RESULTS**

Evo;cTACE showed similar profile in liver enzyme elevation compared to cTACE except at day 7 where ALT was higher. No hematologic/renal toxicity was observed. Animals treated with Evo-cTACE demonstrated smaller tumor volumes, lower tumor growth rate and higher NF compared to cTACE. Evo resulted in a marked reduction in the HF and HC. A significant negative correlation was found between the HF or HC and the magnitude of the NF. Evo or Evo;cTACE promoted antitumor effects as evidenced by increased expression of γ-H2AX and apoptotic biomarkers, with decreased proliferation. Increased HIF1α expression and tumor glycolysis validated HAIAT.

**CONCLUSION**

HAIAT with Evo was feasible, had a favorable toxicity profile and demonstrated antitumor effects by selective targeting of tumor hypoxic areas.

**CLINICAL RELEVANCE/APPLICATION**

The embolic effect of TACE provides an attractive setting for selective activation of bioreductive prodrugs and HAIAT allows for the delivery of high drug doses that may reach tumor regions where hypoxic cells reside in pharmacological sanctuary.

**VSIO41-03 Lessons Learned from XRT/Hyperthermia**

**Wednesday, Dec. 2 1:55PM - 2:10PM Location: S405AB**

Participants
Mark W. Dewhirst, DVM, PhD, Durham, NC (Presenter) Stockholder, Celsion Corporation; Research Grant, Biomimetix Corporation; Research Grant, Johnson & Johnson; Consultant, Nevro Corp; Consultant, Merck KGaA; Consultant, Siva Corporation

**LEARNING OBJECTIVES**

1) Understand the complimentary interactions between hyperthermia and radiotherapy that increase cell killing. 2) Understand importance of measuring temperature during heating and methods for how this is accomplished. 3) Be able to articulate how hyperthermia affects tumor physiology and how these effects influence treatment responses.

**ABSTRACT**

There are more than a dozen positive phase III trials showing that hyperthermia can increase local tumor control when it is combined with radiotherapy. Such trials include head and neck cancer, cervix cancer, GBM, esophageal al cancer and chest wall recurrences of breast cancer. It has been known for more than two decades that hyperthermia augments the cytotoxicity of radiotherapy. Basic tenants underlying this interaction include proof that hyperthermia inhibits DNA damage-repair. Hyperthermia has complimentary cytotoxicity with radiotherapy in different parts of the cell cycle. Further, hyperthermia can increase tumor perfusion, thereby increasing oxygen delivery; lack of oxygen is a source of relative resistance to radiotherapy. In recent years, however, new insights have been made into how these two treatment modalities interact. These insights come from: 1) innovative clinical trials involving functional imaging and genomics and 2) examination of how hyperthermia affects the process of DNA damage repair. These developments point the way toward new methods to further therapeutic gain by taking advantage of cellular responses to these therapies.

**VSIO41-04 The Safety and Efficacy Profile of TACE for Treating Hepatocellular Carcinoma in Patients Co-infected with HIV and HCV: A Propensity Score Matching Study**

**Wednesday, Dec. 2 2:10PM - 2:20PM Location: S405AB**

Participants
Jae Ho Sohn, MD,MS, New Haven, CT (Presenter) Nothing to Disclose
Reham R. Haroun, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Julius Chapiro, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Sonia P. Sahu, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Yan Zhao, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Florian N. Fleckenstein, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Ruediger E. Schernthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Li Zhao, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Susanne Smolka, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Jean-Francois H. Geschwind, MD, Westport, CT (Abstract Co-Author) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

**PURPOSE**

CLINICAL RELEVANCE/APPLICATION

The embolic effect of TACE provides an attractive setting for selective activation of bioreductive prodrugs and HAIAT allows for the delivery of high drug doses that may reach tumor regions where hypoxic cells reside in pharmacological sanctuary.
PURPOSE

Hepatocellular carcinoma (HCC) is becoming an increasing cause of morbidity and mortality in patients co-infected with HIV and HCV. TACE is an important treatment option for unresectable HCC, but to date, there is paucity of data on the safety and efficacy profile of TACE in this specific cohort. The purpose of this study is to compare HCC patients with HIV/HCV co-infection treated with TACE against HCC patients with HCV mono-infection treated with TACE through survival analysis and recording of major complications.

METHODOLOGY AND MATERIALS

This single institution and retrospective study included 456 patients. 35 HIV/HCV co-infected HCC patients with CD4 > 100 (group EXP) and 421 HCV-only HCC patients (group CTRL) who received TACE from 2001 - 2014 were included. Propensity score matching (PSM) with the nearest-neighbor method was performed, adjusting for sex, ethnicity, and BCLC/HKLC, which take into account Child-Pugh Class, ECOG performance score, and tumor characteristics. Covariate balance was confirmed. Kaplan-Meier (KM) estimates with median overall survival (MOS) and log-rank statistic were calculated. Cox regression was performed on EXP group to identify infectious disease parameters of potential significance on survival, such as detectable HIV viral load, CD4 count, and anti-retroviral therapy (ART). Significant complications were recorded.

RESULTS

Of the 456 patients, 35 patients in EXP group were successfully matched to 75 patients in CTRL group. 15 (42.9%) patients had detectable HIV viral load. Median CD4 count was 406 x 106 cells/mm3 (range 121 to 1086). 31 (88.5%) patients were on ART. The cohort spanned all BCLC/HKLC stages. KM revealed MOS of 20.0 months for the EXP group and MOS of 21.3 months for the CTRL group (p = 0.907). Cox model on EXP group did not identify any infectious disease variables of significance on survival. No significant complication, such as death, ICU stay, or fulminant liver failure within 30 days of TACE, was observed in the EXP group.

CONCLUSION

In HCC patients with HIV/HCV co-infection and CD4 > 100, TACE demonstrated comparable safety and efficacy profile as in HCC patients with HCV only.

CLINICAL RELEVANCE/APPLICATION

Interventional oncologists should feel comfortable offering TACE as a treatment option to HCC patients with HIV/HCV co-infection.
CTCs detection is a promising method to predict prognosis in HCC patients underwent TACE. TACE immediately reduce the number of CTCs get into the blood and may reduce the rate of metastasis.

**VSIO41-07 Understanding Post-procedure Inflammation: AKT and c-met Pathways**

Wednesday, Dec. 2 2:45PM - 3:00PM Location: S405AB

Participants
David A. Woodrum, MD, PhD, Rochester, MN (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**VSIO41-08 Microwave Hepatic Ablation Induces Dose Dependent Local Inflammation and Distant Pro-oncogenic Effects**

Wednesday, Dec. 2 3:00PM - 3:10PM Location: S405AB

Participants
Erik Velez, BS, San Francisco, CA (Presenter) Nothing to Disclose
Nahum Goldberg, Jerusalem, Israel (Abstract Co-Author) Nothing to Disclose
Gaurav Kumar, PhD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Yuanguo Wang, Boston, MA (Abstract Co-Author) Nothing to Disclose
Christopher L. Bruns, PhD, Madison, WI (Abstract Co-Author) Shareholder, NeuWave Medical Inc; Consultant, NeuWave Medical Inc; Shareholder, Symply Surgical Inc; Consultant, Symply Surgical Inc
Muneeb Ahmed, MD, Wellesley, MA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

To determine how different doses of microwave ablation (MWA) induce local inflammation and distant pro-oncogenic effects compared to radiofrequency ablation (RFA) in a small animal model.

**METHOD AND MATERIALS**

F344 rats (n=24) were implanted with single subcutaneous R3230 tumors. Average tumor diameter and tumor growth rates were assessed daily. At mean tumor diameter of 10 mm, animals were divided into four groups (n=6/arm), and assigned to one of four treatments: sham (needle x 5 minutes), RFA (70°C x 5 minutes), rapid high-dose MWA (20W x 15 seconds), or slower low-dose MWA (5W x 2 minutes). Settings were selected to produce 11.4±0.8 mm coagulation zones for all ablation settings. Tumors were measured daily for 7 days post-treatment to determine growth rates. Thickness of periablational liver inflammation (heat shock protein 70; Hsp70), local liver IL-6 levels, and distant tumor proliferative indices (Ki-67) were also compared.

**RESULTS**

Hepatic MWA-5W and RFA increased distant tumor growth rates compared to the MWA-20W and sham arms, such that the 7 day mean tumor diameter was greater (MWA-5W 16.3±1.1 mm, RFA 16.3±0.9 mm vs. sham 13.6±1.3 mm, p<0.01, and MWA-20W 14.6±0.9 mm, p<0.05). Although less than MWA-5 or RFA, MWA-20W also resulted in a significantly greater change in tumor diameter compared to the sham arm (p=0.04). Similarly, higher distant tumor proliferation was observed after hepatic MWA-5W and RFA, followed by MWA-20W compared to sham (proliferative indices: MWA-5W 0.82±0.05, RFA 0.79±0.05, MWA-20W 0.65±0.02 vs. sham 0.49±0.05, p<0.01). Finally, lower-energy hepatic MWA and RFA resulted in greater periablational inflammation (Hsp70: RFA 141.5 μm (mean), MWA-5W 134.1 μm, vs. MWA-20W 67.5 μm, p<0.01) with a trend for elevation in IL-6 levels for RFA (542±61 pg/ml) and MWA-5W (486±101 pg/ml), vs. MWA-20W (349±22 pg/mL, p<0.08).

**CONCLUSION**

Hepatic MW ablation can incite periablational inflammation and increased distant tumor growth similar to what has been recently reported for RFA. Yet, such undesired effects may be dependent on heating paradigms, and less pronounced with more rapid, higher power heating.

**CLINICAL RELEVANCE/APPLICATION**

MWA and RFA can have 'off-target' tumor stimulatory effects, which may be decreased using higher MW energy to reduce secondary inflammation in the tissue surrounding the ablation zone.

**VSIO41-09 Systemic Implications of IO Therapies: Increased Tumorigenesis?**

Wednesday, Dec. 2 3:10PM - 3:25PM Location: S405AB

Participants
Muneeb Ahmed, MD, Wellesley, MA, (mahmed@bidmc.harvard.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**VSIO41-10 Systemic Implications of IO Therapies: Beneficial Immune Effects?**

Wednesday, Dec. 2 3:25PM - 3:40PM Location: S405AB

Participants
Joseph P. Erinjeri, MD, PhD, New York, NY, (erinjerj@mskcc.org) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.
LEARNING OBJECTIVES

View learning objectives under main course title.

20 Years of Thermal Ablation: Progress, Challenges and Opportunities

Wednesday, Dec. 2 4:00PM - 4:25PM Location: S405AB

Participants
Stephen B. Solomon, MD, New York, NY (Presenter) Research Grant, General Electric Company

ADVANCED ULtrasound and Fusion Techniques

Wednesday, Dec. 2 4:25PM - 4:40PM Location: S405AB

Participants
Luigi Solbiati, MD, Busto Arsizio, Italy, (lusolbia@tin.it) (Presenter) Nothing to Disclose

State-of-the-Art Angiographic Imaging: Cone Beam CT and beyond

Wednesday, Dec. 2 4:40PM - 4:55PM Location: S405AB

Participants
Ming De Lin, PhD, Cambridge, MA (Presenter) Employee, Koninklijke Philips NV

ABSTRACT

Cone-beam computed tomography (CBCT) is an imaging technique that provides 3D imaging intraprocedurally from a rotational scan acquired with a C-arm equipped with a flat panel detector. Utilizing CBCT images during interventional procedures bridges the gap between the world of diagnostic imaging, where the image acquisition is typically performed separately from the procedure, and that of interventional radiology, which traditionally has been 2-dimensional (fluoroscopy and angiography). In the scope of transcatheter arterial chemomobilization (TACE), CBCT is capable of providing more information than standard two-dimensional imaging alone in localizing and/or visualizing liver tumors (“seeing” the tumor) and targeting tumors though precise microcatheter placement in close proximity to the tumors (“reaching” the tumor). It can also be useful in evaluating treatment success at the time of procedure (“assessing” treatment success).

1) Discuss the role of cone-beam computed tomography (CBCT) for inaprocedural imaging during transcatheter arterial chemomobilization (TACE). 2) Explain the advantages of CBCT over standard 2D angiography in the detection of hepatocellular carcinoma lesions and their feeding arteries. 3) Describe how CBCT during TACE can be used to assess the technical endpoint of embolization. 4) Demonstrate how to choose a CBCT technique using a decision-making algorithm to optimize the use of CBCT at each step of TACE for the identification of the lesion, guidance to reach the lesion, and assessment of embolization end points.
PURPOSE
Cone-beam CT (CBCT) is routinely utilized to determine the optimal location for drug delivery and technical success of embolization during drug-eluting beads transarterial chemoembolization (DEB-TACE). As such, the relationship between intra procedural CBCT findings and therapy response should be investigated. This study examined whether quantified contrast patterns on intraprocedural CBCT could predict tumor response on 1 month follow-up magnetic resonance (MR) imaging in hepatocellular carcinoma (HCC) patients treated with DEB-TACE.

METHOD AND MATERIALS
This retrospective study included 53 lesions in 49 patients (38 men, median age 62.7 years) who underwent DEB-TACE. All patients had a contrast-enhanced CBCT image taken immediately before and an unenhanced CBCT image taken immediately after drug delivery. However, enhancement was seen on the post-TACE CBCT due to retained contrast medium from drug delivery. MR imaging was performed at baseline and 1 month follow-up. On the CBCT images, enhancement of the target lesions was measured in 1 dimension (D), 2D, and 3D. On follow-up CBCT, patients were classified as responders or non-responders using mRECIST, EASL, and quantitative EASL (qEASL). qEASL defines response as a ≥ 65% decrease in 3D enhancement. To assess whether contrast patterns on CBCT could predict 1 month MR response, uni- and multivariate logistic regressions. Baseline characteristics significant in univariate analysis were included in the multivariate model.

RESULTS
On pre- and post-TACE CBCT, median 1D, 2D, and 3D tumor enhancement was 3.4 vs 3.6 cm (p=0.5), 9.9 vs 10.4 cm2 (p=0.7), and 60.7 vs 73.0 % (p=0.4). Response was seen in 34% (mRECIST) and 38% (EASL and qEASL) of lesions. Neither 1D nor 2D enhancement on CBCT could predict mRECIST or EASL response, respectively. However, 3D enhancement was predictive of qEASL response in univariate (pre-TACE CBCT: OR 1.07, 95% CI 1.03-1.11; post-TACE CBCT: OR 1.10, 95% CI 1.5-1.16) and multivariate analysis adjusted for age, hepatitis C, and tumor size (pre-TACE CBCT: OR 1.06, 95% CI 1.02-1.10; post-TACE CBCT: OR 1.09, 95% CI 1.03-1.15).

CONCLUSION
3D enhancement on intraprocedural CBCT can predict 3D tumor response on MR in HCC patients treated with DEB-TACE.

CLINICAL RELEVANCE/APPLICATION
CBCT contrast patterns during DEB-TACE are associated with future tumor response and therefore should guide intraprocedural decisions.

VSIO41-17 Tailoring MR for IO

Wednesday, Dec. 2 5:05PM - 5:20PM Location: S405AB

Participants
Philippe L. Pereira, MD, Heilbronn, Germany (Presenter) Research Consultant, Terumo Corporation; Speaker, AngioDynamics, Inc; Speaker, BSD Medical Corporation; Speaker, Terumo Corporation; Speaker, CeloNova BioSciences, Inc; Speaker, Medtronic, Inc; Speaker, BTG International Ltd; Speaker, Biocompatibles International plc; Advisory Board, Siemens AG; Advisory Board, Terumo Corporation; Advisory Board, Bayer AG; Advisory Board, BTG International Ltd; Advisory Board, Medtronic, Inc; Support, Bracco Group; Support, PharmaCept GmbH; Support, Terumo Corporation; Support, Siemens AG; Support, Novartis AG; Support, GlaxoSmithKline plc; Consultant, CeloNova BioSciences, Inc; Research Grant, Biocompatibles International plc; Research Grant, Siemens AG; Research Grant, Terumo Corporation; Research Grant, BTG International Ltd

LEARNING OBJECTIVES
View learning objectives under main course title.

ABSTRACT
Image guided tumor ablation is a minimally invasive therapy option in the treatment of primary and secondary hepatic malignancies. Magnetic resonance (MR) imaging offers an accurate pre-interventional imaging having important impact on patient selection and planning of the ablation procedure. Peri-interventional imaging is used for targeting, monitoring, and controlling of the ablation procedure. Due to a high soft-tissue contrast offering delineation of tumor tissue and the surrounding anatomy, coupled with multiplanar capabilities, MR imaging is an advantageous targeting technique compared with ultrasonography (US) or computed tomography (CT). Furthermore, a near-online imaging is feasible at interventional MR units facilitating a fast and precise placement of the probe inside the target tissue. MR imaging is sensitive to thermal effects enabling a monitoring of ablation therapy. At low-field, MR scanner T2 weighted sequences are accurate to near-online monitor acute effects of thermally induced coagulation subsequently being supportive to control the ablation procedure. Therefore, MR imaging can fulfill the conditions for overlapping ablations by enabling a precise repositioning of the MR compatible thermal applicator if required. MR imaging can be utilized to define the end point of thermal ablation after complete coverage of the target tissue is verified. Thus, the probability of achieving complete coagulation in larger tumors within a single therapy session is supposedly increased. A monitoring of thermal effects is moreover essential in order to prevent unintended tissue damage from critical structures in the surroundings of the target tissue. Subsequently, the possibility to monitor and control thermal ablation by MR imaging has an important impact on the safety and effectiveness of the ablation procedure. At least, first use of MR compatible microwave antennas will be presented in this refresher.

VSIO41-18 3D Quantitative Tumor Burden Analysis in Patients with Hepatocellular Carcinoma before TACE: Comparing Multi-lesion vs. Single-lesion Imaging Biomarkers as Predictors of Patient Survival

Wednesday, Dec. 2 5:20PM - 5:30PM Location: S405AB

Participants
Florian N. Fleckenstein, MS, New Haven, CT (Presenter) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Ruediger E. Schernthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose
Jae Ho Sohn, MD,MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Sonia P. Sahu, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Yan Zhao, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Bernhard Gebauer, MD, Berlin, Germany (Abstract Co-Author) Research Consultant, C. R. Bard, Inc; Research Consultant, Sirtex
LEARNING OBJECTIVES

1) Compare advantages of PET/CT with other imaging modalities in guiding interventional radiology procedures. 2) Describe strategies to improve lesion targeting during PET/CT interventional procedures. 3) Apply various PET/CT imaging techniques for the intra-procedural assessment of tumor ablation margins.

ABSTRACT

Positron Emission Tomography/Computed Tomography (PET/CT) enhances our capabilities in image-guided interventions in multiple ways. PET/CT enables targeting of disease foci not visible using other imaging modalities, provides uninterrupted visibility of targets despite intraprocedural changes in surrounding tissues or thermal effects of ablation, and facilitates unique intraprocedural strategies for assessing tumor ablation results. Many case examples will be shown that highlight rationales, strategies and emerging techniques for successful PET/CT-guided interventions.

Purpose

This study compared the value of multi-lesion vs. single-lesion assessment for the prediction of overall survival (OS) in patients with hepatocellular carcinoma (HCC) before transarterial chemoembolization (TACE) using 3D quantitative and diameter-based tumor burden analysis.

Method and Materials

122 patients with HCC treated with TACE were retrospectively included. Baseline arterial-phase, contrast-enhanced MRI was used to measure overall and enhancing diameters in a total of 296 HCC lesions. A 3D segmentation analysis was performed to assess total liver volumes and to quantify enhancing tumor volume (ETV) for each lesion. Enhancing tumor burden (ETB) was defined as the ratio between total ETV and total liver volume. Patients were stratified into high and low tumor burden groups following the BCLC staging (5cm for unifocal HCC and 3cm for 3 lesions for multifocal HCC; accordingly 65cm^3 and 45cm^3 were used for 3D cutoffs). A threshold of 4%, based on the ROC curve, was used for ETB. Survival was assessed using Kaplan-Meier analysis as well as uni- and multivariate cox proportional hazard ratios (HR). Concordances of each assessment technique were calculated and the method with the highest correlation was further evaluated in order to identify the ideal number of lesions needed for an accurate prediction of OS.

Results

A significant separation of the survival curves was achieved for all methods (log rank, p<0.05). Multivariate analysis, according to 3D methods showed the highest predictivity of OS as compared to 1D techniques (HR 5.2 [95%CI, 3.1-8.8, p<0.001] for ETV and HR 6.6 [95%CI, 3.7-11.5, p<0.001] for ETB vs. HR 2.6 [95%CI, 1.2-5.6, p=0.012] for overall diameter and HR 3.0 [95%CI, 1.5-6.3, p=0.003] for enhancing diameter). Concordances were found to be the highest for ETB. The difference between ETB concordances of all (0.782) and single largest lesion (0.759) was below two-times the standard error (0.038).

Conclusion

3D quantitative assessment of enhancing tumor burden as represented by the largest HCC lesion is a stronger predictor of OS as compared to diameter-based measurements. Assessing multiple lesions on baseline imaging provides no added accuracy in predicting patient OS.

Clinical Relevance/Application

3D volumetric analysis of the largest lesion is a strong predictor of OS and superior to 1D diameter-based methods used in current staging systems. Hence, 3D methods should be considered for future staging systems.

VSIO41-19 Interventional PET/CT

Wednesday, Dec. 2 5:30PM - 5:45PM Location: S405AB

Participants

Paul B. Shyn, MD, Boston, MA, (pshyn@bwh.harvard.edu) (Presenter) Nothing to Disclose

Learning Objectives

1) Compare advantages of PET/CT with other imaging modalities in guiding interventional radiology procedures. 2) Describe strategies to improve lesion targeting during PET/CT interventional procedures. 3) Apply various PET/CT imaging techniques for the intra-procedural assessment of tumor ablation margins.

Abstract

Positron Emission Tomography/Computed Tomography (PET/CT) enhances our capabilities in image-guided interventions in multiple ways. PET/CT enables targeting of disease foci not visible using other imaging modalities, provides uninterrupted visibility of targets despite intraprocedural changes in surrounding tissues or thermal effects of ablation, and facilitates unique intraprocedural strategies for assessing tumor ablation results. Many case examples will be shown that highlight rationales, strategies and emerging techniques for successful PET/CT-guided interventions.

VSIO41-20 Molecular Imaging

Wednesday, Dec. 2 5:45PM - 6:00PM Location: S405AB

Participants


Learning Objectives

View learning objectives under main course title.
LEARNING OBJECTIVES

1) To apply oncologic decision making in prostate cancer. 2) To recognize critical clinical manifestations of prostate cancer. 3) To discern clinically significant from insignificant signs and findings in prostate cancer.
SSM22

Radiation Oncology (Radiation Biology)

Wednesday, Dec. 2 3:00PM - 4:00PM Location: S104A

AO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

FDA Discussions may include off-label uses.

Participants
Meng X. Welliver, MD, Columbus, OH (Moderator) Nothing to Disclose
Sunil Krishnan, MD, Houston, TX (Moderator) Research Grant, Shell Oil Company; Researcher, Celgene Corporation

Sub-Events

SSM22-01 Treatment of Primary Tumors through Immunogenic Cell Death, with Concurrent Treatment of Metastasized Tumors through the Abscopal Effect, Via Targeted anti-CD4 siRNA, HMGB1, and ATP Nanoparticles Combined with Radiotherapy

Wednesday, Dec. 2 3:00PM - 3:10PM Location: S104A

Participants
Satoshi G. Harada, MD, Morioka, Japan (Presenter) Nothing to Disclose
Shigeru Ebara, MD, Morioka, Japan (Abstract Co-Author) Nothing to Disclose
Keiho Ishii, PhD, Sendai, Japan (Abstract Co-Author) Nothing to Disclose
Takahiro Satoh, Dsc, Takasaki, Japan (Abstract Co-Author) Nothing to Disclose
Koichiro Sera, Takizawa, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

We aimed to image and treat primary tumors through immunogenic cell death (ICD) and metastasized tumors through the abscopal effect in LM17 cell xenografts in BALB/c mice using microcapsules that release liposome-protamine-hyaluronic acid nanoparticles (LPH-NPs) in response to three sessions of radiation.

METHOD AND MATERIALS

For session one, LPH-NPs containing 5% iopamiron were mixed with 1.0 mL of a solution containing 4.0% alginate, 3.0% hyaluronate, 1 mg ascorbate, and 1 µg/mL P-selectin. LPH-NPs were then added to 0.5 mM FeCl2 supplemented with 1 µg/mL α4β1 antibody (Ab). Mice were injected intravenously (IV) with microcapsules. The primary tumor was exposed 9 h later to 10 or 20 Gy 60Co γ-rays. In session two, dendritic cell (DC)-associated cross-priming of CD8+ T cells was intensified for treatment of lung metastases by the abscopal effect. To this end, LPH-NPs containing 250 nmol anti-CD47 siRNA, 250 nmol anti-CD47 siRNA (modified with an scFv Ab against CD4), 40 ng HMGB1, and 10 µmol ATP were mixed with the abovementioned cocktail and added to 0.5 mM FeCl2 supplemented with 1 µg/mL anti-P-selectin Ab. Microcapsules (ten billion) were injected IV and they interacted with P-selectin. After 9 h, the second radiation session was conducted using the same protocol as for the first session. In session three, 4 cGy 60Co whole-body γ-rays were administered at 24-h intervals for 5 d to activate CD8+ T cells.

RESULTS

Anti-α4β1 microcapsules accumulated around the primary tumor and metastases, which was detected by computed tomography. The microcapsules in the primary tumor released P-selectin-Ag with LPH-NPs after the first irradiation. In session two, microcapsules accumulated around the primary tumor through P-selectin-Ab reaction and released LPH-NPs containing anti-CD47 siRNA, HMGB1, and ATP, which intensified ICD in the primary tumor and DC-associated cross-priming of CD8+ T cells. In session three, primed CD8+ T cells were activated and targeted metastases. These treatments reduced the sizes of the primary tumor and metastases by 91.7%.

CONCLUSION

Our microcapsules improved diagnoses and promoted the effects of radiotherapy on metastases.

CLINICAL RELEVANCE/APPLICATION

Imaging-targeted ICD and promotion of the abscopal effect by anti-CD47 siRNA, HMGB1, and ATP improved diagnoses and extended the effects of radiotherapy to metastases.

SSM22-04 Transient Hypoxia with Accelerated EPR pO2 Images using a Low-rank Tensor/navigator Projection Image Model

Wednesday, Dec. 2 3:30PM - 3:40PM Location: S104A

Participants
Howard J. Halpern, MD, PhD, Chicago, IL (Presenter) Nothing to Disclose
Boris Epel, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Zhi-Pei Liang, PhD, Urbana, IL (Abstract Co-Author) Nothing to Disclose
Anthony Christodoulou, Urbana, IL (Abstract Co-Author) Nothing to Disclose
Victor Tormyshev, PhD, Novosibirsk, Russia (Abstract Co-Author) Nothing to Disclose

PURPOSE

The role of transient hypoxia is an outstanding question in tumor physiology. Electron paramagnetic resonance (EPR) imaging has been shown to define regions of mouse tumors that are hypoxic and correlated the extent of this hypoxic region with sensitivity to radiation. Changes in hypoxia can significantly affect the relevance of such measurements. Thus we need to accelerate the rate at
which molecular oxygen images can be obtained.

**METHOD AND MATERIALS**

We developed a low-rank tensor image model to acquire and analyze dynamic pO2 maps from highly undersampled (k,t)-space data. The model represents a set of dynamic images collected with different pulse sequence parameters in a low-dimensional, time-varying parameter subspace. Correlations between images across time, parameter space (pO2), and location are captured and extends our previous work on accelerated parameter mapping using low-rank models and dynamic imaging using low-rank models. The model dictates a data acquisition scheme allowing direct determination of the time-varying parameter subspace and a reconstruction algorithm to recover high-quality images from highly undersampled (k,t)-space data using the resulting subspace constraint.

**RESULTS**

To demonstrate the model utility for dynamic pO2 imaging, we performed simulations and in vivo experiments. We will show results from a simulation using a numerical phantom for which one region experiences an instantaneous change in pO2. In vivo results were obtained from a mouse tumor image, wherein pO2 fluctuations were induced by cycling the fraction of inspired oxygen (FiO2), toggling the FiO2 with variable timing. 3D pO2 images at one time point as well as a graph of the pO2 variation over time for one voxel at the center of the tumor showed resolution and image quality of the low-rank tensor method to be superior to previous methods.

**CONCLUSION**

Low-rank tensor method captures oxygen fluctuations with a temporal resolution of 31 seconds.

**CLINICAL RELEVANCE/APPLICATION**

The oxygen variation frequency captured by this technique are comparable to the highest frequencies in the literature. This will show the biologic and clinical relevance of transient hypoxia.

**SSM22-06 DNA Double-strand Breaks in Blood Lymphocytes of Patients Undergoing Coronary CT: Comparison with the Physical CT Radiation Exposure Index**

**Wednesday, Dec. 2 3:50PM - 4:00PM Location: S104A**

Participants

Wataru Fukumoto, Hiroshima, Japan (Presenter) Nothing to Disclose

Mari Ishida, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Satoshi Tashiro, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Kenji Kajiwara, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Makoto Ida, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Kazuo Awai, MD, Hiroshima, Japan (Abstract Co-Author) Research Grant, Toshiba Corporation; Research Grant, Hitachi, Ltd;

Research Grant, Bayer AG; Research Grant, DAIICHI SANKYO Group; Medical Advisor, DAIICHI SANKYO Group; Research Grant, Eisai Co, Ltd; Research Grant, Nemoto-Kyourindo;

Chikako Fujioka, RT, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

Masao Kuguchi, RT, Hiroshima, Japan (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

DNA double-strand breaks (DSBs) are the most significant DNA damage inflicted by ionizing radiation (IR) and phosphorylated form of histon H2AX (γ-H2AX) has drawn attention as a DSB biomarker. However, it remains undetermined whether CT-induced DSBs are accurately estimated with γ-H2AX. The purpose of this study was to assess the DSBs induced by radiation exposure from coronary CT and to determine the relationship between γ-H2AX and the physical CT radiation exposure index, e.g. the CT dose index (CTDI), size-specific dose estimates (SSDE), and the dose length- and the SSDE length product (DLP, SSDE-LP).

**METHOD AND MATERIALS**

We obtained institutional review board approval and the written informed consent from 45 patients (40 men, 5 women, median age 63 years, range 30-76 years) with arrhythmia who underwent coronary CT before ablation therapy. Blood samples were obtained before- and 15 min- and a few days after CT performed before ablation therapy. We identified DSBs in lymphocytes as cytologically visible "foci" by using an antibody against γ-H2AX. For data analysis, we applied the Tukey-Kramer test. To assess the relationship between the physical CT radiation exposure index (CTDI, SSDE, DLP, and SSDE-LP) and increase rate of γ-H2AX ([15 minutes after CT - before CT]/before CT) and subjected the results to the Pearson correlation coefficient test.

**RESULTS**

The mean γ-H2AX foci number before CT, 15 min after CT, and a few days after CT were 1.21, 1.92, and 1.06 x10-3 foci/cell, respectively. The γ-H2AX foci number were significantly increased after CT and returned to baseline after a few days. The mean CTDI, SSDE, DLP, and SSDE-LP were 102.5 mGy, 138.2 mGy, 1560.5 mGy cm, and 1932.5 mGy cm, respectively. A statically significant correlation was observed between γ-H2AX foci number and CTDI, SSDE, DLP, and SSDE-LP (r=0.53, 0.54, 0.54, and 0.53).

**CONCLUSION**

DSBs were significantly increased after coronary CT and the radiation-induced γ-H2AX level correlated with the physical CT radiation exposure index.

**CLINICAL RELEVANCE/APPLICATION**

DSBs were induced by radiation exposure even after a single CT study. This finding alerts to the importance of reducing the radiation dose for CT.
**Personalized Medicine: Thorax**

**Thursday, Dec. 3 8:30AM - 10:00AM Location: S504AB**

**Participants**
Kristy K. Brock, PhD, Ann Arbor, MI (*Moderator*) License agreement, RaySearch Laboratories AB;

**Sub-Events**

**RC622A  Personalized Medicine: Thorax - Motion and IGRT**

Participants
Geoffrey Hugo, PhD, Richmond, VA, (gdhugo@vcu.edu) (*Presenter*) Research Grant, Koninklijke Philips NV; Research Grant, Varian Medical Systems, Inc

**LEARNING OBJECTIVES**
1) Understand how respiration impacts radiotherapy imaging and delivery and how to implement strategies to mitigate these issues.
2) Understand types and magnitude of geometric changes in thoracic anatomy during radiotherapy, and determine approaches to correct for discrepancies between the planned and delivered dose to the patient.

**ABSTRACT**
Radiotherapy is in widespread use for both early and advanced stage lung cancer, as a sole modality and also in combination with other modalities such as chemotherapy. Due to the potential for both acute and late toxicities in organs adjacent to treated regions, modern techniques seek to limit the extent of the high dose volume. The purpose of this session is to develop an understanding for how geometric and anatomic changes during radiotherapy can be managed. The focus will be on solutions readily available in the clinic today, particularly with respect to imaging modalities and planning solutions.

**RC622B  Functional Targeting and Adaptation**

Participants
Martha M. Matuszak, PhD, Ann Arbor, MI (*Presenter*) Research Grant, Varian Medical Systems, Inc

**LEARNING OBJECTIVES**
1) Understand the opportunities for targeting and avoidance based on functional imaging in lung. 2) Discuss the technical details of functional targeting for tumor and functional avoidance in normal tissue for lung cancer in the pre-treatment and adaptive settings.

**ABSTRACT**
Radiation therapy continues to play an important role in the treatment of lung cancer although many opportunities remain to improve local control and survival as well as reduce toxicity, especially in advanced stage lung cancer. The use of functional imaging and biomarkers to predict tumor burden and response as well as measure and predict normal tissue toxicity has begun to increase in the community. This session aims to summarize the different modalities and types of information available to perform functional targeting or avoidance of tumor and normal tissue in lung cancer, including imaging (such as PET and SPECT) and other data (such as blood-based biomarkers). The session will also highlight the technical details associated with the use of functional data for treatment planning, treatment response, and adaptation.
Radiomics Mini-Course: Oncologic Applications

Thursday, Dec. 3 8:30AM - 10:00AM Location: S103AB

Participants
Sandy Napel, PhD, Stanford, CA (Director) Medical Advisory Board, Fovia, Inc; Consultant, Carestream Health, Inc; Scientific Advisor, EchoPixel, Inc

Sub-Events

RC625A  Breast Cancer with PET-CT

Participants
Richard L. Wahl, MD, Saint Louis, MO (Presenter) Research Consultant, Nihon Medi-Physics Co, Ltd;

LEARNING OBJECTIVES
1) Describe the FDG pet uptake characteristics before therapy of 'triple - negative' breast cancers vs other subtypes.

ABSTRACT

Honored Educators
Presenters or authors on this event have been recognized as RSNA Honored Educators for participating in multiple qualifying educational activities. Honored Educators are invested in furthering the profession of radiology by delivering high-quality educational content in their field of study. Learn how you can become an honored educator by visiting the website at: https://www.rsna.org/Honored-Educator-Award/

Richard L. Wahl, MD - 2013 Honored Educator

RC625B  Radiogenomics of Lung Cancer

Participants
Michael D. Kuo, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To discuss the principles behind lung cancer radiogenomics. 2) Highlight clinical applications of lung cancer radiogenomics.

ABSTRACT

RC625C  Brain Cancer: Radiomics, Radiogenomics, and Big Data

Participants
Rivka R. Colen, MD, Houston, TX, (rcolen@mdanderson.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Define the field of radiomics and imaging genomics. 2) Apply radiomics and imaging genomics in brain tumors. 3) Describe the use of MRI as a biomarker for genomic signatures and profiles. 4) Define role of MRI in personalized medicine for target discovery of therapeutic targets. 5) Explain the use of MRI in drug development and clinical trials. 6) Assess the research available in imaging genomics and radiomics. 7) Define and describe the integration of radiomics and imaging genomics into big data platforms.

ABSTRACT

This objective of this course is to introduce the recently emerged field of radiomics and imaging genomics (radiogenomics) in brain tumors, specifically glioblastoma (GBM). Emphasis will be on radiomics with regards to the high-dimensional, high-throughput feature extraction of imaging features from medical images, specifically MRI; the second emphasis will be on the use of imaging in relation to underlying tumor genomics, how to use MRI as a biomarker, surrogate and correlate of tumor genomics as well as the use of MRI as a genomic target discovery tool and its application in therapeutic discovery and drug development. The role of radiomics and imaging genomics in the era of big data and how we can leverage the imaging-omic data will also be discussed.
**PURPOSE**

To investigate the value of dual energy spectral CT in differential diagnosis of pathological subtypes of renal cell carcinoma.

**METHOD AND MATERIALS**

75 cases of renal cell carcinoma (RCC), including 54 cases of clear cell RCC (CCRCC) and 21 cases of papillary RCC (PRCC) confirmed by following pathological experiments, were analyzed retrospectively. All patients underwent non-enhanced CT and dual-phase contrast enhanced CT with dual energy spectral mode. For each lesion, the CT value on monochromatic images of 40-140 keV and iodine concentration were measured, normalized iodine concentrations (NIC) was calculated by normalized to those of the aorta and spectrum curve slope was calculated according to the formula: the slope=(CT40keV-CT70keV)/30. Data was compared with student t test. Sensitivity and specificity of the quantitative parameters were analyzed by receiver operating characteristic curve. Quantitative parameters were analyzed by receiver operating characteristic curve.

**RESULTS**

NICs and spectrum curve slope of CCRCC differed significantly from those of PRCC during CP and PP: mean NICs were 0.41±0.17 vs 0.18±0.07 during CP, 0.80±0.21 vs 0.50±0.12 during PP; the mean slope were 5.21±1.82 vs 2.4±0.96 during CP, 3.35±0.87 vs 2.03±0.54 during PP (Table 1). The water concentration ratios of CCRCC and PRCC had no statistically significant during both phases (P>0.05). The CT value at 40 keV monochromatic images and NIC had higher sensitivity and specificity during AP than other parameters in differentiating CCRCC from PRCC.

**CONCLUSION**

Dual energy spectral CT with the quantitative analysis of iodine concentration may help increase the accuracy of differentiating pathological subtypes of renal cell carcinoma.

**CLINICAL RELEVANCE/APPLICATION**

Dual energy spectral CT may contribute to diagnosis of renal cell carcinoma preoperatively.
Glucosamine Augments Sensitivity of Cancer Cells to Radiation

PURPOSE
Glucosamine (GlcN), a supplement commonly used for the treatment of osteoarthritis, has been shown to decrease the incidence of adenocarcinoma of the lung and colon. GlcN has been shown to be toxic to cancer cells in vitro at concentrations attainable in humans. Here we hypothesize that GlcN, at a lower concentration, may sensitize cancer cells to ionizing radiation.

METHOD AND MATERIALS
Clonogenic survival assays with several human lung cancer cell lines in the presence of GlcN was performed. Cell lines were divided into two groups based on susceptibility to GlcN, and gene expression profiling was compared using the Cancer Cell Line Encyclopedia (CCLE) and ingenuity pathway analysis (IPA). Clonogenic assays with H460 incubated with GlcN at various time points and radiation was performed. Amount of apoptosis was measured with annexin-PI staining using flow cytometry. Cell cycle analysis was performed using flow cytometry.

RESULTS
Immortalized human cancer cell lines have varying susceptibility to GlcN and pathway analysis suggests that NOS signaling and production of reactive oxygen species are correlated to susceptibility. We show GlcN inhibits cell growth in a dose-dependent manner. GlcN acts as a radioprotectant when incubated with H460 cancer cells prior to radiation, while incubation with GlcN following radiation results in radiosensitization. Increased apoptosis is observed in H460 cell lines following treatment with GlcN or radiation alone. However combined treatment resulted in highest amount of apoptotic cells. In contrast, this was not observed in immortalized benign lung epithelial cell line (HBEC-3KT).

CONCLUSION
These findings demonstrate the promising potential for concurrent GlcN and radiation therapy in cancer treatment. Mechanisms by which this is observed will be further investigated.

CLINICAL RELEVANCE/APPLICATION
This investigation explores the potential of using a nutritional supplement to enhance cancer treatment. It also answers the question if it is safe for patients to take this supplement while receiving radiation therapy.
Interventional Oncology Series: Management of Hepatic Metastases from Colorectal Cancer and Neuroendocrine Tumors

Thursday, Dec. 3 1:30PM - 6:00PM Location: S405AB

Participants
Sarah B. White, MD, MS, Philadelphia, PA, (sbwhite@mcw.edu) (Moderator) Nothing to Disclose

ABSTRACT

LEARNING OBJECTIVES
1) To identify the role and timing of surgical resection of metastatic colorectal cancer in improving survival of patients. 2) To identify potential pitfalls and risks in implementing surgical resection with regional therapies to the liver. 3) To understand the evolving role of hepatic arterial infusional therapy in the management of patients with unresectable CRLM.

ADVANCED ONCOLOGY SERIES

VSIO51-01 Setting the Stage: NCCN/ESMO Guidelines for mCRC

Thursday, Dec. 3 1:30PM - 1:45PM Location: S405AB

Participants
Mary F. Mulcahy, MD, Chicago, IL (Presenter) Nothing to Disclose

VSIO51-02 Advances in the Surgical Toolbox for Colorectal Liver Metastases

Thursday, Dec. 3 1:45PM - 2:00PM Location: S405AB

Participants
Kiran Turaga, Milwaukee, WI (Presenter) Speakers Bureau, Caris Life Sciences; Consultant, Johnson & Johnson

LEARNING OBJECTIVES
1) To understand the role of ablation for colorectal metastases. 2) To identify which patients may be the best candidates for ablation. 3) To review the advantages/disadvantages of the liver ablation technologies.

VSIO51-03 Colorectal Liver Metastases: To Ablate or not to Ablate?

Thursday, Dec. 3 2:00PM - 2:15PM Location: S405AB

Participants
David A. Woodrum, MD, PhD, Rochester, MN (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To understand the role of ablation for colorectal metastases. 2) To identify which patients may be the best candidates for ablation. 3) To review the advantages/disadvantages of the liver ablation technologies.

VSIO51-04 K-ras Mutation is Associated with a Shorter Overall Survival after RF Ablation of Colorectal Liver Metastases

Thursday, Dec. 3 2:15PM - 2:25PM Location: S405AB

Participants
Waleed Shady, MBBCh, New York, NY (Presenter) Nothing to Disclose
Vassilios S. Sotirochos, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Elena N. Petre, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Etay Ziv, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Jeremy C. Durack, MD, New York, NY (Abstract Co-Author) Scientific Advisory Board, Adient Medical Inc Investor, Adient Medical Inc
Constantinos T. Sofocleous, MD, PhD, New York, NY (Abstract Co-Author) Consultant, Sirtex Medical Ltd
Stephen B. Solomon, MD, New York, NY (Abstract Co-Author) Research Grant, General Electric Company
Efsevia Vakiani, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Mithat Gonen, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose
Rona D. Yaeger, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Nancy Kemeny, MD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
To describe the incidence and patterns of genetic marker mutations, and to evaluate their potential prognostic value on local tumor progression (LTP)-free and overall survival (OS) after RFA of colorectal cancer liver metastases (CLM).
METHOD AND MATERIALS
We performed an IRB approved retrospective review of a HIPPA compliant clinical ablation database for patients with CLM treated with RFA between December 2002 and December 2012. Only patients with available genetic testing profiles were included. Genetic profiles were obtained by mass-spectrometry based sequenom assay of surgical/biopsy specimens obtained from primary/metastatic sites. Genes analyzed for mutations included: (1) k-ras, (2) K-ras and BRAF, or (3) an 8 gene panel (K-ras, N-ras, BRAF, PIK3CA, Akt1, MEK1, ERBB2, and EGFR). Kaplan-Meier methodology was used to calculate LTP-free and OS rates. The log-rank test was used to evaluate the prognostic value of genetic marker mutations.

RESULTS
This study enrolled 90 patients with 139 CLM. Median tumor size was 1.7 cm (range: 0.6-5 cm). The median follow-up was 52 months. Results for the mutation status were available for k-ras in all patients, for BRAF in 58 patients, and for the 8 genes in 23 patients. K-ras was mutated in 40% of patients (36/90), BRAF in 7% (4/58), PIK3CA in 17% (4/23), N-ras in 9% (2/23), and no mutations were observed for the other genes. There was a trend towards shorter median OS in patients with mutated genes; K-ras (29 months versus 46 months), BRAF (22 months versus 53 months), PIK3CA (22 months versus 51 months), N-ras (8 months versus 51 months). Statistical significance was only reached for K-ras (P=0.037) and N-ras (P=0.001), but not for BRAF (P=0.18) and PIK3CA (P=0.8). There was no difference in the LTP-rates with mutations of K-ras 46% (22/48) versus 42% (38/90) (P=0.26), BRAF 33% (2/6) versus 39% (43/88) (P=0.69), PIK3CA 0% (0/5) versus 39% (15/38) (P=0.16), or N-ras 50% (1/2) versus 34% 14/41 (P=0.17). There was a trend towards shorter LTP-free survival with K-ras mutations; median of 26 months versus 37 months.

CONCLUSION
Mutations of K-ras and N-ras are associated with a shorter overall survival after RFA of CLM. Mutations of K-ras are associated with a shorter LTP-free survival, although LTP rate was not statistically different.

CLINICAL RELEVANCE/APPLICATION
K-ras mutant patients require more strict follow-up and could benefit from adjuvant chemotherapy after RFA of CLM.

METHOD AND MATERIALS
We performed a retrospective review to identify patients who have undergone bland hepatic arterial embolization for the treatment of primary liver cancer or liver metastases that also had available a panel of genetic testing results—specifically, an assay that identifies mutations in any of 341 ‘druggable’ genes by sequencing tumor samples and comparing with germline mutations. A total of 10 patients were identified whose biopsy specimens were recovered either prior to or after embolization of the liver tumors. Of the ten patients identified, 4 had hepatocellular carcinoma (HCC), and the other 6 had non-HCC tumors included pancreatic neuroendocrine tumor (2), melanoma (1), thyroid (1), kidney carcinoid (1), and acinar cell tumor (1). We used principal component analysis for dimensionality reduction and to identify the genes which most contributed to the variance in the data. Patients were categorized using RECIST criteria as either responders (partial response or complete response) or non-responders (progressive disease or stable disease) post-embolization.

RESULTS
Of the ten patients identified, half demonstrated either complete response or partial response post-embolization (two of these were HCC patients). The rest were categorized as non-responders. A principal component analysis demonstrates that much of the variance in the data can be summarized by the two groups (responders and non-responders), and that the second principal component may predict tumor response to embolization (see Figure 1). The top genes contributing to this principal component are involved in cross-talk between the Wnt/B-catenin signaling pathway and hypoxia signaling pathway (see Table 1).

PALLIATIVE EMBOLOTHERAPY: NEW TECHNOLOGY, NEW PROMISES?
Thursday, Dec. 3 2:25PM - 2:40PM Location: S405AB

Participants
Tobias F. Jakobs, MD, Munich, Germany, (tobias.jakobs@barmherzige-muenchen.de) (Presenter) Speaker, Sirtex Medical Ltd;
Research Consultant, Sirtex Medical Ltd; Speaker, Siemens AG; Speaker, Terumo Corporation; Speaker, Surefire Medical, Inc;
Speaker, BTG International Ltd

LEARNING OBJECTIVES
1) Indications for palliative embolotherapy.2) Results of palliative embolization in mCRC patients.3) Products and devices for embolotherapy.

ABSTRACT
Embolisation has become an accepted modality of cancer treatment in patients with a variety of clinical scenarios. It is commonly used in clinical practice in the treatment of hepatocellular carcinoma, hepatic metastases from colorectal and breast cancer and neuroendocrine tumors. This review summarizes the current evidence for the efficacy of embolotherapy in mCRC patients, together with the associated complications and future options.

A GENE SIGNATURE TO PREDICT TUMOR RESPONSE TO HEPATIC ARTERIAL EMBOLIZATION
Thursday, Dec. 3 2:40PM - 2:50PM Location: S405AB

Participants
Etay Ziv, MD,PhD, New York, NY (Presenter) Nothing to Disclose
Elena N. Petre, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Stephen B. Solomon, MD, New York, NY (Abstract Co-Author) Research Grant, General Electric Company
Franz E. Boas, MD, PhD, New York, NY (Abstract Co-Author) Co-founder, ClaritPACS
Karen T. Brown, MD, New York, NY (Abstract Co-Author) Nothing to Disclose
Joseph P. Erinjeri, MD, PhD, New York, NY (Abstract Co-Author) Nothing to Disclose

PURPOSE
To identify a gene mutation signature that may potentially be used to predict tumor response to hepatic arterial embolization.

METHOD AND MATERIALS
We performed a retrospective review to identify patients who have undergone bland hepatic arterial embolization for the treatment of primary liver cancer or liver metastases that also had available a panel of genetic testing results—specifically, an assay that identifies mutations in any of 341 ‘druggable’ genes by sequencing tumor samples and comparing with germline mutations. A total of 10 patients were identified whose biopsy specimens were recovered either prior to or after embolization of the liver tumors. Of the ten patients identified, 4 had hepatocellular carcinoma (HCC), and the other 6 had non-HCC tumors included pancreatic neuroendocrine tumor (2), melanoma (1), thyroid (1), kidney carcinoid (1), and acinar cell tumor (1). We used principal component analysis for dimensionality reduction and to identify the genes which most contributed to the variance in the data. Patients were categorized using RECIST criteria as either responders (partial response or complete response) or non-responders (progressive disease or stable disease) post-embolization.

RESULTS
Of the ten patients identified, half demonstrated either complete response or partial response post-embolization (two of these were HCC patients). The rest were categorized as non-responders. A principal component analysis demonstrates that much of the variance in the data can be summarized by the two groups (responders and non-responders), and that the second principal component may predict tumor response to embolization (see Figure 1). The top genes contributing to this principal component are involved in cross-talk between the Wnt/B-catenin signaling pathway and hypoxia signaling pathway (see Table 1).
CONCLUSION

A gene mutation signature suggests that tumor response to embolization may be predicted by the underlying mutation profile of the tumor and moreover, suggests a central role for the involvement of hypoxia and Wnt/B-catenin signaling pathways.

CLINICAL RELEVANCE/APPLICATION

A gene signature that can predict tumor response to embolization may be used to better stratify patients as well as potentially broaden the scope of embolization to liver metastases not traditionally treated by this procedure.

Delayed-arterial Phase Cone-Beam CT Improves the Visibility of Liver Metastasis during Intra-arterial Therapy

Thursday, Dec. 3 2:50PM - 3:00PM Location: S405AB

Participants
Ruediger E. Schermenthaner, MD, Vienna, Austria (Presenter) Nothing to Disclose
Reham R. Haroun, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Rafael Duran, MD, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Howard Lee, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Sarah B. White, MD, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Jae Ho Sohn, MD, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Julius Chapiro, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose
Yan Zhao, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Boris Gorodetski, Baltimore, MD (Abstract Co-Author) Nothing to Disclose
Florian N. Fleckenstein, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Susanne Smolka, New Haven, CT (Abstract Co-Author) Nothing to Disclose
Ming De Lin, PhD, Cambridge, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Alessandro G. Radaelli, PhD, MS, Best, Netherlands (Abstract Co-Author) Employee, Koninklijke Philips NV
Martijn Van Der Bom, MSC, Andover, MA (Abstract Co-Author) Employee, Koninklijke Philips NV
Jean-Francois H. Geschwind, MD, Westport, CT (Abstract Co-Author) Researcher, BTG International Ltd; Consultant, BTG International Ltd; Researcher, Koninklijke Philips NV; Consultant, Koninklijke Philips NV; Researcher, Guerbet SA; Consultant, Guerbet SA; Consultant, Terumo Corporation; Consultant, Threshold Pharmaceuticals, Inc; Consultant, PreScience Labs, LLC; Researcher, Boston Scientific Corporation; Consultant, Boston Scientific Corporation

PURPOSE

Improved visibility of liver metastasis during intra-arterial therapy (IAT) could improve tumor targeting. The purpose of this study was to compare the visibility of liver metastasis on dual-phase cone-beam CT (DP-CBCT) and digital subtraction angiography (DSA), with reference to pre-interventional contrast-enhanced magnetic resonance imaging (CE-MRI) of the liver.

METHOD AND MATERIALS

Of 416 patients with liver metastasis treated with IAT between January 2010 and October 2014 at our institution, 15, 10 and 3 patients with neuroendocrine, colorectal and sarcoma liver metastasis (NELM, CRCLM and SLM), respectively, had intra-procedural DP-CBCT and were included in this retrospective study. DP-CBCT was acquired after a single injection of contrast agent in the tumor-feeding arteries at an early and delayed arterial phases (EAP and DAP). The visibility of each lesion was graded by two radiologists in consensus on a three rank scale (complete, partial and none) on DP-CBCT and DSA images when compared to CE-MRI. McNemar's test was used.

RESULTS

47 NELM, 45 CRCLM and 16 SLM lesions were included. On DSA, 59.6%, 15.6% and 18.8% of NELM, CRCLM and SLM lesions were completely depicted, respectively. Complete depiction rate on EAP-CBCT was significantly higher for CRCLM (44.4%; p<0.001), but significantly lower for NELM (40.4%; p=0.049) and similar for SLM (25%, p=1.0). On DAP-CBCT however, the highest rates of complete depiction were found - NELM (97.1%), CRCLM (91.1%) and SLM (100%), all p<0.001. Complete or partial depiction was achieved on DSA for 85.1%, 42.2% and 37.5% of NELM, CRCLM and SLM, respectively. EAP-CBCT yielded significantly higher sensitivities of 84.4% and 87.5% for CRCLM and SLM, respectively (p<0.02), but not for NELM (89.4%; p=0.625). DAP-CBCT again demonstrated the highest sensitivity at 100%, 95.6% and 100% for NELM, CRCLM and SLM, respectively (p<0.002). In summary, out of 108 metastatic liver lesions, 106 (98.1%) were at least partially depicted and only 2 (1.9%) CRCLM could not be identified on DAP-CBCT. In contrast, 43 (39.8%) lesions could not be identified on DSA.

CONCLUSION

DAP-CBCT significantly improves the visibility of liver metastasis during IAT and should be used as standard intra-procedural imaging technique.

mCRC Tumor Board

Thursday, Dec. 3 3:00PM - 3:30PM Location: S405AB

Participants
Michael C. Soulen, MD, Philadelphia, PA (Presenter) Royalties, Cambridge University Press; Consultant, Guerbet SA; Research support, Guerbet SA; Consultant, BTG International Ltd; Research support, BTG International Ltd; Consultant, Merit Medical Systems, Inc; Speaker, Sirtex Medical Ltd
Sarah B. White, MD, MS, Philadelphia, PA, (sbwhite@mwc.edu) (Presenter) Nothing to Disclose
Mary F. Mulcahy, MD, Chicago, IL (Presenter) Nothing to Disclose
Kiran Durug, Milwaukee, WI (Presenter) Speakers Bureau, Caris Life Sciences; Consultant, Johnson & Johnson
David A. Woodrum, MD, PhD, Rochester, MN (Presenter) Nothing to Disclose
Tobias F. Jakobs, MD, Munich, Germany, (tobias.jakobs@barmherzige-muenchen.de) (Presenter) Speaker, Sirtex Medical Ltd;
LEARNING OBJECTIVES

ABSTRACT

VSIO51-09 Setting the Stage mNET

Thursday, Dec. 3 3:40PM - 3:55PM Location: S405AB

Participants

Emily Bergsland, MD, San Francisco, CA (Presenter) Research funding, Novartis AG Research support, F. Hoffmann-La Roche Ltd Consultant, Pfizer Inc Consultant, Lexicon Pharmaceuticals, Inc Consultant, Novartis AG

LEARNING OBJECTIVES

1) Review the epidemiology and classification of gastroenteropancreatic neuroendocrine tumors (GEPNETs). 2) Discuss the role of somatostatin analogs for the treatment of GEPNETS. 3) Summarize the current systemic treatment options for metastatic GEPNETS. 4) Examine commonly applied treatment algorithms for advanced GEPNETS.

ABSTRACT

VSIO51-10 Aggressive Surgical Management in mNET

Thursday, Dec. 3 3:55PM - 4:10PM Location: S405AB

Participants

Robert E. Roses, MD, Philadelphia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss the role of liver resection or ablation in the multidisciplinary management of neuroendocrine tumors.

ABSTRACT

The management of neuroendocrine tumors has evolved considerably in recent years with the introduction of new systemic and local therapies. Surgery remains an important component of therapy. Indications for surgery for primary tumors and metastases as well nuances of therapy sequencing and multidisciplinary decision making will be discussed.

VSIO51-11 Imaging Biomarkers of Tumor Response in Neuroendocrine Liver Metastases Treated with Intraarterial Therapy: Can Whole Liver Response Patterns Predict Patient Survival?

Thursday, Dec. 3 4:10PM - 4:20PM Location: S405AB

Participants

Sonia P. Sahu, New Haven, CT (Presenter) Nothing to Disclose

Ruediger E. Schernthaner, MD, Vienna, Austria (Abstract Co-Author) Nothing to Disclose

Roberto Ardon, Suresnes Cedex, France (Abstract Co-Author) Employee, Koninklijke Philips NV

Julius Chapiro, MD, Berlin, Germany (Abstract Co-Author) Nothing to Disclose

Jae Ho Sohn, MS, Baltimore, MD (Abstract Co-Author) Nothing to Disclose

Florian N. Fleckenstein, MS, New Haven, CT (Abstract Co-Author) Nothing to Disclose

PURPOSE

Neuroendocrine liver metastases (NELM) usually appear diffuse and bi-lobar. However, conventional therapy response assessments (WHO, RECIST, mRECIST, and EASL) are lesion-based and thus challenging to implement in NELM patients. We propose a new approach that uses 3D liver segmentation to assess the total enhancing tumor volume (ETV). The purpose of this study was to investigate whether changes in ETV on contrast-enhanced T1 weighted MRI could be an early biomarker for survival after the first transarterial chemoembolization (TACE).

METHOD AND MATERIALS

This retrospective study included 51 patients (men: 28; median age: 58.3 years) with diffuse bi-lobar NELM who underwent MRI 3-6 weeks before and after the first TACE. Using prototype semi-automatic 3D software, two independent readers segmented the whole liver, placed a 1 cm3 region of interest (ROI) in healthy liver parenchyma, and measured the ETV in the arterial phase. Enhancement was defined as >2 standard deviations the average intensity of the ROI. Intraclass correlation (ICC) assessed inter-reader agreement. Paired t-test compared the ETV before and after TACE. If ETV decreased by ≥ 50%, patients were classified as responders. Survival analysis included Kaplan-Meier curves with the log-rank test and Cox-proportional hazards modeling. Baseline characteristics that were statistically significant on univariate analysis were adjusted for in the multivariate model.

RESULTS

Mean ETV decreased significantly after TACE from 1432.6 to 826.6 cm3 (p <0.01) and 20 (39.2%) patients were classified as responders. Responders had a significantly better prognosis than non-responders, with a median overall survival of 84.3 vs. 16.7 months, respectively (p<0.01). In univariate analysis, response was a significant predictor of survival (HR: 0.15, 95% CI: 0.06-0.39) and in the multivariate model adjusted for ECOG ≥1, portal vein thrombosis and extrahepatic disease, response was the only significant covariate (HR: 0.21, 95% CI: 0.08-0.60). Inter-reader agreement was high before and after TACE (ICC 0.999, 95% CI: 0.998-0.999, and ICC 0.998, 95% CI: 0.997-0.999, respectively).
CONCLUSION

Changes in the total enhancing tumor volume can identify NELM patients who will experience prolonged survival as early as 1 month after TACE.

CLINICAL RELEVANCE/APPLICATION

Total enhancing tumor volume in 3D is recommended as an early imaging biomarker for survival in NELM patients treated with TACE.

Intra-arterial Therapies of GEP-NET: Techniques and Indications

Thursday, Dec. 3 4:20PM - 4:35PM Location: S405AB

Participants
Thierry J. De Baere, MD, Villejuif, France (Presenter) Consultant, Terumo Corporation; Speaker, Medtronic, Inc; Consultant, General Electric Company; Consultant, Guerbet SA;

LEARNING OBJECTIVES

1) To understand particular natural history of NET metastases and indication for local therapies. 2) To know intra-arterial therapies available for NET inclusion bland embolization, TACE and radioembolization. 3) To know published results on efficacy of intra-arterial therapies on NET liver metastases. 4) To know about possible complications of intra-arterial therapies on NET liver metastases.

ABSTRACT

gastro-entero pancreatic-neuroendocrine tumors (GEP-NET) from small intestine and pancreas are most common cause of NET liver metastases. Grade 1 (carcinoid / < 2 mitoses / 10 microscopic fields and Ki-67 < 2%) and grade 2 (well- differentiated / 2 to 20 mitoses and Ki-67 from 3 to 20%) (1) are potential candidate for liver directed therapies where G3 carcinoma are candidate for systemic treatment (2). For secretory syndrome, liver directed therapies are second line treatment after somatostatin analogs. For control of tumor growth, liver directed therapies are used upon progression or for large tumor burden. Intra-arterial therapies combine occlusion of the tumor feeders, with or without chemotherapy or radiation therapy including trans-arterial chemoembolization (TACE), trans-arterial embolization (TAE), and radioembolization (RE). GEP NET liver metastases are usually bilobar and two sessions of treatment will be delivered sequentially 4-8 weeks apart to each lobes. If the tumors are in small number, hyper-selective will be delivered. Patients with >75% of liver involvement must be treated a few segments of liver at once, and will require several sessions.Contraindications includes liver insufficiency, obstructive jaundice, biloenteric anastomoses, portal vein thrombosis and renal insufficiency (3). In biloenteric anastomoses or portal vein thrombosis RE could be an interesting alternative in early reports (4). TACE using Lipiodol used for more than 20 years provides 52-86 % response on the secretory syndrome for over 12 months (5, 6). OS has a median of 38.6 months (33-55 months for non-pancreatic-NET and 23-43 months for pancreatic-NET) (7-9). Our recent unpublished data highlight a median OS of 7 year in 103 patients treated with TACE for G1 and G2 GEP NET. A review of 148 patients treated with 185 radio-embolization procedures (CR:2.7%, PR:60.5%, SD:22.7%, PD:4.9%) reported a Median OS of 70 months, with no radiation-induced liver disease (10). Grade 3 or higher adverse events were fatigue (6.5%), nausea (3.2%), pain (2.7%), and ascites (0.5%).

Y-90-4mNET

Thursday, Dec. 3 4:35PM - 4:50PM Location: S405AB

Participants
Steven C. Rose, MD, San Diego, CA (Presenter) Stockholder, Sirtex Medical Ltd; Proctor, Sirtex Medical Ltd; Scientific Advisory Board, Surefire Medical, Inc; Consultant, Surefire Medical, Inc; Consultant, Embolx, Inc


Thursday, Dec. 3 4:50PM - 5:00PM Location: S405AB

Participants
Johannes M. Ludwig, Pittsburgh, PA (Presenter) Nothing to Disclose
Yongkang Gai, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Sun Lingyi, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Dexing Zeng, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Hyun S. Kim, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

RESULTS

Fluorescence Microscopy showed specific binding of SW43-DOX-Cy3 in Panc-1, HT-29 & HEPG2 cells. Panc-1 cells showed a specific uptake of SW43-DOX-Lu177 at 5h (0.83 nmol/mg prot.), which increased to 1.36 and 1.21 nmol/mg prot. at 5h and 3h (p<.01) respectively. Compared to DOX, SW43-DOX demonstrated significantly superior viability reduction (at least p<.01 for all comparison) of PANc-1 cells treated with DOX or SW43-DOX: 98.7% vs. 64% (25μM) and 88.3% vs. 33.3% (50μM) after 6h; 46.6% vs. 30.6% (25μM) and 39.5% vs. 5.3% (50μM) after 24 h and 15% vs. 2.9% (25μM) and 9.5% vs. 0.54% (50μM) after 48 h. Results from HEPG2, besides 25 μM (6h) & 50 μM (48h), and HT-29 cells also proved statistical superioriy of SW43-DOX over DOX (p<.01). Loading on DEB was 95% within 24h.

Theranostic Approaches to the Management of Neuroendocrine Tumors

Thursday, Dec. 3 5:00PM - 5:15PM Location: S405AB

Participants
Chaitanya Dvigi, MD, New York, NY (Presenter) Nothing to Disclose

Intra-arterial Therapy in Liver Metastases: The 5 Best Papers of the Past Year?
LEARNING OBJECTIVES

1) To comprehend 5 interesting papers of the last year on intrarterial therapies of liver metastasis. 2) To update the evidence on mCRC intrarterial therapies. 3) To discuss the best laboratory research paper on the topic. 4) To discuss the largest published series on Y90 radioembolization outcome in mCRC. 5) To update the intrarterial therapies in mNET.

**mNET Tumor Board**

Thursday, Dec. 3 5:30PM - 6:00PM Location: S405AB

Participants

Michael C. Soulen, MD, Philadelphia, PA *(Presenter)* Royalties, Cambridge University Press; Consultant, Guerbet SA; Research support, Guerbet SA; Consultant, BTG International Ltd; Research support, BTG International Ltd; Consultant, Merit Medical Systems, Inc; Speaker, Sirtex Medical Ltd

Sarah B. White, MD, MS, Philadelphia, PA, (sbwhite@mcw.edu) *(Presenter)* Nothing to Disclose

Emily Bergsland, MD, San Francisco, CA *(Presenter)* Research funding, Novartis AG Research support, F. Hoffmann-La Roche Ltd Consultant, Pfizer Inc Consultant, Lexicon Pharmaceuticals, Inc Consultant, Novartis AG

Robert E. Roses, MD, Philadelphia, PA *(Presenter)* Nothing to Disclose

Thierry J. De Baere, MD, Villejuif, France *(Presenter)* Consultant, Terumo Corporation; Speaker, Medtronic, Inc; Consultant, General Electric Company; Consultant, Guerbet SA; Chaitanya Divgi, MD, New York, NY *(Presenter)* Nothing to Disclose

Ricardo D. Garcia-Monaco, MD, PhD, Buenos Aires, Argentina *(Presenter)* Consultant, CeloNova BioSciences, Inc; Consultant, BTG International Ltd; Speaker, Siemens AG
Hot Topic Session: Imaging-guided Radiation Therapy

Thursday, Dec. 3 3:00PM - 4:00PM Location: S404AB

Participants
Lei Xing, PhD, Stanford, CA (Moderator) Research Grant, Varian Medical Systems, Inc

Sub-Events

SPSH54A Projection and Volumetric X-ray Imaging and Their Roles in Image-Guided Radiation Therapy

Participants
Ning Jeff Yue, PhD, New Haven, CT, (yuenj@rutgers.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe the current status of x-ray imaging modalities that are used in radiotherapy 2) Explain the roles and importance of 2D, 3D and 4D x-ray Imaging in radiotherapy. 3) Assess the limitation of current x-ray imaging modality in radiotherapy. 4) Explore the potential imaging technical advancement in radiotherapy.

ABSTRACT

SPSH54B Recent Advancements in PET/CT and PET/CT-Guided Radiation Therapy

Participants
Stephen R. Bowen, PhD, Seattle, WA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Understand the role of 3D and 4D PET/CT in radiation therapy planning. 2) Understand the role of PET/CT in treatment response assessment for adaptive radiation therapy. 3) Describe image guidance techniques using PET/CT in charged particle therapy.

SPSH54C MRI-based Treatment Planning and Therapeutic Assessment - Where Do We Stand?

Participants
Lei Xing, PhD, Stanford, CA (Presenter) Research Grant, Varian Medical Systems, Inc

LEARNING OBJECTIVES
1) Present background knowledge of MR and MR simulation for radiation therapy. 2) Describe essential roles of MRI in radiation therapy treatment planning, target definition, treatment planning and verification, and therapeutic assessment. 3) Highlight recent advancements and emerging applications of MR imaging in radiation therapy.
The use of imaging and other biomarkers to increase the efficacy of treatment and decrease the risk of toxicity increased in the abdomen. Functional imaging and serum-based biomarkers can enable a more detailed understanding of the tumor, its characteristics, and early indications of its response to therapy. In addition, they can also be utilized to assess an individual patient risk for toxicity, enabling a personalized approach to radiotherapy. These advanced imaging techniques can be combined with anatomical information to generate high precision treatment plans which can be adapted over the course of treatment to account for identified uncertainties, changes, and deviations which may compromise the delivery of the intended treatment or identify the ability to re-optimize treatment to improve the therapeutic ratio. In this session, technical and clinical concepts will be described to design and deliver personalized radiotherapy in the abdomen. Technical concepts will include incorporation of multi-modality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaptation. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**Sub-Events**

**RC722A**  **IGRT and Anatomical Adaptation**

**Participants**
Kristy K. Brock, PhD, Ann Arbor, MI (Moderator) License agreement, RaySearch Laboratories AB;

**LEARNING OBJECTIVES**
1) Describe the processes necessary for the safe and accurate integration of multi-modality imaging for treatment planning. 2) Understand the role of image guidance for abdominal radiotherapy. 3) Illustrate methods to perform functional and anatomical adaptation in the abdomen.

**ABSTRACT**
The use of imaging and other biomarkers to increase the efficacy of treatment and decrease the risk of toxicity increased in the abdomen. Functional imaging and serum-based biomarkers can enable a more detailed understanding of the tumor, its characteristics, and early indications of its response to therapy. In addition, they can also be utilized to assess an individual patient risk for toxicity, enabling a personalized approach to radiotherapy. These advanced imaging techniques can be combined with anatomical information to generate high precision treatment plans which can be adapted over the course of treatment to account for identified uncertainties, changes, and deviations which may compromise the delivery of the intended treatment or identify the ability to re-optimize treatment to improve the therapeutic ratio. In this session, technical and clinical concepts will be described to design and deliver personalized radiotherapy in the abdomen. Technical concepts will include incorporation of multi-modality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaptation. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**RC722B**  **Functional Targeting, Clinical Goals, and Toxicity Risks**

**Participants**
Joseph M. Herman, MD, MSc, Baltimore, MD (Presenter) Consultant, Merrimack Pharmaceuticals, Inc

**LEARNING OBJECTIVES**
1) Review methods to obtain, process and analyze tissue and serum based biomarkers for abdominal tumors. 2) Describe current dose/fractionation regimens as well as normal tissue constraints utilized in treating abdominal tumors. 3) Explain potential advantages of assessing treatment response with MRI and quantitative PET/SPECT (PERCIST) imaging over CT based response (RECIST) in abdominal tumors.

**ABSTRACT**
In order to deliver personalized radiation therapy in abdominal tumors, it is important to understand the methods used to obtain, analyze, and interpret serum and tissue-based biomarkers. Most research to date has focused on identifying specific biomarkers used to personalize systemic or targeted therapies. Radiation-specific biomarkers are emerging and may eventually be used to determine whether radiation is indicated or identify specific radiation sensitizers for use in abdominal tumors. Radiation therapy planning has historically used computed tomography (CT)-based imaging. Molecular imaging using hybrid positron emission tomography (PET)/CT scanning or single-photon emission computed tomography (SPECT) imaging and functional magnetic resonance imaging (MRI) has provided new insights into the precise identification of gross tumor volume (GTV) and clinical tumor volume (CTV) and has provided response information during and after therapy. The effective use of PET/SPECT and MRI in clinical practice, however, requires an appreciation of the unique challenges inherent to these modalities. Fundamental physical issues of limited spatial resolution relative to the biological process, partial volume effects, image misregistration, motion management, and edge delineation must be carefully considered and can differ by agent or the method applied. Integration of PET/SPECT and MRI imaging into multicenter clinical trials and clinical practice can be particularly challenging due to differences in imaging protocols, machines, and anatomy. Imaging protocols that clearly outline scan and fusion parameters are crucial. Further, interpretation of tumor response should be standardized, and scans should be obtained at consistent time intervals. In addition, it is important to consider novel tracers of tumor biology (e.g. hypoxia, proliferation, apoptosis) beyond the commonly used radiotracers. In this
session, we will discuss these applications and challenges as well as provide guidance on how to integrate PET/SPECT/MRI into radiation treatment planning and assessing treatment response. Finally, we will evaluate common dose and fractionation regimens as well as established dose constraints used in treating abdominal tumors with conventional and stereotactic body radiation therapy.
Participants
Mahadevappa Mahesh, MS, PhD, Baltimore, MD (Moderator) Author with royalties, Wolters Kluwer nv

ABSTRACT
Radiation incidents in diagnostic radiology and radiation oncology is never a favorite item for anyone. Many a times, a single error or miss may lead to devastating result and can shine media spotlight. The purpose of this refresher course is to address this issue from various stake-holders. The course includes a tag-team of physicians-physicists addressing what one needs to next after a radiation incident occurs. The main objective of this refresher course is to provide ways audience can implement in their settings to address such events.

Sub-Events
RC724A Radiation Incidents in Diagnostic Radiology: What Does the Physicist Do Next?

Participants
Mahadevappa Mahesh, MS, PhD, Baltimore, MD, (mmahesh@jhmi.edu) (Presenter) Author with royalties, Wolters Kluwer nv

LEARNING OBJECTIVES
1) To examine settings to ensure radiation incidents do not occur. 2) To develop plan of action for post radiation incident evaluation. 3) To reflect on processes such as quality control, training etc.

ABSTRACT
Even though radiation incidents in diagnostic radiology may not be as life threatening as in radiation oncology, yet it is equally important to devise plans of action to address radiation incidents in diagnostic radiology. This talk will discuss various measures medical physicists can do to address such situations. Defining radiation incidents in diagnostic imaging settings are key. Radiation incidents can lead to deterministic effects such as hair-loss or skin erythema, which are rare but possible due to prolonged fluoroscopy procedures or CT scans (CT perfusion studies) due to incorrect settings. Even though prevention is better and is achievable by routine review of equipment and protocol settings, but when radiation incidents occur, a physicist can do the following. First, physicist should record details of scan settings that have led to the radiation incident. Next, it is important to assess and make necessary changes to the scan settings to avoid future incidents. This should be followed by detail assessment of radiation exposure to patients (skin dose and organ dose) and work with the radiologists and other physicians to address the radiation events. In addition, tasks including regulatory compliance, staff training, and others will be discussed in this talk.

RC724B Radiation Incidents in Radiation Oncology: What Does the Physicist Do Next?

Participants
Eric Ford, PhD, Seattle, WA, (eford@uw.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Appreciate the systems-based approach to addressing the underlying causes of incidents. 2) Understand the medical physicist's specific role in this. 3) Gain familiarity with emerging error reduction tools in radiation oncology.

ABSTRACT
Incidents in healthcare are a symptom of an underlying condition. In order to improve the quality and safety of care one must address these underlying conditions and not just the particulars of an incident itself. What is the physicist’s role in this? In its simplest form, the medical physicist in radiation oncology performs quality assurance tests and commissioning procedures to ensure that the next incident does not happen. These tasks are often prescriptive in nature. As a quality management expert, though, the medical physicist’s contribution extends far beyond these routine duties into the realm of understanding and controlling clinical process at the broadest level. There is an array of emerging tools from the AAPM and elsewhere that enable this. It is now possible, for example, to characterize and quantify the risks associated with clinical processes. It is also possible to benchmark performance in safety-critical area against other clinics. And it is possible to participate in incident investigation and learning through the newly released national incident learning system. All of these activities are core competencies of a medical physicist in radiation oncology in the modern era. By leading and participating in such efforts the medical physicist has a direct impact on improving the quality and safety of care.

RC724C Radiation Incidents in Diagnostic Radiology: What Does the Diagnostic Radiologist Do Next?

Participants
Kimberly E. Applegate, MD, MS, Zionsville, IN, (keapple@emory.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To describe common incidents and their root cause in diagnostic radiology departments where patients are exposed to unintended radiation doses. 2) Understand both qualitative and quantitative metrics in a radiology safety program. 3) Provide examples of quality assurance and improvement projects based on a safety event and that promote a culture of safety.
ABSTRACT
Safety is necessary but not sufficient to ensure quality healthcare. Radiology departments and healthcare systems must be in alignment with their programs on safety culture, policies, and practice to best minimize patient harm. When events happen—and they will—it is critical to understand how to disclose them, how to learn from them, and how to improve processes so that future patients in the system may not be harmed. Further, it is important that the culture of the radiology department embraces learning from near misses that provide the opportunity to improve practice before a patient is harmed. This lecture will share stories that led to quality improvement projects.

RC724D Radiation Incidents in Radiation Oncology: What Does the Radiation Oncologist Do Next?

Participants
Naomi R. Schechter, MD, Los Angeles, CA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Describe strategies for responding to variety of potential near misses and errors in radiation oncology department as pertains to individual patient care. 2) Describe strategies for learning from near misses and errors in radiation oncology department for purpose of quality improvement and prevention of future errors.

ABSTRACT
In a radiation oncology department, incidents can range from minor to severe. We take them all seriously. Due to our many checks and balances, it is unusual for an error to reach the patient. In the rare case that an error does reach the patient, most can be corrected for, with minimal if any harm to the patient. Our goal is to learn from every incident, review our processes and continually improve the delivery of radiation therapy to prevent future errors from occurring.
Interventional Series: Complications in Interventional Oncology-Avoidance and Damage Control
Friday, Dec. 4 8:30AM - 12:00PM Location: N228

AMA PRA Category 1 Credits ™: 3.25
ARRT Category A+ Credits: 3.75
FDA Discussions may include off-label uses.

Participants
Charles E. Ray JR, MD, PhD, Chicago, IL (Moderator) Advisory Board, Novate Medical Ltd; Editor, Thieme Medical Publishers, Inc.; ; ; ;
Robert J. Lewandowski, MD, Chicago, IL (Moderator) Advisory Board, BTG International Ltd; Advisory Board, Boston Scientific Corporation; Consultant, Cook Group Incorporated; Consultant, ABK Medical Inc

LEARNING OBJECTIVES
1) List 2 important recent publications in interventional oncology. 2) Explain the mechanism of one complication related to thermal ablation. 3) Describe 1 pitfall of radioembolization. 4) Outline 3 complications in combination therapy for hepatocellular carcinoma. 5) List three complications of chemo-embolization.

ABSTRACT

Sub-Events
RC814-01 Chemoembolization Complications
Friday, Dec. 4 8:30AM - 8:45AM Location: N228

Participants
Charles E. Ray JR, MD, PhD, Chicago, IL (Presenter) Advisory Board, Novate Medical Ltd; Editor, Thieme Medical Publishers, Inc.; ; ; ;

LEARNING OBJECTIVES
View learning objectives under main course title.

RC814-02 DNA ChemoFilter: Novel Method to Prevent Toxicity from Intra-Arterial Administration of Chemotherapeutic
Friday, Dec. 4 8:45AM - 8:55AM Location: N228

Participants
Mariam S. Aboian, MD, PhD, San Francisco, CA (Presenter) Nothing to Disclose
Chia-Hung Sze, MS, San Francisco, CA (Abstract Co-Author) Researcher, ChemoFilter Inc
Jay F. Yu, MS, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Ayushi Gautam, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Prasheel Lillaney, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
David M. Wilson, MD, PhD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Anand S. Patel, MD, San Francisco, CA (Abstract Co-Author) Stockholder, ChemoFilter, Inc Officer, ChemoFilter, Inc
Mark W. Wilson, MD, San Francisco, CA (Abstract Co-Author) Nothing to Disclose
Steven W. Hetts, MD, San Francisco, CA (Abstract Co-Author) Consultant, Silk Road Medical Inc Consultant, Medina Medical Inc Research Grant, Stryker Corporation Data Safety Monitoring Board, Stryker Corporation

PURPOSE
Chemofilter is a novel medical device that limits systemic toxicity of chemotherapeutics by filtering non-target drug from blood that could be described as intra-vascular dialysis. This method has a potential to prevent toxicity associated with treatment of head and neck cancer, such as renal failure associated with cisplatin. We report a novel method to bind chemotherapeutics in blood that uses immobilized DNA as a platform for binding chemotherapeutics with intrinsic DNA binding activity.

METHOD AND MATERIALS
DNA binding experiments were carried out in vitro with doxorubicin in PBS solution. Genomic DNA was used to determine the concentration of DNA that shows optimum binding kinetics. Binding kinetics in nylon mesh of different pore size was evaluated.

RESULTS
DNA binding kinetics by doxorubicin is dose dependent and is very rapid with 94% decrease in drug concentration from solution within 1 minute of reaction time. DNA demonstrates faster binding kinetics by doxorubicin as compared to previously published polystyrene resin that uses ion exchange to filter doxorubicin out of the solution. DNA sequestered within the Nylon mesh demonstrates approximately 70% decrease in doxorubicin concentration from solution within 5 minutes.

CONCLUSION
DNA ChemoFilter demonstrates rapid binding of doxorubicin and is a model for filtration of DNA binding chemotherapeutics from the bloodstream.

CLINICAL RELEVANCE/APPLICATION
DNA ChemoFilter is optimized for DNA intercalating chemotherapeutics and minimizes their systemic toxicity after intra-arterial administration for treatment of liver and head and neck malignancies.
Repetitive Transarterial Chemoocclusion with Degradable Starch Microspheres (DSMs-TACO) of Unresectable Hepatocellular Carcinoma: A Single Center Experience

Friday, Dec. 4 8:55AM - 9:05AM Location: N228

Participants
Fabrizio Chegal, MD, Rome, Italy (Presenter) Nothing to Disclose
Antonio Orlacchio, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Stefano Merolla, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Laura Greco, Roma, Italy (Abstract Co-Author) Nothing to Disclose
Elisa Costanzo, Rome, Italy (Abstract Co-Author) Nothing to Disclose
Giovanni Simonetti, MD, Rome, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
To evaluate the efficacy and safety of trans-arterial chemo-occlusion (TACO) using Degradable-Starch-Microspheres (DSMs) for unresectable hepatocellular carcinoma (HCC) treatment.

METHOD AND MATERIALS
We prospectively enrolled 28 HCC cirrhotic patients (23/5 M/F, mean age 66.3±10.5 years), to be treated with three repeated DSMs-TACO procedures (225 mg of DSMs, Embocept®, PharmaCept and Doxorubicin Cloridrate, 50 mg/m2), performed at 4-6 week intervals. Patients were clinically evaluated before and after each procedure and disease severity scored according to Child Pugh and MELD scores. Treatment response was assessed by CT-scan 4 weeks after each procedure, according to mRECIST criteria.

RESULTS
Complete response (CR) was observed in 6 (20.8%), 11 (37.5%) and 14 (58.3%) patients after the first, second and third procedure, respectively. At the end of the treatment course all patients experienced at least a partial response. Patients with monolobar disease (16/28: 57.1%) showed higher CR rates after the first procedure compared to those with bilobar HCC (6 vs 0, p=0.017). No differences between mon or bi-lobar disease were observed in CR (64.2% vs 50%; p=ns). Eight patients (33.3%) did not complete the planned repeated procedures. In most cases treatment discontinuation was due to worsening liver function, mainly in patients with more advanced liver disease.

CONCLUSION
DSMs-TACO offers a valid therapeutic option in patients with unresectable HCC. A careful patients selection is required in order to avoid worsening liver function in patients with borderline liver compensation. Further investigations to establish the best treatment schedule and to define the effect of DSMs-TACO on survival are required.

CLINICAL RELEVANCE/APPLICATION
Temporary embolization of the hepatic artery using DSMs is feasible and safe in patients with HCC and an impaired liver function.

Repeated Transarterial Radioembolization Using 90Y

Friday, Dec. 4 9:05AM - 9:15AM Location: N228

Participants
Francesco Somma, MD, Napoli, Italy (Presenter) Nothing to Disclose
Roberto D’Angelo, MD, Naples, Italy (Abstract Co-Author) Nothing to Disclose
Gianluca Gatta, Naples, Italy (Abstract Co-Author) Nothing to Disclose
Francesco Fiore, MD, Naples, Italy (Abstract Co-Author) Nothing to Disclose
Giovanni Pecoraro, Napoli, Italy (Abstract Co-Author) Nothing to Disclose

PURPOSE
Our purpose is to assess effectiveness and safety of Trans-arterial Radioembolization (TARE) using microspheres containing 90Y in case of advanced HCC with thrombosis of both portal branches.

METHOD AND MATERIALS
Between March 2010 and March 2013, 41 TARE were performed in 33 patients with unresectable HCC and bilirubine values up to 2.8 mg/dl. Among these, 23 had one portal branch thrombosis and 11 had thrombosis of both portal branches. Multislice Computed Tomography (MSCT) scans and angiography were used to assess the baseline burden and the follow-up studies according to the modified RECIST guideline. Some patients underwent the embolization of the Gastro-duodenal artery, using micro-coils. In these cases, a previous study was performed with the injection of TC-99MAA through a 3F microcatheter. Proton-Pump Inhibitors (PPI) were administered to prevent gastritis and ulcers.

RESULTS
The average dose administered was 1.8GBq. After the treatment, a post-embolization syndrome was found in 31/41 patients with no statistically significant difference between patients with portal thrombosis and those without. According to the RECIST guideline at least a partial response was found in 33/41 (79%) of cases three months after the procedure and in 35/41 (88%) at nine months. At two-year follow-up, patients with thrombosis of two portal branches presented survival rates similar to patients with one portal branch thrombosis, and only slightly inferior if compared to patients without thrombosis. Moreover, a retraction of portal vein thrombosis was registered in more than 60% of patients with thrombosis (21/34).

CONCLUSION
TARE showed to be a safe and effective locoregional treatment of locally advanced HCC, even in case of patients with portal vein thrombosis. Indeed, it does not worsen the post-embolization symptoms, while helping retracting portal vein thrombosis if present. Therefore, this condition not only has no impact on TARE, but represents an indication, even in case of thrombosis of both portal branches.
**RC814-05 Irreversible Electroporation (IRE) of Malignant Liver Tumors Close to Major Portal or Hepatic Veins Does not Influence Perfusion of Hepatic or Portal Veins but Can Result in Bile Duct Strictures**

Friday, Dec. 4 9:15AM - 9:25AM Location: N228

Participants

Martina Distelmaier, Aachen, Germany (Presenter) Nothing to Disclose
Alexandra Barabasch, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Nils A. Kraemer, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Heil, Aachen, Germany (Abstract Co-Author) Nothing to Disclose
Christiane K. Kuhl, MD, Bonn, Germany (Abstract Co-Author) Nothing to Disclose
Philipp Bruners, MD, Aachen, Germany (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

IRE has been proposed as a non-thermal ablation method that offers specific advantages over thermal ablation, notably absence of heat sink effect and preservation of both, blood vessels and bile ducts. The purpose of our study was to verify the theoretical advantages of IRE by systematically investigating clinical efficacy and complications of percutaneous IRE for hepatic malignancies located immediately adjacent to major portal and bile ducts or hepatic veins. We were specifically interested in the long-term patency of adjacent venous and biliary vessels.

**METHOD AND MATERIALS**

CT-guided percutaneous IRE of 37 primary or secondary liver malignancies (mean size 17 mm; range 7-44 mm) was performed in 27 patients (mean age 59 y; 13 men). All lesions were located immediately adjacent to major hepatic veins (n=16), portal vein branches or both (n=21) and therefore not suitable for RFA or MWA. Per standard IRE protocol, 3 to 5 probes (active tip length 1.5-2.5 cm) were placed strictly parallel under CT-guidance. All patients underwent systematic follow-up by CT or MRI.

**RESULTS**

No major procedure-related complications were observed. All adjacent major portal or hepatic veins remained perfused even at long term follow-up. Complete ablation of the target was achieved in 34/37 (92%) cases with a safety margin of 5-10 mm, confirmed by CT and MRI. In 9 cases (24%) local recurrences within or adjacent to the ablation zone were observed between 1-12 months after treatment. 5 patients with tumors located next to portal veins/ bile ducts (5/21=24%) developed mild to moderate segmental/lobar cholestasis, not requiring treatment. In one patient a clinically asymptomatic arterio-portal fistula developed.

**CONCLUSION**

IRE for primary and secondary liver malignancies located adjacent to large portal or hepatic veins proved to be safe and effective with regards to local control, and will leave venous blood vessels unaffected. Bile duct strictures may, however, occur, in up to 25% of lesions located close to portal structures.

**CLINICAL RELEVANCE/APPLICATION**

CT-guided IRE is a useful ablation method for primary and secondary liver tumors that are not amenable to thermal ablation (RFA, MWA). While blood vessels are preserved, bile duct stricutures do occur.
ABSTRACT

Not applicable.

RC814-09 Incidence of Tumor Seeding after Percutaneous Radiofrequency Ablation of Hepatocellular Carcinoma: A Six Year Experience in 581 Nodules in 305 Consecutive Patients

Friday, Dec. 4 10:25AM - 10:35AM Location: N228

Participants
Somrach Thamtorawat, MD, Los Angeles, CA (Presenter) Nothing to Disclose
Steven S. Raman, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose
Justin P. McWilliams, MD, Santa Monica, CA (Abstract Co-Author) Nothing to Disclose
Michael L. Doueck, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
Simin Bahrami, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose
David Y. Lu, MD, Los Angeles, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Tumor seeding along the needle tract or peritoneum is dreaded complication of percutaneous liver ablation, especially in potential liver transplant patients with a reported incidence up to 4.4%. Therefore, the objective of our study was to determine the incidence of tumor seeding after percutaneous RF ablation of hepatocellular carcinoma (HCC).

METHOD AND MATERIALS

With IRB approval and HIPAA compliance, our institutional clinical database was queried to access all patients who had development of one or more extrahepatic recurrences in the skin, subcutaneous tissues, or peritoneum from March 2006 to December 2012. The study cohort consisted of 305 consecutive patients (217 men and 88 women) and a total of 498 RFA sessions. All lesions were treated with single, double or cluster internally cooled straight electrodes mated to a 200W generator and switching controller (Covidien, Boulder Co) by one of four experienced interventionalists. Tract ablation was used in almost all cases. Six patients were treated by using combined ethanol injection.

RESULTS

Over a 6 year period, 581 HCC nodules were treated by RF ablation with a mean follow up of 28±16 months (range from 3-66 months). Tumor seeding was evaluated by pathological report of explant liver in 96 patients and by imaging follow up in 209 patients. During this time in two patients, single chest wall nodules were detected in or near the needle tract (0.3% per nodule, 0.6% per patient) in the setting of extrahepatic metastases. One nodule was detected at 5.3 months post ablation concurrent with lymph node metastasis. The other nodule was detected at 18.3 month after liver transplantation in a patient with concurrent lung metastases. In both cases, the ablated nodules were subcapsular, poorly differentiated on concurrent biopsy with direct electrode insertion into the nodule. There was no further lesion treatment due to advanced metastatic disease.

CONCLUSION

In this series, no needle tract seeding was detected in patients without concurrent extrahepatic metastases. However, with two solitary chest wall nodules at or near the needle tract, the possible risk of tumor seeding after RF Ablation of HCC was 0.3% per nodule and 0.6% per patient. Both nodules were poorly differentiated and subcapsular.

CLINICAL RELEVANCE/APPLICATION

Using optimal technique, there is very low risk of possible tumor seeding after percutaneous radiofrequency ablation of hepatocellular carcinoma.

RC814-10 Utility and Safety of Radiofrequency Ablation for Focal Hepatic Lesions Adjacent to Gallbladder in Ablating between GB Fossa and Contralateral Safety Margin

Friday, Dec. 4 10:35AM - 10:45AM Location: N228

Participants
In Young Choi, MD, Seoul, Korea, Republic Of (Presenter) Nothing to Disclose
Pyo Nyun Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Hyung Jin Won, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
So Yeon Kim, MD, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose
Yong Moon Shin, Seoul, Korea, Republic Of (Abstract Co-Author) Nothing to Disclose

PURPOSE

To evaluate safety and therapeutic efficacy of radiofrequency (RF) ablation for treatment of focal hepatic lesions (FHL) adjacent to gallbladder (GB) with reduction of ablation time and rearrangement of electrode.

METHOD AND MATERIALS

We retrospectively evaluated 36 patients who underwent RF ablation of FHL adjacent to GB(less than 10mm) from January 2011 to March 2014. Follow-up period was ranged from 9 to 50 months (mean, 25 months). The electrode was inserted parallel direction to GB. Patients were divided into two subgroups based on whether the lesion was abutting GB (less than 5mm, n=17) or not (more than 5mm, n=19). In abutting group, the electrode was inserted eccentrically after measuring the diameter between GB fossa and contralateral safety margin and ablation time was decreased for reducing the diameter of ablated zone in horizontal axis to GB. Fourteen of abutting group were performed with artificial ascites (5% dextrose aqueous solution) and 8 of non-abutting group were performed with artificial ascites. A panel of radiologists blinded to the patients’ clinical histories reviewed immediate follow up CT for complication and late follow up CT for local tumor progression. Statistical evaluation was performed with Chi-square test and
Fisher's exact test.

RESULTS

There were no major complications in both groups. Enhancing wall thickening of GB adjacent to RFA zone was noted in 19.4% (7/36, abutting group; 5, non-abutting group; 2) and it disappeared on subsequent follow-up imaging. There is no statistically significant difference between abutting group and non-abutting group (p >0.05). The technical success rate based on immediate follow-up and one-month follow-up CT was 94.4% (34/36) and two patients remained enhancing foci on immediate follow up (1 abutting group, 1 non-abutting group) and they were retreated successfully. Local tumor progression of completely ablated tumors during follow-up period less than 6 months was noted in two patients (2/34, 1 abutting group, 1 non-abutting group). Except these two patients, there was no local tumor progression during follow-up periods.

CONCLUSION

RF ablation can be a safe and effective treatment for FHL adjacent to GB with rearrangement of electrode and reduction of ablation time.

CLINICAL RELEVANCE/APPLICATION

The treatment of FHL adjacent to GB is challenging issue. RF ablation may be a safe and effective treatment option even though the lesion is located right beside GB.

RC814-11 Combination Therapy Complications
Friday, Dec. 4 10:45AM - 11:00AM Location: N228

Participants
Thuong G. Van Ha, MD, Chicago, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC814-12 Complications due to Imaging Errors
Friday, Dec. 4 11:00AM - 11:15AM Location: N228

Participants
Aradhana M. Venkatesan, MD, Houston, TX, (avenkatesan@mdanderson.org) (Presenter) Institutional research agreement, Koninklijke Philips NV

LEARNING OBJECTIVES

View learning objectives under main course title.

ABSTRACT

RC814-13 Tumor Board-Ask the Experts
Friday, Dec. 4 11:15AM - 11:30AM Location: N228

Participants
Charles T. Burke, MD, Chapel Hill, NC (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

RC814-14 Literature Review: The Most Important IO Papers from the Past 5 Years that Everyone Should Know
Friday, Dec. 4 11:30AM - 11:45AM Location: N228

Participants
Ryan Hickey, MD, Chicago, IL (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

View learning objectives under main course title.

Handout: Ryan Hickey
http://abstract.rsna.org/uploads/2015/15002217/The Most Important IO Papers from the Past 5 years that Everyone Should Know.docx

RC814-15 Questions and Wrap-up
Friday, Dec. 4 11:45AM - 12:00PM Location: N228

Participants
**LEARNING OBJECTIVES**

1) An important aspect of Nuclear Medicine and Molecular Imaging is that the same core compound of the administered radiopharmaceutical can be labeled with both gamma emitters (for diagnostic) and beta (or alpha) emitters (for therapy), allowing for the targeted treatment of lesions. This is an expression of theranostics, the combination of therapy and diagnostics that is based on the specific tumor biology of each patient's disease. This proposed session will provide several examples of such paired diagnostic studies and treatments using Nuclear Medicine methods.

**Sub-Events**

**SPN61A** Radioactive Iodine and Thyroid Cancer - Current Use and Controversies

Participants
Douglas Van Nostrand, MD, Washington, DC, (douglas.van.nostrand@medstar.net) (Presenter) Speakers Bureau, sanofi-aventis Group

**LEARNING OBJECTIVES**

1) Define remnant ablation, adjuvant treatment, and treatment of locoregional/distant metastases. 2) Discuss the indications and controversies of 131I for each. 3) Discuss the range of prescribed activity of 131I for each.

**SPN61B** Bone Scintigraphy and the Use of Radionuclides in the Management of Patients with Metastatic Castrate-Resistant Prostate Cancer

Participants
Hossein Jadvar, MD, PhD, Los Angeles, CA, (jadvar@med.usc.edu) (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To review bone scintigraphy with single photon and PET radiotracers in the imaging evaluation of patients with prostate cancer. 2) To summarize the results of the ALSYMPCA clinical trial for 223Ra dichloride therapy in patients with castrate resistant metastatic prostate cancer.

**SPN61C** Updates on the Use of PET/CT (and PET/MRI) and Radioimmunotherapy in NHL

Participants
Erik S. Mittra, MD, PhD, Stanford, CA (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

View learning objectives under main course title.

**SPN61D** Peptide Receptor Radionuclide Imaging and Therapy: Where Are We in Europe and What Shall the US Do to Catch Up?

Participants
Frederik L. Giesel, MD, MBA, Heidelberg, Germany (Presenter) Nothing to Disclose

**LEARNING OBJECTIVES**

1) To understand the concept of theragnostic. 2) Identify promising candidates for PRRT. 3) Challenges and limitations of PRRT. 4) Future perspective using alpha-emitters.

**ABSTRACT**

Well-differentiated neuroendocrine tumors (NETs) demonstrate modest responses to conventional chemotherapy due to their slow proliferation rate. However, the expression of somatostatin receptors by NET enables targeting with high affinity peptides. When these octreotide analogue peptides are labelled with beta emitters such as 90Y or 177Lu promising anti-tumor effects have been observed. The presentation will introduce the concept of theragnostic (68Ga-DOTATOC and 90Y/177Lu-DOTATOC) for improved patient stratefication. Today, PRRT is well established for a long time in NET-patients. However challenges and limitations will be discussed in regard to other systemic therapies such as everolimus or sunitinib. Finally, outlook will be given in regard to the novel of targeted alpha therapy in NET-patients and its implication to other tumor entities.
Selective Internal Radiation Therapy for Hepatic Malignant Lesions

Ghassan El-Haddad, MD, Tampa, FL, (ghassan.elhaddad@moffitt.org) (Presenter) Speaker Bureau, Bayer AG

LEARNING OBJECTIVES

View learning objectives under main course title.
**SST13-01 Reproducibility of F18-FDG PET Radiomics Features through Different Cervical Tumors Delineation Methods**

**Participants**
Kamil M. Yenice, PhD, Chicago, IL (Moderator) Nothing to Disclose
Cem Altunbas, PhD, Aurora, CO (Moderator) Nothing to Disclose

**Background**
Several studies discussed various methods of tumor delineation based on PET FDG uptake. Where delineation based on a %threshold of SUVmax is the method most commonly used. This study recruited radiomics as an investigative tool to first, evaluate the sensitivity of radiomics features to the effect of different image segmentation and second, to evaluate the differences between tumors delineated based on SUVmax, SUVpeak and manually delineated Metabolic Tumor Volume (MTV).

**Evaluation**
Two radiation oncologists contoured primary tumors in cervix region based on pretreatment F-18 FDG PET/CT for a cohort of 74 patients. The cohort characteristics are: FIGO stage IB-IVA, age range 31-76 years, treated with external beam radiation therapy to a dose range between 45-50.4 Gy (median dose: 45 Gy), concurrent cisplatin chemotherapy and MRI-based Brachytherapy to a dose of 20-30 Gy (median total dose: 28 Gy). Co-occurrence (COM), Gray Level Size Zone (GLSZM), Run-Length (RLM) and Intensity Based (IBM) matrices were employed to extract the radiomics features. Mean Percentage Differences (Δ) of features were determined for each pair of contoured volumes; MTV was set as the reference contour in comparison with SUVmax then SUVpeak.

The reproducibility among each pair of contours was assessed by Bland-Altman analysis. In addition, Interobserver agreement for 1) all three contours and 2) pairs of MTV-SUVpeak and MTV-SUVmax was assessed using Interclass Correlation Coefficients test (ICC) within the context of the test re-test format.

**Discussion**
Radiomics features, which showed statistical significance of (p-value <0.05) on Bland-Altman test, indicated higher reproducibility between reference contour (MTV) and SUVpeak based contour. We set an acceptable reproducibility range of (±15). ICC test results were concordant with Bland-Altman results with absolute agreement range (0.75 - 0.95).

**Conclusion**
In general, 5 COM, 4 GLSZM and 4 IBM features were insensitive to contour delineation techniques. ICC revealed that MTV-SUVpeak contours pair scored higher interobserver agreement and precision than MTV-SUVmax contour pair.

**SST13-02 By the Position of the Treatment Interruption: How to Affect the Local Control Rate**

**Participants**
Hiroshi Sekine, MD, PhD, Tokyo, Japan (Presenter) Nothing to Disclose
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**Abstract**
Purpose/Objective(s): Over the New Year, Golden Week, and other local holidays, radiation therapy is sometimes stopped for long periods of time. In such cases, declines in the local control rates have been reported. Thus, we next investigated the effects of the length of time without treatment and the timing of this treatment break on the local control rate. Deliberately introducing a break period in a real clinical situation poses ethical problems; therefore, tumor model was created, and the local control rate was estimated after fractionated exposure with a set break period. The compensatory dose required to maintain the control rate was also estimated.

Materials/Methods: The radiosensitivity of multifocal malignant tumors appears to be non-homogeneous. 1. We randomly allocated 1-7 tumor different radiosensitive clones. 2. Each clone multiplied exponentially. 3. The survival rate was determined using the novel LQ model.

Design: Control arm includes 20 groups. In one group, total of 500 tumor cases were generated as per the above method, and each case was exposed to a standard treatment of 60 Gy/30 Fr, 5Fr/w. Test arm includes 5x20 groups. We assumed treatment interval of 2 weeks after continuous 5Fr, 10Fr, 15Fr, 20Fr, and 25Fr, for respective
groups. Results: When the 2-week break was introduced after the 5Fr, 64 Gy (adding 2x2Gy) was no significant difference in the control rate compared with continuous fractionated exposure of 60 Gy ($p = 0.181)$. When the break was introduced after the 10Fr and the dose was increased by 2 Gy, the local control rate was lower than that of continuous fractionated exposure of 60 Gy. However, when the dose was increased by 2 x 2 Gy each, a significant increase in the control rate was observed. When the break period was introduced after the 15Fr or 20Fr and the dose was increased by 2 Gy, resulting in a total exposure of 62 Gy, there was no significant difference in the local control rate compared to continuous fractionated exposure of 60 Gy ($p = 0.75$ and $p = 0.106$, respectively). When the break period was introduced at the 25 Fr, a dose increase of 2 Gy resulted in an increased local control rate compared to that of continuous exposure of 60 Gy. On the other hand, when the break was introduced after the 25 Fr and there was no dose increase, the control rate was significantly reduced; and therefore, increases of at most 2 Gy are deemed appropriate. Conclusion: As the local control rates are further reduced when breaks occur sooner after the initiation of radiation, it is necessary to increase the compensatory dose in these cases.

**ABSTRACT**

**Purpose/Objective(s):** The direct-conversion flat-panel detector (d-FPD) has led the possibility of transformation for QA of a 192-Ir source. Our goal is to establish a new quality assurance (QA) for 192-Ir source positional accuracy test using the d-FPD. **Materials/Methods:** Initially, the 192-Ir core position is adjusted to 1500.00 mm by two-point calibration with mechanical engineers using by dummy source and radioactive source as well as the d-FPD image. In subsequent 2-dimensional (2-D) verification using check ruler, six points (1500, 1450, 1400, 1350, 1300, 1250 mm) were measured weekly for six month. As for the 3-D verification, 14 dwell(5.0 mm step) coordinates in a series were compared between planned position and actual 192-Ir core, after planning by semi-orthogonal method with X-ray catheter using two intracavitary applicators (Fletcher Williamson tandem; bending 15° and CT/MR-compatible ovoid; bending 45°). The center of the applicator coordinate system (ACS) was set at the arbitrarily-position using spherical metal marker. Five series are evaluated for each applicator, and also measured sagging shift caused by the d-FPD orthogonal movement. 3-D distances were calculated by following formula: $d = \sqrt{(x1-x2)^2+(y1-y2)^2+(z1-z2)^2}$ **Results:** 192-Ir core was adjusted 1500.05 mm by image-assisted positional calibration. An average (±SD) of all errors was 0.234±16 in 2-D verification. The highest accuracy point was 1500 mm where the most frequently used point in our clinical treatment, and it's error was 0.19±0.40 mm. Sagging shift was 0.80 mm in superior direction. The most curved point of each applicator was the largest differences in 3-D verification, and it was 1.74±0.02 mm for CT/MR-applicator and 1.01±0.01 mm for Fletcher applicator. The largest coordinate difference was 1.71 mm in anterior direction for CT/MR-applicator. **Conclusion:** The recommendation of the AAPM (American Association of Physicists in Medicine) for 192-Ir source positional accuracy is ± 1.0 mm (± 2.0 mm relative to the applicator system). In this study, all measurement errors for 192-Ir source positional accuracy were within the acceptable range. The source adjustment with the d-FPD may more accurately, and also d-FPD could confirm the movement and position (angle) of the 192-Ir core in the applicator. Our quality assurance process using the d-FPD system may serve to improve aspects of QA, as well as the quality of HDR brachytherapy.

**ABSTRACT**

**Purpose**

Tumor hypoxia is correlated with treatment failure. To date, there are no published studies investigating hypoxia in patients with small, localized non-small cell lung cancer (NSCLC) undergoing SBRT. We aim to use 18F-fluoromisonidazole (18F-FMISO) PET imaging to non-invasively quantify the tumor hypoxic fraction (HF), to elucidate the potential roles of reoxygenation and tumor vascular response at high doses, and to identify an optimal time point for imaging with prognostic value.

**METHOD AND MATERIALS**

Six patients with NSCLC tumors >1 cm and eligible for SBRT were prospectively enrolled in an IRB-approved study. CT and dynamic PET images (0-120 min, 150-180 min, and 210-240 min post-injection of radiotracer) were acquired using a Siemens Biograph mCT PET/CT scanner. This 18F-FMISO PET imaging protocol was performed at 3 different time points around a single SBRT delivery of 18 Gy and comparisons of HFs were made using a tumor-to-blood ratio (TBR) > 1.2 and the rate of influx, kinetic parameter $K_i$ ($mCi/mg/min$). HF regions were normalized to the absolute tumor volume defined by CT. TBR was defined as the ratio of the 18F-
RESULTS

Results of all patients show substantial variation in the HF during SBRT. Using a TBR threshold >1.2, the HFs increased by nearly a factor of 2 after 18 Gy and then decreased almost to baseline 96 hours later in more than half of patients who completed the imaging protocol. In one representative patient, shown in Figure 1, the HFs were 19%, 31% and 13% of total tumor volume on day 0, 2 (48 hours post-SBRT), and 4 (96 hours post-SBRT).

CONCLUSION

For NSCLC patients receiving SBRT, 18F-FMISO PET imaging has the potential to measure temporal changes in tumor hypoxia. With the results of six patients, this novel pilot study highlights the potential benefit of non-invasive molecular imaging as results indicate substantial variation in tumor hypoxic fraction post-SBRT. Ongoing work includes the development of tracer kinetics analysis of respiratory-corrected dynamic data to enable treatment individualization based on patient-specific biological information.

CLINICAL RELEVANCE/APPLICATION

This novel pilot study highlights the potential benefit of non-invasive molecular imaging as results indicate substantial variation in tumor hypoxic fraction post-SBRT.

SST13-08  Dosimetric Impact of the Presence of the Bowel Gas in IMRT / VMAT Planning for Patients with Abdominal Tumors

ABSTRACT

Purpose/Objective(s): To investigate dosimetric consequences of IMRT / VMAT planning with presence of the bowel gas for patients receiving SBRT / IMRT for abdominal tumors. Materials/Methods: Six patients, 4 with pancreas tumor, 1 with adrenal gland receiving SBRT and 1 with pancreas tumor receiving conventional IMRT (with large PTV extending into bowel), who had extensive bowel gas visible in the planning CT images and treated with CBCT image guidance, were selected for this study. Two coplanar IMRT or VMAT plans were retrospectively created with the prescription dose (Rx) to 95% of PTV (27.5 Gy in 5 fractions for the SBRT plans and 50.4 Gy in 28 fractions for the IMRT plan), with and without overriding the bowel gas density to water in Pinnacle 9.6. Dose was calculated with heterogeneity correction and collapsed cone convolution algorithm. Planning CT and pre-treatment CBCT images were registered by aligning to the tumor. Patient body external and bowel gas was contoured on the planning CT and CBCT (5 random selected for pancreas IMRT case to represent whole treatment). The external and bowel gas contours were transferred from the CBCT to the planning CT. To estimate actual delivered dose, the following density overrides were performed on the planning CT. The CBCT external outside the CT external were assigned density one and the CT external outside the CBCT external were assigned density zero. The bowel gas contour in CT was assigned one and the transferred bowel gas contour from CBCT were assigned zero. The dose was calculated on the planning CT. This process was repeated for all CBCTs. Finally, dose was accumulated from 5 fractions. For pancreas IMRT case, dose was rescaled to original prescription for analysis. The estimated delivered CTV-VRx, PTV-VRx, maximum dose received by 0.5cc (D0.5cc) of bowel (duodenum, small and large bowel) were compared to plans made with and without bowel gas overriding. Results: For SBRT patients (PTV range: 25.9 – 144.4 cc), without and with override of bowel gas density, mean delivered PTV-VRx was 93.7 ± 2.0% (range: 90.8% - 95.6%) and 96.0 ± 1.6% (range: 95.0 - 99.5%), change in bowel D0.5cc between planning and delivery was 0.1 ± 0.7 Gy (range: -1.0 Gy, 1.5 Gy) and 0.8 ± 0.6 Gy (range: -0.6 Gy, 1.9 Gy), respectively. For the IMRT patient (PTV volume: 2184 cc), without and with override of bowel gas density, delivered PTV-VRx was 66.5% and 93.2% and change in bowel D0.5cc was -2.7 Gy and 1.5 Gy, respectively. CTV-VRx was not affected by density overrides (100% for both techniques) for SBRT patients. For the IMRT patient, delivered CTV-VRx was 65.9% and 100% respectively without override and with override. Conclusion: Planning with overriding bowel gas density to water was better for target coverage but caused slightly increased toxicity to bowel compared to that without overriding. With the presence of the bowel gas, a lower bowel planning constraint may be applied if bowel gas is overridden.

SST13-09  Are Prostate Target Margins Adequate for Combined Brachytherapy Followed by External Beam Treatments?

ABSTRACT

Purpose/Objective(s): In this study, external beam prostate treatments were delivered as a boost after I-125 permanent prostate implants. Prostate motion during external beam treatments involves a novel combination of the implant dose moving with the prostate leaving the external beam irradiation susceptible to motion. The adequacy of target expansions on the combined external beam and implant dose was examined based on the measured daily motion of the prostate. Materials/Methods: Thirty patients received an I-125 prostate implant prescribed to dose of 90 (25 patients) or 120 (5 patients) Gy. This was followed by an external beam boost to deliver a dose of 90 Gyeq (external beam equivalent) to the prostate over 10 to 30 fractions. An ideal IMRT plan was developed by optimizing the external beam dose based on the delivered implant dose. Targets in addition to the prostate were seminal vesicles (SV) (30 patients) and lymph nodes (LN) (13 patients). Target expansions were 0.5, 0.7 and 0.5 cm for the prostate, SV and LN, respectively. The limiting dose to the rectal volume had a higher priority during optimization over target coverage. The implant dose was converted to an equivalent external beam dose using the linear quadratic model. Patients were set up on the treatment table by daily orthogonal imaging and aligning the marker seeds in the prostate. For treatments 2 to 6,
orthogonal films were obtained at the end of treatment to assess the motion of the prostate. Based on the observed motion of the markers between the initial and final images, 5 individual plans showing the actual dose delivered to the patient were calculated. A final true dose distribution was established based on summing the implant dose and the 5 external beam plans. Dose to the prostate, SV, LN and normal tissues, rectal wall, urethra and lower sphincter were calculated. On 18 patients who were sexually active, dose to the corpus cavernosum and internal pudendal artery was also calculated.

Results: The average prostate motion in 3 orthogonal directions was less than 1 mm with a standard deviation of less than ±2 mm. Dose and volume parameters for the targets and normal tissue are shown in the table below. Average Planned (Gy eq or cc) Average Delivered (Gy eq or cc) Average Planned/delivered

<table>
<thead>
<tr>
<th>Target</th>
<th>Average Planned</th>
<th>Average Delivered</th>
<th>Average Planned/delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate D99</td>
<td>93.7±8.0</td>
<td>92.8±9.2</td>
<td>1.00±0.1</td>
</tr>
<tr>
<td>SV</td>
<td>50.0±9.7</td>
<td>49.1±9.9</td>
<td>1.01±0.1</td>
</tr>
<tr>
<td>LN</td>
<td>45.1±1.1</td>
<td>44.2±1.4</td>
<td>1.02±0.02</td>
</tr>
<tr>
<td>Rectal Wall V801</td>
<td>7±0.4</td>
<td>6.7±0.2</td>
<td>1.08±0.1</td>
</tr>
<tr>
<td>Urethra D90</td>
<td>71.7±25.0</td>
<td>70.6±26.8</td>
<td>1.01±0.1</td>
</tr>
<tr>
<td>Lower Sphincter D90</td>
<td>67.4±15.4</td>
<td>66.7±16.2</td>
<td>1.00±0.1</td>
</tr>
<tr>
<td>Corpus Cavernosum D904</td>
<td>4±2.5</td>
<td>4.2±2.6</td>
<td>0.99±0.04</td>
</tr>
<tr>
<td>Internal Pudinal Artery D9016</td>
<td>6±7.1</td>
<td>7.16±8.51</td>
<td>1.02±0.2</td>
</tr>
</tbody>
</table>

Conclusion: The delivered dose to the targets was within 2% of the planned dose indicating that the target margins are adequate. Combined brachytherapy and external beam dose delivered to the prostate was not sensitive to prostate motion.