Radiation Oncology
Participants
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David Horowitz, MD, New York, NY (Abstract Co-Author) Consultant, Champions Oncology

TEACHING POINTS
Review normal anatomy. Discuss radiographic modalities to help assist radiation oncology treatment planning for patients with pancreatic cancer. Review treatment planning for patients with pancreatic cancer including intact pancreas, post-operative pancreas, and stereotactic body radiotherapy.

TABLE OF CONTENTS/OUTLINE
Pancreatic cancer staging General anatomy Imaging modality for work up and radiation planning Treatment Strategy Radiation in the post-operative setting Radiation in patients with intact pancreas Clinical imaging: CT Simulation and Image Guided Radiation Therapy with Cone beam CT
Initial Experience in the Usefulness of Dual Energy Technique in the Abdomen

All Day Room: RO Community, Learning Center

Participants
Silvina E. De Luca, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose
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Eduardo P. Eyheremendy, MD, Buenos Aires, Argentina (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Dual energy is an innovative imaging technique that has been described to have a considerable effect on the care of oncological patients. It operates applying two different energy settings that makes it possible to differentiate materials with different molecular compositions on the basis of their attenuation profiles. In this exhibit we review in which oncological patients this technique proved beneficial and in which it showed no added value.

TABLE OF CONTENTS/OUTLINE
**Prognosis is the Key for Radiation Therapy in Management of Bone Metastases**

All Day Room: RO Community, Learning Center

**Awards**
Identified for RadioGraphics

**Participants**
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Yoko Matsumoto, Akashi-city, Japan (Abstract Co-Author) Nothing to Disclose
Yosuke Ota, MD, Akashi-city, Japan (Abstract Co-Author) Nothing to Disclose
Kayoko Tsujino, Akashi-city, Japan (Abstract Co-Author) Nothing to Disclose

**TEACHING POINTS**

The goal of palliative radiation therapy for bone metastasis is pain relief, management of metastatic spinal cord compression (MSCC), prevention of MSCC or pathological fracture, and treatment of oligometastasis. Radiation oncologists rely on the predictive prognosis to determine the indication for radiation therapy or dose fractionation schedules. The aims of this exhibit on bone metastasis are as follows: 1. Understand the treatment algorithm for managing bone metastasis; 2. Learn the appropriate dose fractionation schedules; and, 3. Discuss factors relating to prognosis prediction for patients with bone metastases.

**TABLE OF CONTENTS/OUTLINE**

1. Background: Overview of the etiology and clinical features of bone metastasis.
2. Imaging diagnosis: Review clinically important imaging findings including MSCC and impending fracture.
3. Treatment algorithm: Elucidate the algorithm used to determine the management of bone metastasis.
4. Radiation therapy: Describe the evidence used to determine the dose fractionation schedule and radiation treatment modalities.
5. Prognostic prediction: Discuss cases from our hospital (n = 629), including survival in the different groups of patients by age, sex, PS, KPS, and primary tumor. There were significant differences in survival with regards to patient sex, PS, KPS and primary tumor.
**Prostatic Carcinoma Treated with Brachytherapy: Multiparametric Magnetic Resonance (MR) Patterns of Recurrence**

All Day Room: RO Community, Learning Center

**Participants**
Gianpiero Cardone, MD, Milano, Italy (*Presenter*) Nothing to Disclose  
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Antonella Messina, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose  
Andrea Losa, MD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose  
Paola Mangili, PhD, Milano, Italy (*Abstract Co-Author*) Nothing to Disclose  
Fraco Gaboardi, MD, Milan, Italy (*Abstract Co-Author*) Nothing to Disclose  
Giuseppe Balconi, Ornago, Italy (*Abstract Co-Author*) Nothing to Disclose

**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 (DCE)  
   d) periprostatic changes after treatment  
4) Radiation therapy seeds MRI evaluation  
5) MR most frequent recurrence patterns. MR evaluation showed parenchimal fibrosis and atrophy of the gland on T2w images. DCE MR showed reduction of the vascularization of the gland. Radiation therapy seeds were seen as small foci of focal signal intensity void. Recurrent prostate carcinoma typically appears as focal nodular region of intermediate-to-low signal intensity on morphologic T2w MR images, with greater enhancement compared to the perilesional prostatic tissue on DCE and restricted diffusion on DWI. 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.
Prostatic Carcinoma Treated with Focal Brachytherapy: Multiparametric Magnetic Resonance (MR) Imaging Patterns

All Day Room: RO Community, Learning Center

Participants
Gianpiero Cardone, MD, Milano, Italy (Presenter) Nothing to Disclose
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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 Morphologic MR evaluation showed reduction in size of the treated area of the gland and diffuse reduction of signal intensity on T2w images due to parenchimal fibrosis and atrophy. DCE and Spectroscopy showed atrophy of treated areas and normal patterns on spared portion of the gland. Radiation therapy seeds were seen as small foci of focal signal intensity void. MR can be an effective imaging technique in the follow-up of prostate tumors treated with FB, in the early evaluation of post-implant dosimetry and in patients with clinical or biochemical suspect of recurrence.
Providing MR Imaging for Radiation Therapy Planning: Lessons for Radiologists

All Day Room: RO Community, Learning Center

Awards
Identified for RadioGraphics

Participants
Thomas P. Sullivan, MD, Maywood, IL (Presenter) Nothing to Disclose
Steven M. Shea, PhD, Oak Park, IL (Abstract Co-Author) Nothing to Disclose
Matthew M. Harkenrider, MD, Maywood, IL (Abstract Co-Author) Nothing to Disclose
Abbie M. Diak, PhD, Maywood, IL (Abstract Co-Author) Nothing to Disclose
Joseph H. Yacoub, MD, Maywood, IL (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Role of MRI in radiation treatment planning (RT) MRI for RT in gynecologic brachytherapy is ideal Imaging and workflow challenges using MRI for RT Image acquisition Future applications

TABLE OF CONTENTS/OUTLINE
MRI in RT is evolving/increasing, but not without challenges Current applications of MRI in RT Brain, head, neck Chest wall, breast Liver Pelvic organs Reasons for increasing use of MR in RT soft tissue resolution and increasing clinical use coregistration Challenges acquisition geometric distortion Artifacts Motion Workflow Diagnostic and therapeutic imaging procedures differ sequence parameters patient preparation Interepartmental coordination Safety precautions Our institutional experience with cervical & endometrial brachytherapy Why gyn European MR-only RT Electron density maps less necessary water-dense target assumed Less motion Current CT-MR workflow Phantom work characterizing applicator artifact MR safety Imaging protocol Reducing distortion/artifacts 3D acquisition Future applications MR-only cervical cancer RT Plastic applicators Improved targeted dose planning MR-only / combined MR for Linac RT 4D MRI for abdominal and lung RT
Clear cell renal carcinoma (RCC) is the most common malignant renal tumor in adults. Multidetector computed tomography (MDCT) remains the most effective modality for the detection and staging of RCC. The extent of the primary tumor at initial diagnosis, including location, size, relationship to the pelvicaliceal system and blood vessels is critical for accurate management of disease as the prognosis for patients diagnosed with renal cell carcinoma is directly related to stage at presentation. We reviewed 50 patients with diagnosis of RCC who underwent CT and were treated surgically in our institution, between January 2014 and March 2016. Images of the primary tumor were evaluated according to TNM system of the American Joint Committee on Cancer. There was an error rate in the T and N staging of 35%. In these cases 92% were due to misdiagnosis in T stage and the main reasons were errors of measurement (in borderline cases) and evaluation of local extension (perirenal fat and Gerota invasion). Evaluation stage N was successful in 94% of the cases. MDCT represents the best method for characterizing and staging renal lesions. Its main limitations are related to the evaluation of size and locorregional extension in borderline cases.
CHEST MRI: Problem Solving Tool in Broncho Pulmonary Cancer in Radiation Oncology

All Day Room: RO Community, Learning Center

Participants
Hajer Jarraya, Lille, France (Presenter) Nothing to Disclose
Laurent Basson, Lille, France (Abstract Co-Author) Nothing to Disclose
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Abel Cordoba, Lille, France (Abstract Co-Author) Nothing to Disclose
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Luc Ceugnart, MD, Lille, France (Abstract Co-Author) Nothing to Disclose

TEACHING POINTS
Chest MRI can provide useful information that cannot be provided with other noninvasive or minimally invasive imaging techniques. Chest MRI is helpful in target delineation of bronchopulmonary cancer associated with parenchymal collapse before radiation delivery and is also useful in differentiating tumor recurrence from radiation injury after treatment.

TABLE OF CONTENTS/OUTLINE
This educational exhibit will be designed as case study comparing for each case CECT, chest MRI and PET FDG and showing the value of chest MRI in patient management and follow up after stereotactic body radiotherapy of the chest. All reported cases were performed in a 3T MRI for 15 patients who were referred for radiation therapy for bronchopulmonary cancer associated with adjacent parenchymal collapse, making contour definition difficult, or for assessing treatment response after treatment when there was discordance. Chest MRI significantly helped delineation of tumors associated with collapse, or local recurrence of previously treated tumors in all cases and was concordant with PET FDG uptake areas. It reduced the gross tumor volume of target lesions compared to CE CT scan delineation. After treatment in follow up, MRI helped differentiating focal radiation lung lesions from targeted tumor and made response assessment to therapy easier and more adequate compared to CECT.
Pathology and Images of Radiation Induced Hepatitis

Awards
Certificate of Merit

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Shigeyuki Takamatsu, MD, PhD, Kanazawa city, Japan (Presenter) Nothing to Disclose
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TEACHING POINTS
Thanks to recent advancement of radiation therapy such as stereotactic body radiotherapy (SBRT) and particle beam therapy, the indication of radiotherapy (RT) for liver tumors has been extended greatly. But, because of poor hepatic radiation tolerance, the estimation of irradiated liver by RT is important, especially in cirrhotic liver. The pathological changes of irradiated liver after RT are perivenular fibrosis and sinusoidal obstruction and damage to Kupffer cells and hepatocyte itself. Clinical images can visualized these pathological changes. The purpose of this exhibit is to: Illustrate the pathological change in the radiation induced liver disease (RILD). Illustrate the time course change of irradiated liver by RT. Illustrate the estimation of hepatic tumor after RT.

TABLE OF CONTENTS/OUTLINE
Pathology of RILD Temporal change of irradiated liver and surrounding liver and adjacent structure Imaging findings of RILD and surrounding liver Imaging of irradiated liver in Multimodality Estimation of therapeutic effect
Participants
Kathryn J. Fowler, MD, Chesterfield, MO (Moderator) Nothing to Disclose

Sub-Events

**SPIO11A**  Pretreatment Imaging Evaluation of Liver Cancer

Participants
Ihab R. Kamel, MD, PhD, Baltimore, MD (Presenter) Research Grant, Siemens AG

**SPIO11B**  Surgical Intervention for Liver Cancer

Participants
Sam G. Pappas, MD, FACS, Maywood, IL (Presenter) Nothing to Disclose

**SPIO11C**  Interventional Radiology Procedures for Liver Cancer

Participants
Sandeep Vaidya, MD, Seattle, WA (Presenter) Nothing to Disclose

**SPIO11D**  Radiotherapy for Liver Cancer and Post-RT Evaluation of Response

Participants
Michael I. Lock, MD, FRCPC, London, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how to distinguish normal post radiation image changes versus recurrence. 2) Review an approach to liver image interpretation post radiation.

ABSTRACT

Radiation for liver is becoming common. However, the literature reveals a large variation in practice and outcome. This review of the data will provide an organized summary of the evidence and an understanding of the various methods of radiating liver cancers. The primary objective is to review an approach to liver image interpretation post radiation. The presentation will cover expected imaging changes with time after radiation, provide predictive imaging tools to identify i) which patients will progress ii) when patients will progress and iii) which patients will survive.

URL
none
Radiation Oncology (Lymphoma/Biology/Non-Malignant Disease)

Sunday, Nov. 27 10:45AM - 12:15PM Room: S104A

Outcomes with R-CHOP and Consolidative Radiation in Advanced Diffuse Large B-Cell Lymphoma

Participants
Matthew Mills, BS, Tampa, FL (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The role of consolidative radiation (RT) after R-CHOP in advanced stage Diffuse Large B-Cell Lymphoma (DLBCL) is typically given for bulky disease, but remains a clinical question. In particular the role of RT in double-hit DLBCL has not been well defined. Therefore, we evaluated the outcome of patients treated with R-CHOP followed by consolidative RT with a particular focus on double-hit DLBCL. Materials/Methods: The records of 63 advanced stage (3-4) DLBCL patients treated with R-CHOP and consolidative RT between 1999 and 2014 were retrospectively analyzed. A total of 78 lesions treated in 63 patients were identified for analysis. Patient demographics, tumor/treatment details, and outcomes were abstracted from the electronic medical record. Outcomes including freedom from progression (FFP) following RT and overall survival (OS) were estimated with Kaplan-Meier univariate analysis (UVA). Cox proportional hazard ratio (HR) model was used to assess the effect of patient, tumor, and other predictive factors. Results: Median follow-up following completion of RT was 21.9 months (range: 0.23-168 months). Median age of diagnosis was 57 years (range: 20-99), the majority were male (53%) and white (90%). The cohort consisted of stages 3A (29%), 3B (14%), 4A (35%), and 4B (22%). The majority of patients had a poor International Prognostic Index (IPI) (51%), B symptoms (52%) and extra-nodal involvement (78%). Median LDH at diagnosis was 591 (range: 161-20680). Regarding treatment, the median number of chemotherapy (CT) cycles received before and after RT was 6 (range: 0-16) and 0 (range: 0-15), respectively. The median number of cycles of Rituximab before and after RT was 6 (range: 0-14) and 0 (range: 0-14), respectively. Four (6%) patients received bone marrow transplant prior to RT and 9 (14%) after RT. Median RT dose was 35 Gy (range: 5.4-40.4 Gy). At the time of analysis 44 patients were alive and the median OS was not reached. Survival at 6, 12, 24, 36, and 60 months was 93%, 83%, 71%, 71%, and 71%, respectively. 6, 12, 24, 36, and 60 month FFP was 75%, 74%, 74%, 74%, 70%. No significant difference in OS was noted between stage (p=0.58), IPI (p=0.77), B symptoms (p=0.35), extra-nodal/BM involvement (p=0.64). On UVA, bulky disease (>5cm) predicted worse OS with a HR of 3.42 (95% CI 1.1-14.9, p=0.03). Double/triple hit positivity was determined in 19 patients; 4 had a double-hit and 2 had triple hit. Double/triple hit DLBCL was associated with worse FFP with HR 4.9 (95% CI: 1.02-21.7, p=0.05) and a trend for worse OS with HR 2.9 (95% CI 0.77-13.9 p=0.12). Bulky disease (p=0.48) and radiation dose (p=0.48) were not significant for FFP (p=0.48). Conclusion: Consolidative RT after R-CHOP provides good local control benefit in advanced DLBCL patients, comparable to previous studies. Also, double/triple hit positivity may aid in stratifying responders.

Evaluation of Radiotherapy Techniques for Gastric Mucosa-Associated Lymphoid Tissue (MALT) Lymphoma

Participants
Grace Kusumawidjaja, MD, Oak Brook, IL (Presenter) Nothing to Disclose
Syazana Mohamed Rashid, Singapore, Singapore (Abstract Co-Author) Nothing to Disclose
Kevin Lee Min Chua, Singapore, Singapore (Abstract Co-Author) Nothing to Disclose
Kheng Wei Yeoh, Singapore, Singapore (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Refractory primary gastric MALT lymphoma patients, primarily treated with radiotherapy (RT), achieve excellent long-term outcomes. Modern RT such as intensity-modulated radiation therapy (IMRT) and helical tomotherapy (HT) aims to minimize doses to normal tissues, potentially reducing long-term toxicities. We hypothesize that the incremental benefits of modern techniques may not be significant in all instances and resource limitation globally highlight the need for a screening criteria which will identify patients most likely to benefit from complex RT delivery. Materials/Methods: Retrospective analysis of 15 patients who had previously received RT was performed. Prescription dose was 30Gy in 1.5 Gy fractions. 5 different plans were generated - Anterior-posterior (APPA), 3D conformal with field in field (FIF) and without (3D) techniques, IMRT and HT. A dosimetric comparison was performed, focusing primarily on coverage of planning target volume (PTV) by 95% of the prescription dose (V95) and heart and kidney doses. Based on the CT simulation images, patients were also grouped into categories based on the amount of overlap between PTV and kidneys – Category A (Non-overlapping) and Category B (Overlapping). Results: The difference between V95 for HT and IMRT compared to 3D was not statistically significant (HT v 3D, p=0.07; IMRT v 3D, p=0.07). QUANTEC dose constraints for mean dose to both kidneys (mean dose 0.05); this was not seen in category A patients. QUANTEC dose constraints for mean heart doses of Conclusion: We demonstrate the dosimetric benefits with complex RT techniques were primarily seen in reducing V25 heart. For other dose constraints, differences between the techniques were marginal. Patients with kidneys not overlapping with
the stomach at screening CT simulation did not benefit from complex techniques. Table. Dosimetric parameters of RT techniques (all patients) V95 (%) Both Kidneys Mean (Gy) Heart Mean (Gy) Heart V25 (%) APPA 87.57 +/- 7.0110.28 +/- 7.1610.20 +/- 3.6225.66 +/- 12.073 D C T R 96.71 +/- 2.348.17 +/- 5.0211.79 +/- 2.3423.37 +/- 6.84FIF98.57 +/- 1.805.39 +/- 3.8911.38 +/- 3.3127.28 +/- 11.411 M T R 99.99 +/- 0.056.94 +/- 4.539.62 +/- 2.3415.64 +/- 5.27HFI99.94 +/- 0.075.11 +/- 2.4110.16 +/- 1.8815.35 +/- 4.81

SSA23-09 A Novel Pre-Clinical Model of Cognitive and Neuro-Inflammatory Consequences of Precision Radiation and Immunotherapy

Sunday, Nov. 27 12:05PM - 12:15PM Room: S104A

Awards

Student Travel Stipend Award

Participants

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Jacob Raber, MD, PhD, Portland, OR (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The use of electron beam therapy (EBT) for benign superficial fibromas of the hands (Dupuytren's Disease [DD]) and feet (Ledderhose Disease [LD]) is becoming more prevalent as a definitive treatment modality. However, there exists a paucity of information on optimal planning methods and gaging treatment response. Our hypothesis is that magnetic resonance imaging (MRI) can provide additional information over physical exams in the planning and follow-up of patients undergoing EBT for DD and LD.

Materials/Methods: - Our single institutional retrospective review (eProst protocol #20150048) included 8 patients with a total of 23 superficial fibromas measuring at least 3 mm of the hands (DD) and/or feet (LD) who had pre- and post-EBT MRI scans with and without contrast. There were six females and two males with median age of 55.8 years. EBT delivered approximately 30 Gy at 3 Gy per daily fraction with a planned 12 week hiatus between fraction #5 and #6. All patients had the disease sites clinically marked with radio-opaque wiring by the radiation oncologist (RO) at time of CT-simulation. MRI fusion of the T2-weighted contrast-enhanced images with the planning CT images was performed to determine the appropriate beam energy, thickness of bolus, and prescription isodose line. Pre- and post-EBT MRIs were evaluated to determine disease volume (mL) signal intensity (SI) on T-2 weighted images (1-4 ordinal scale), and post-contrast enhancement pattern (1-4 ordinal scale) by a fellowship-trained musculoskeletal radiologist. MRI findings were correlated with the physical exam findings of the RO. Results: On MRI, the 23 superficial fibromas had a pre-EBT mean size of 0.63 +/- 1.1 mL, mean T2 hyperintensity score = 2.13 +/- 0.87, and mean enhancement score = 2.12 +/- 0.83. Post-EBT at about 3 months were available for 10 lesions of which all 10 showed a grade 1 T2 intensity (p=0.005); however, volume of the 10 were not significantly reduced (mean difference = -0.06 mL (p=0.61)).

Conclusion: This small study suggests that MRI may be more useful than physical palpation in the planning of patients receiving definitive EBT for DD and LD. T2 hypointensity more than volume changes may be a better indicator of EBT response. An international prospectively randomized trial should be considered to provide the opportunity to further evaluate the role of MRI as a planning and follow-up tool for these uncommon benign diseases.
Neuroinflammation and subsequent cognitive and behavioral alterations should be considered in treatment planning and utilization of combination immunotherapy and radiotherapy in the context of cancer-related neurological dysfunction.
Purpose/Objective(s): Electronic medical records (EMRs) are widely used to capture unstructured clinical patient information. Analyzing patient outcomes using EMRs is limited by its retrospective nature and the significant resources it requires. We have designed and implemented a web-based, electronic data capture (EDC) system for head and neck cancer patients receiving radiation therapy in order to analyze outcomes prospectively, enhance the quality of clinical information recorded, and to generate regular Quality Improvement and patient safety reports. Materials/Methods: Our institution uses two different implementations of the same EMR at two separate hospitals, one a private NCCN Comprehensive Cancer Center, and the other a safety net hospital. Prior to implementation of the EDC, documentation was performed by both dictation and transcription services as well as direct entry into the EMR. A separate radiation oncology-specific record and verify system maintains all radiation therapy information, including the radiation prescription and treatment plan. The EDC was designed to record patient demographics, history, cancer and treatment characteristics, and to be used for on-treatment visit (OTV) and follow-up visit documentation and reporting. Generated OTV and follow-up visit forms are exported to the EMR. Patient-reported quality of life outcomes were collected prior to treatment, end of treatment, and at each follow-up. Common Toxicity Criteria for Adverse Events version 4.0 is used for observer rated toxicity scoring at all encounters. Results: The EDC system was implemented in February 2016 after an orientation for providers and nurses. It has been used by four providers and three nurses in two clinics for 35 patient encounters. Compliant data was recorded for 2 of 3 new patients, 18 of 20 follow-up patients, and 15 of 15 OTV encounters (total compliance of 92%). Preliminary feedback suggests that the EDC has streamlined OTV and follow-up documentation for providers. Only 10 of 21 (48%) quality of life questionnaires were successfully completed. Low computer literacy rates seen in the safety net hospital setting pose a significant challenge to compliance for patient reported outcomes. Conclusion: Designing and implementing a radiation oncology quality of life and outcomes database is feasible for head and neck cancer patients. Providers and nurses demonstrated compliance with its use. This has the potential to significantly reduce the resources required to analyze patient outcomes, and for enhancing patient safety and Quality Improvement initiatives. We aim to further evaluate user experience, improve the EDC, make it available to share with other institutions, and adapt it to other disease sites.

ABSTRACT

Electronic medical records (EMRs) are widely used to capture unstructured clinical patient information. Analyzing patient outcomes using EMRs is limited by its retrospective nature and the significant resources it requires. We have designed and implemented a web-based, electronic data capture (EDC) system for head and neck cancer patients receiving radiation therapy in order to analyze outcomes prospectively, enhance the quality of clinical information recorded, and to generate regular Quality Improvement and patient safety reports. Materials/Methods: Our institution uses two different implementations of the same EMR at two separate hospitals, one a private NCCN Comprehensive Cancer Center, and the other a safety net hospital. Prior to implementation of the EDC, documentation was performed by both dictation and transcription services as well as direct entry into the EMR. A separate radiation oncology-specific record and verify system maintains all radiation therapy information, including the radiation prescription and treatment plan. The EDC was designed to record patient demographics, history, cancer and treatment characteristics, and to be used for on-treatment visit (OTV) and follow-up visit documentation and reporting. Generated OTV and follow-up visit forms are exported to the EMR. Patient-reported quality of life outcomes were collected prior to treatment, end of treatment, and at each follow-up. Common Toxicity Criteria for Adverse Events version 4.0 is used for observer rated toxicity scoring at all encounters. Results: The EDC system was implemented in February 2016 after an orientation for providers and nurses. It has been used by four providers and three nurses in two clinics for 35 patient encounters. Compliant data was recorded for 2 of 3 new patients, 18 of 20 follow-up patients, and 15 of 15 OTV encounters (total compliance of 92%). Preliminary feedback suggests that the EDC has streamlined OTV and follow-up documentation for providers. Only 10 of 21 (48%) quality of life questionnaires were successfully completed. Low computer literacy rates seen in the safety net hospital setting pose a significant challenge to compliance for patient reported outcomes. Conclusion: Designing and implementing a radiation oncology quality of life and outcomes database is feasible for head and neck cancer patients. Providers and nurses demonstrated compliance with its use. This has the potential to significantly reduce the resources required to analyze patient outcomes, and for enhancing patient safety and Quality Improvement initiatives. We aim to further evaluate user experience, improve the EDC, make it available to share with other institutions, and adapt it to other disease sites.

TEACHING POINTS

Share information about the damaging, long term effects of radiation therapy on coronary structures including, but not limited to the arteries and valves. Identify which patients will benefit from the use of this collaborative approach to radiation therapy Learn about the protocol used to generate detailed imaging of the location of these important structures of the heart and other vulnerable structures of the body and how they are used to design a radiation therapy treatment plan.

TABLE OF CONTENTS/OUTLINE

Background Widespread use of radiation therapy (lymphoma, breast CA, etc) Danger to cardiac structures (coronary arteries, aortic valve, etc) Cardiac CTA can identify these structures and help design a radiation therapy plan to avoid them Workflow Identification of patients (RT, CT protocol (CT Radiation therapy map (RT) Benefits Radiation plans Average radiation dose to radiosensitive structures – without & with “planning” Coronary arteries: left main, left anterior descending, circumflex, RCA Aortic valve Mitral...
Conclusion Radiation therapy planning using ECG-gated CT angiography has the potential to significantly reduce radiation dose to sensitive cardiac structures in patients referred for radiation therapy of the chest and mediastinum.
**PURPOSE**

We aimed to image and treat primary tumors and metastasized tumors in vivo through immunogenic cell death (ICD) and abscopal effect, respectively, using microcapsules that release liposome-protamine-hyaluronic acid nanoparticles (LPH-NPs) in three radiation sessions under blockade of CTLA-4 and PD-1.

**METHOD AND MATERIALS**

Six hours before session one, 6 mg of anti-CTLA-4 antibody (Ab) was injected intraperitoneally into BALB/c mice with primary LM17 tumor in the left hind leg and lung metastases. For session one, LPH-NPs containing 5% iopamiron and 400 μg anti-PD-1 Ab were mixed with 1 mL 4.0% alginate, 3.0% hyaluronate, and 1 μg/mL P-selectin solution and added to 0.5 mM FeCl2 with 1 μg/mL α4β1 Ab. The microcapsules (ten billion) were injected intravenously (IV). After 9 h, primary tumors were exposed 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, 40 ng HMGB1, and 10 μmol ATP were mixed with the above cocktail and added to 0.5 mM FeCl2 with 1 μg/mL anti-P-selectin Ab. Microcapsules (ten billion) were injected IV, which interacted with P-selectin. After 9 h, tumors were irradiated as before. For session three, 4 cGy 60Co whole-body γ-rays were administered at 24 h intervals for 5 days.

**RESULTS**

CTLA-4 was blocked before the first session. In session one, anti-α4β1 microcapsules accumulated around the primary tumor and metastases, which was detected by CT. Microcapsules released P-selectin-Ag and anti-PD-1 Ab with LPH-NPs after first irradiation. In session two, microcapsules accumulated around the primary tumor through P-selectin Ag-Ab reaction and released LPH-NPs containing anti-CD47 siRNA, HMGB1, and ATP, which intensified ICD in the primary tumor and CD8+ T-cell priming under CTLA-4 blockade. In session three, primed CD8+ T cells were activated by low dose whole body irradiation and targeted metastases whose PD-1 was blocked in session one. These treatments reduced the size of primary tumors and metastases by 92.4%.

**CONCLUSION**

Our targeted radioimmunotherapy system has the potential to improve tumor diagnosis and treatment.

**CLINICAL RELEVANCE/APPLICATION**

Targeted dendritic-cell-mediated T-cell priming and immune checkpoint blockade through CTLA-4 and PD-1 enhanced the effects of radiotherapy on primary tumors and metastases.
Participants
Eric Leung, MD, FRCPC, Toronto, ON (Moderator) Nothing to Disclose

Sub-Events
RC120A  Fundamentals in Radiation Oncology Imaging of Sarcoma

Participants
David B. Mansur, MD, Cleveland, OH, (david.mansur@UHhospitals.org) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Identify optimal diagnostic imaging to characterize adult extremity soft tissue sarcomas. 2) Describe how proper diagnostic imaging aids in target delineation, staging, and treatment planning in adult extremity soft tissue sarcoma. 3) Understand the overall indications, target volumes, and dose for radiation therapy for adult extremity soft tissue sarcoma.

RC120B  Fundamentals in Radiation Oncology Imaging of Breast Cancer

Participants
William Small JR, MD, Maywood, IL, (wmsmall@lumc.edu) (Presenter) Speakers Bureau, Carl Zeiss AG; Advisory Board, Varian Medical Systems, Inc

LEARNING OBJECTIVES
1) To enable attendees to understand the contribution of various imaging modalities in the initial evaluation of breast cancer.
2) To review imaging modalities role in radiation treatment planning for breast cancer.
3) To review the use of imaging modalities in the follow-up of breast cancer.

RC120C  Fundamentals in Radiation Oncology Imaging of Prostate Cancer

Participants
Stanley L. Liauw, MD, Chicago, IL, (sliauw@radonc.uchicago.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) The primary objective of this session is to enable attendees to understand the contribution of various imaging modalities (including CT, MRI, bone scan, and novel imaging) in the management of prostate cancer by the practicing radiation oncologist.

ABSTRACT

RC120D  Fundamentals in Radiation Oncology Imaging of Pancreatic Cancer

Participants
Suzanne M. Russo, MD, Cleveland, OH (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1. To identify different imaging techniques used for staging and therapy recommendations.
2. To understand appropriate incorporation of imaging into radiation treatment planning for pancreatic cancer.
3. To explore the potential of imaging for 'adaptive therapy' in pancreatic cancer.
Imaging for Proton Treatment Planning

Sunday, Nov. 27 2:00PM - 3:30PM Room: S403A

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 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.

Sub-Events

RC122A Uncertainties in Imaging for Dose Calculations
Participants
Andrew Wroe, PhD, Loma Linda, CA (awroe@llu.edu) (Presenter) Nothing to Disclose

RC122B Uncertainties in Motion for Treatment Planning
Participants
Heng Li, Houston, TX (hengli@mdanderso.org) (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.
Participants
Mukesh G. Harisinghani, MD, Boston, MA (Presenter) Nothing to Disclose
Theodore S. Hong, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Achieve a basic understanding of the anatomy pertinent to the pancreatico-biliary region and imaging appearance of pancreaticobiliary tumors. 2) Understand strengths and limitations of imaging techniques, including MRI, PET-CT and CT, as they are used in delineating primary tumor and staging involved regional nodes. 3) Identify reasons for local recurrence and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for anorectal tumors, both in the locally advanced and postoperative setting.

ABSTRACT
In this course cross sectional imaging will be used to contour normal pancreatico-biliary anatomy as well as tumors involving this anatomical region. Also patterns of spread of pathological lymph nodes will be shown, and cross sectional imaging will be used to contour the regional nodal lesions. Cases will be presented and the participants will be stimulated to do the contouring themselves, and will have feedback on their results.
LEARNING OBJECTIVES

1) Describe how to differentiate gliomas from lymphoma, metastases as well as non-neoplastic etiologies such as demyelinating lesions: Role of functional imaging modalities.  
2) Describe imaging characteristics of gliomas based on genomic differences: Imaging phenotype genotype correlation.  
3) Advanced imaging techniques as a surveillance tool in post-therapy gliomas with emphasis on genomic markers.

ABSTRACT

Recent advances in glioma genomics have significantly changed our understanding of tumor biology and hence, affected how these patients are treated. Similarly, integrating imaging data with genomic markers has also helped create better prognostic and predictive biomarkers which offer promising future for personalized medicine. This session will highlight a multi-disciplinary approach with the focus on advanced imaging and genomics markers before and after therapy in gliomas.
Participants
Simon S. Lo, MD, Seattle, WA, (simonslo@uw.edu) (Moderator) Research support, Elekta AB; Travel support, Accuray Incorporated; Speaker, Accuray Incorporated;

LEARNING OBJECTIVES
After the course, participants should be able to discuss: 1. Imaging Evaluation, Target Delineation and Response Evaluation for Stereotactic Radiotherapy for Skull Base Tumors. 2. Imaging Evaluation, Target Delineation and Response Evaluation for Stereotactic Body Radiotherapy for Spinal Metastases.

ABSTRACT

Sub-Events

RC220A Imaging Evaluation of Skull Base and Spinal Tumors

Participants
Pejman Jabehdar Maralani, MD, FRCPC, Toronto, ON (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) To demonstrate the role of various imaging modalities for detection and follow up of spinal and skull base metastasis. 2) To demonstrate the role of imaging in pre-radiation planning with a focus on SBRT.

ABSTRACT
The aim of this presentation is to discuss the diagnostic performance of plain film, CT scan, bone scan, MRI and PET for detection and follow up of spinal and skull base bony metastasis. We will discuss the latest trends and limitations regarding each modality. We also discuss dedicated role of imaging in planning for SBRT.

RC220B Target Delineation and Response Evaluation for Skull Base Stereotactic Radiosurgery/Radiotherapy

Participants
Lia M. Halasz, MD, Seattle, WA, (lhalasz@uw.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Recognize the challenges of target and normal structure delineation in the skull base. 2) Identify imaging modalities helpful to target and normal structure delineation. 3) Review data on pseudoprogression after radiation therapy to skull base tumors.

ABSTRACT
The aim of this session is to understand the challenges of target delineation and response evaluation in the treatment of skull base tumors. We will discuss helpful imaging modalities to aid in contouring and the issue of pseudoprogression in determining response.

RC220C Target Delineation for Spinal Stereotactic Radiosurgery/Radiotherapy

Participants
Kristin J. Redmond, MD, MPH, Baltimore, MD (Presenter) Research support, Elekta AB

RC220D Response Evaluation for Spinal Stereotactic Radiosurgery/Radiotherapy

Participants
Sten Myrehaug, MD, FRCP, Toronto, ON (Presenter) Speakers Bureau, Pfizer Inc; Speakers Bureau, Novartis AG

LEARNING OBJECTIVES
1) Appreciate the challenges of spine response determination. 2) Issue of radiographic pseudoprogression. 3) Clinical trials and incorporation of response criteria.

ABSTRACT
The aim of this session is to understand the challenges of response determination with spine SBRT. In particular the issues of radiographic changes following high dose radiation. Clinical trials are in flux and determining how to handle response which will be discussed.
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.
Participantes
Anna Shapiro, MD, Syracuse, NY (Moderator) Nothing to Disclose
Tarita O. Thomas, MD, PhD, Chicago, IL (Moderator) Nothing to Disclose

Sub-Event
MSRO22-01 Invited Speaker: Gastrointestinal Radiation Oncology

Participants
Richard Tuli, MD, PhD, Los Angeles, CA (Presenter) Nothing to Disclose

Participants
Chongda Zhang, Beijing, China (Presenter) Nothing to Disclose
Hongmei Zhang, MD, Beijing, China (Abstract Co-Author) Nothing to Disclose

PROPÓSITO
Para evaluar el valor diagnóstico de la evolución del área máxima (MA) en el tumor para predecir la respuesta completa patológica (pCR) a la quimioterapia de adyuvancia (CRT) en pacientes con cáncer de recto avanzado (LARC).

MÉTODO Y MATERIALES
101 pacientes consecutivos con LARC que recibieron CRT seguido de mesorectal excisión (TME) fueron reclutados. Se midió el área máxima antes (MApre) y después (MApost) de CRT en imágenes axiales de RM con alta resolución espacial. Se calculó la reducción de área máxima como:

\[
\text{MApre} - \text{MApost} / \text{MApre} \times 100\%.
\]

RESULTADOS
Se obtuvieron diferencias estadísticamente significativas entre los respondores completos y incompletos en los predictores de MApre, MApost y MARR con un valor de p de 0.046, menor de 0.000 y 0.002, respectivamente. El área bajo la curva ROC (AUC) para MApre, MApost y MARR fue de 0.639, 0.763 y 0.707, respectivamente. Se obtuvo un valor óptimo de corte de 155.5 mm² para MApost con una sensibilidad de 64.6% y una especificidad de 86.4% para predecir la pCR.

CONCLUSIÓN
La evaluación cuantitativa del área máxima de tumor fue factible para diferenciar pCR de no-pCR en pacientes con cáncer de recto avanzado. MApre, MApost y MARR parecen ser herramientas potenciales para distinguir respondores completos para el tratamiento individualizado.

RELEVANCIA CLÍNICA/APLICACIÓN
La RM funcional puede demostrar áreas máximas de tumores en el cáncer de recto y se recomienda como parte de un estudio de RM para evaluar las respuestas a la quimioterapia adyuvante.

PROPÓSITO
Para evaluar el valor diagnóstico de la evolución de la intensidad de señal T2 (SI) en el tumor para predecir la respuesta completa patológica (pCR) a la quimioterapia de adyuvancia (CRT) en pacientes con cáncer de recto avanzado (LARC).

MÉTODO Y MATERIALES
101 pacientes consecutivos con LARC que recibieron CRT seguido de mesorectal excisión (TME) fueron reclutados. Se midieron SI(SIpre) y SI promedio de músculo obturatriz interna (SIm) antes y después de CRT en imágenes axiales de RM con alta resolución espacial. Se normalizó la SI por SIm (SI = SIpre / SIm) para reducir la influencia de factores específicos de la imagen. Se calculó la reducción de SI como:

\[
\text{SIpre} - \text{SIpost} / \text{SIpre} \times 100\%.
\]

RESULTADOS
Se obtuvieron diferencias estadísticamente significativas entre los respondores completos y incompletos en los predictores de SIpre, SIpost y SIRR con un valor de p de 0.046, menor de 0.000 y 0.002, respectivamente. El área bajo la curva ROC (AUC) para SIpre, SIpost y SIRR fue de 0.639, 0.763 y 0.707, respectivamente. Se obtuvo un valor óptimo de corte de 155.5 mm² para SIpost con una sensibilidad de 64.6% y una especificidad de 86.4% para predecir la pCR.

CONCLUSIÓN
La evaluación cuantitativa de la máxima masa tumoral fue factible para diferenciar pCR de no-pCR en pacientes con cáncer de recto avanzado. SIpre, SIpost y SIRR parecen ser herramientas potenciales para distinguir respondores completos para el tratamiento individualizado.

RELEVANCIA CLÍNICA/APLICACIÓN
La RM funcional puede demostrar maximales de tumores en el cáncer de recto y se recomienda como parte de un estudio de RM para evaluar las respuestas a la quimioterapia adyuvante.
Multiparametric MRI as A Predictive Response Biomarker in Esophageal Cancer

**ABSTRACT**

Purpose/Objective(s): We hypothesized that imaging intratumoral angiogenesis/hypoxia may be predictive response biomarkers in esophageal cancer. We evaluated the predictive value of multiparametric MRI in neoadjuvant chemotherapy response assessment in patients with esophageal cancer. We evaluated the predictive value of multiparametric MRI in neoadjuvant chemotherapy response assessment in patients with esophageal cancer.

RESULTS

Statistically significant differences between pathological complete responders and incomplete responders were obtained in the predictors of SIpost and SIRR with p value of 0.003 and 0.001, respectively. While the difference was not considered significant with a p value of 0.783 for SIpre. Area under the ROC curve (AUC) value was 0.705 for SIpost and 0.743 for SIRR. The optimal cutoff values of 1.56 (sensitivity=70.9%, specificity=63.6%) and 0.365(sensitivity=77.3%,specificity=68.4%) were obtained for SIpost and SIRR respectively.

CONCLUSION

Quantitative evaluation of T2 signal intensity was feasible to differentiate between pCR and non-pCR groups to CRT in rectal cancer. SIpost and SIRR seem to be potential tools for distinguishing pathological complete responders to aid appropriate individually tailored therapies.

CLINICAL RELEVANCE/APPLICATION

Functional MR can demonstrate signal intensity of tumors in rectal cancer and is recommended as part of a MR study to evaluate responses to neoadjuvant chemoradiotherapy.

**RESULTS**

Statistically significant differences between pathological complete responders and incomplete responders were obtained in the predictors of SIpost and SIRR with a p value of 0.003 and 0.001, respectively. While the difference was not considered significant with a p value of 0.783 for SIpre. Area under the ROC curve (AUC) value was 0.705 for SIpost and 0.743 for SIRR. The optimal cutoff values of 1.56 (sensitivity=70.9%, specificity=63.6%) and 0.365(sensitivity=77.3%,specificity=68.4%) were obtained for SIpost and SIRR respectively.

**CONCLUSION**

Quantitative evaluation of T2 signal intensity was feasible to differentiate between pCR and non-pCR groups to CRT in rectal cancer. SIpost and SIRR seem to be potential tools for distinguishing pathological complete responders to aid appropriate individually tailored therapies.

CLINICAL RELEVANCE/APPLICATION

Functional MR can demonstrate signal intensity of tumors in rectal cancer and is recommended as part of a MR study to evaluate responses to neoadjuvant chemoradiotherapy.

**MSRO22-05 Negative FNA of Suspicious Inguinal Nodes is Associated with a Low Risk of Recurrence in Patients with Anal Carcinoma**

**ABSTRACT**

Purpose/Objective(s): Non-metastatic anal cancer is treated with definitive chemoradiation (CRT). Standard of care includes intensity modulated radiation therapy (IMRT) with dose levels defined by clinical stage and lymph node involvement, as defined by clinical exam and 18F-fluorodeoxyglucose Positron Emission Tomography (FDG-PET), but non-specific uptake in the inguinal lymph regions can complicate staging. Fine needle aspiration (FNA) is often used to evaluate equivocal FDG-PET findings, but the accuracy of the test is not well-known, as surgical dissection is a common part of management. We report our experience with groin FNA as a component of initial work-up for anal carcinoma.

Materials/Methods: Patients with non-metastatic anal carcinoma and staging FDG-PET were included and charts were reviewed. Patients were treated with Nigro regimen chemotherapy (5-fluorouracil and mitomycin C) and concurrent radiation using 3 dimensional-conformal radiotherapy (3D-CRT) or IMRT, with low-dose RT to elective regions and boost to the primary tumor and involved lymph node regions. FNA was performed under ultrasound or CT-guidance.

Results: 153 patients were identified with anal cancer and staging FDG-PET treated from 2003-2013. Inguinal lymph nodes were interpreted as positive or equivocal for metastatic involvement on staging FDG-PET in 58 patients (38%). Of these, 17 underwent groin FNA (30%). 8 aspirates were positive for carcinoma (47%), 9 were negative and 1 was non-diagnostic. Median dose to inguinal regions was 30Gy (range 30-45Gy) for patients with negative FNA and 54Gy (range 50.4-56Gy) for patients with positive FNA. After a median follow-up of 30.1 months, 42 patients (27%) had died, and 28 (18%) had experienced recurrence. Of patients with negative inguinal FNA, all but one patient was alive and none had experienced recurrence of disease, compared to 5 deaths and 7 recurrences among patients with positive inguinal FNA, including 2 inguinal failures.

Conclusion: In a contemporary cohort of patients with anal cancer and staging FDG-PET, FNA was commonly employed for equivocal FDG-PET findings. FNA confirmed suspicion of lymph node involvement half the time. Although accuracy of FNA cannot be determined without subsequent groin dissection, recurrence is low after negative FNA of suspicious or equivocal FDG-avid adenopathy.

**MSRO22-07 Multiparametric MRI as A Predictive Response Biomarker in Esophageal Cancer**

**ABSTRACT**

Purpose/Objective(s): We hypothesized that imaging intratumoral angiogenesis/hypoxia may be predictive response biomarkers in esophageal cancer. We evaluated the predictive value of multiparametric MRI in neoadjuvant chemotherapy response assessment in
esophageal cancer. Materials/Methods: Patients treated with neoadjuvant chemotherapy for resectable esophageal adenocarcinoma were recruited for this IRB-approved exploratory prospective study. Patients underwent baseline (TIME0), post-cycle 1 (TIME1) and post-neoadjuvant chemotherapy (TIME2) 1.5T MRI which included high-resolution T2-weighted (T2w) parameters: signal intensity histogram, diffusion-weighted (DW parameters: apparent diffusion coefficient (ADC) histogram) and dynamic contrast-enhanced MRI (DCE-MRI parameters: transfer constant (Ktrans), rate constant (kep) extravascular-extracellular volume (ve), and plasma volume (vp) derived using an extended Toft’s model). A whole primary tumor volume was defined as a volume-of-interest using an in-house software. Relative change in all MR parameters between TIME1/2 and TIME0 were calculated. Primary end-point was pathological tumor regression grade defined as per the Mandar’s criteria with TRG1-3 classified as responders and TRG4-5 as non-responders. Mann-Whitney U test was used to assess for associations between absolute and relative change in MR parameters and pathological tumor response. Mean±SD are presented; pResults: There were 5 responders (36%) and 9 (64%) non-responders. 1/5 (7%) patients had complete response. Baseline TIME0 ADC skewness was associated with pathological response (responders vs. non-responders: -0.2±0.1 vs. -0.5±0.3, p=0.042). The following post-treatment TIME2 parameters were also significant predictive response markers: DCE Ktrans (0.7±0.1 vs. 1.6±0.9, p=0.006), T2w entropy (4.0±0.1 vs. 3.7±0.1, p=0.003), T2w fractal lacunarity (0.006±0.002 vs. 0.004±0.001, p=0.011) and T2w mean fractal dimension (2.9±0.1 vs. 2.8±0.1, p=0.045). However, relative MR changes between TIME1/2 and TIME0 were not predictive of pathological response. A complete responder had the lowest TIME2 Ktrans value (0.54 min⁻¹) indicating that post-treatment Ktrans may be a sensitive imaging response biomarker after neoadjuvant chemotherapy, related to reduced vascular perfusion/permeability. Conclusion: Baseline MRI ADC and post-treatment DCE/T2w parameters, but not relative change over baseline, showed potential as imaging response biomarker in esophageal cancer treated with neoadjuvant chemotherapy. These results coupled with its superior soft tissue definition make MRI an attractive imaging (re)staging modality, and bodes well for future integrated PET/MRI studies in this setting.

**MSRO22-09** Proton Therapy Posterior Beam Approach with Pencil Beam Scanning for Esophageal Cancer: Clinical Outcome, Dosimetry, and Feasibility

Monday, Nov. 28 11:50AM - 12:00PM Room: S103AB

Participants
Jing Zeng, MD, Seattle, WA (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): With increasing availability of proton therapy as well as evolving proton technology, more patients with esophageal cancer have access to proton therapy as a treatment option. We present the feasibility and preliminary clinical results of a novel pencil beam scanning (PBS) posterior beam technique of proton treatment for esophageal cancer in the setting of trimodality therapy, which could potentially further lower dose to normal organs. Materials/Methods: From February 2014 to June 2015, 13 patients with locally advanced esophageal cancer (T3-4N0-2M0) were treated with trimodality therapy (neoadjuvant chemoradiation, followed by esophagectomy). Eight patients were treated with uniform scanning (US) and five patients were treated with PBS. Comparison planning with PBS was performed using 3 plans: 1) AP/PA beam arrangement; 2) PA plus left posterior oblique (LPO) beams, and 3) single PA beam (treated twice for motion mitigation). Patient outcomes, including pathologic response and toxicity were evaluated. Results: All 13 patients completed chemoradiation to 50.4 Gy (RBE) and all but one patient underwent surgery. Of the 12 evaluable patients, 100% had a R0 resection and pathologic complete response was seen in 25% (3/12). There was no difference in outcome between patients treated with PBS and US. There was one grade 5 post-operative mortality (20% vs 17%, PConclusion: Proton therapy with a single PA beam PBS technique for preoperative treatment of esophageal cancer appears safe and feasible. Given the superior dosimetric sparing of normal tissues compared to other proton techniques, this technique should be further explored and validated.
PURPOSE
We have recently presented high resolution treatment response assessment maps (TRAMs) enabling efficient separation between tumor (contrast clearance >1 hr post injection, blue) and treatment-effects (TEs, contrast accumulation, red), validated histologically in 54 resected patients. Here we demonstrate potential advantages in delineating stereotactic radiosurgery (SRS) dose-effects.

METHOD AND MATERIALS
In a preliminary study on 7 brain metastases, T1-Gd and the TRAMs were co-registered to the SRS dose-plan and pixel-by-pixel analysis was performed comparing baseline T1-Gd/TRAMs and dose-plan to T1-Gd/TRAMs acquired 141±12 days (day140) post SRS.

RESULTS
Tumor-growth rates were significantly correlated with initial tumor volumes when calculated from blue regions in the TRAMs (r²=0.77;p<0.03) but not when calculated from enhancing regions in T1-Gd (r²=0.4;p<0.19), consistent with the TRAMs superiority over T1-Gd in depicting true tumor tissues. T1-Gd showed that the % of enhancing pixels at baseline (normal-appearing brain) that turned enhancing at day140 increased linearly to 20.2Gy, where it raised sharply to 48% followed by a sharp drop at 21.2Gy. The TRAMs showed that the increase to 20.2Gy may be explained by new blue/tumor growth with a sharp drop at 20.2Gy, while the sharp rise at 20.2Gy may be explained by development of TEs (red). Per-lesion analysis showed significant correlations between dose and blue growth-rates (r²=0.81;p<0.014). % of blue volumes exposed to >20Gy was found higher in solid (88%) vs cystic (54%) lesions.

CONCLUSION
These preliminary results demonstrate the TRAMs potential advantages in delineating SRS dose effects. Efficacy was higher at lower doses when studied by the TRAMs vs T1-Gd and thresholds were delineated better. The TRAMs suggest induction of TEs and prevention of new tumor growth in normal-appearing brain at >20Gy.
The ability of the TRAMs to provide high resolution differentiation between tumor/treatment-effects may enable improved determination of thresholds for tumor kill and side effects, thus may be applied for individual dose painting radiotherapy.

**MSRO25-04 Temporally Dependent Intracranial Control of Melanoma Brain Metastasis by Stereotactic Radiotherapy in Patients Treated with CTLA-4 Blockade**

**PURPOSE**

Numerous studies suggest that radiation can boost antitumor immune response via stimulating the release of tumor-specific antigens. However, the optimal timing between radiotherapy and immune checkpoint blockade to achieve synergistic benefits is unclear. Our current study investigated whether the timing of stereotactic radiosurgery (SRS) for patients who developed new brain metastases from advanced melanoma after receiving the CTLA-4 inhibitor ipilimumab affects intracranial control and survival.

**METHOD AND MATERIALS**

This is a multi-institutional retrospective analysis of patients diagnosed with metastatic melanoma who had received ipilimumab and SRS to the brain for new metastases after immunotherapy from 2007 to 2014. A total of ninety-nine patients with metastatic melanoma to the brain were eligible and included in the analysis. All patients had received at least 2 doses of ipilimumab before SRS, and all must had complete blood-test information available before SRS.

**RESULTS**

From the training cohort, patients who received SRS within 5.5 months (n=51) of their last dose of ipilimumab had significantly improved intracranial control compared with patients who received SRS after 5.5 months (n=20) (median interval 8.09 vs. 3.63 months, hazard ratio [HR] 0.474, 95% confidence interval [CI] 0.253-0.887, P=0.019). Overall survival (OS) was not significantly different between the two arms. The improved intracranial control rate was confirmed using an independent cohort of patients (n=28) treated at a second comprehensive cancer center. We also found that circulating absolute lymphocyte count before SRS predicted treatment response: those with baseline count >1000/µL had reduced risk of intracranial recurrence compared with those with ≤1000/µL (HR 0.378, 95% CI 0.212-0.675, P=0.001).

**CONCLUSION**

In this multi-institutional study, we found that patients who received SRS for new brain metastases within 5.5 months after ipilimumab therapy had better intracranial disease control than did patients who received SRS later; moreover, circulating lymphocyte count predicted intracranial disease control.

**CLINICAL RELEVANCE/APPLICATION**

Timing of radiation in relation to CTLA4 blockade is critical for promoting immune-mediated intracranial control of melanoma brain metastasis and is recommended to be delivered within close proximity to immunotherapy administration.

**MSRO25-05 Radiation Dose-Dependent Hippocampal Atrophy Detected with Longitudinal Volumetric MRI**

**PURPOSE**

Following brain radiation therapy (RT) patients often experience memory dysfunction, thought to be mediated in part by damage to the hippocampus. Hippocampal atrophy measured by MRI is a known correlate of cognitive decline in other disease processes. We sought to determine whether patients undergoing brain RT would show radiation dose-dependent hippocampal atrophy on volumetric MRI.
METHOD AND MATERIALS

Hippocampal volume was measured with MRI in 52 patients who underwent fractionated, partial brain RT for primary brain tumors. Study patients had high-resolution, 3D volumetric MRI (inversion recovery spoiled gradient-echo sequence: TE, 2.8ms; TR, 6.5 ms; TI, 450 ms; flip angle, 8 degrees; FOV, 24cm; 0.93 x 0.93 x 1.2mm; sagittal) prior to and one year post-RT. Images were processed using software with FDA clearance and CE marking for automated measurement of hippocampal volume. Processing included correction for distortion and segmentation of the hippocampus bilaterally. Automated results were inspected visually for accuracy and for censoring of tumor and surgical changes. Radiation dose data were co-registered with processed MRI data. Mean dose to each hippocampus was tested for correlation with change in hippocampal volume in the year following RT. Average hippocampal volume change was also calculated for hippocampi receiving >40 Gy mean dose and for hippocampi receiving <10 Gy mean dose. Statistical significance was evaluated with Student’s t-test at α = 0.05.

RESULTS

Median prescribed RT dose was 60 Gy (range 50.4 to 60 Gy). Most patients (96%) received temozolamide. Greater hippocampal volume loss was seen at higher mean hippocampal doses ( r = -0.24, p = 0.016). Hippocampi receiving mean dose >40 Gy had a mean volume loss of 5.8% (p = 0.009), whereas hippocampi receiving <10 Gy had a mean volume loss of 1.2% (p = 0.103).

CONCLUSION

Higher mean radiation dose to the hippocampus was associated with greater hippocampal atrophy one year later.

CLINICAL RELEVANCE/APPLICATION

RT dose avoidance of the hippocampus is being tested in clinical trials. Measurement of hippocampal atrophy holds value as an imaging biomarker and may be associated with cognitive outcomes.

MSRO25-06 Variation in Outcomes of 1p19q Co-deleted Gliomas by Grade

Participants
Debra Yeboa, MD, Houston, TX (Presenter) Travel support, Eli Lilly and Company
James B. Yu, MD, New Haven, CT (Abstract Co-Author) Travel Grant, 21st Century Oncology, Inc
Joseph N. Contessa, MD, PhD, Ann Arbor, MI (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Recent retrospective molecular analyses of patients with lower grade gliomas suggest 1p19q-co-deleted subtype have similar survival outcomes irrespective of pathological grade. This finding prompted a re-evaluation of glioma prognostic groups. Whether these similar outcome are present in large observational cohorts in the US are unknown. We therefore examined survival outcomes for patients with 1p19q co-deleted treated with definitive therapy. Materials/Methods: Using the National Cancer Data Base, 703 patients diagnosed between 1998 and 2012 with grade II or III gliomas with 1p19q co-deletion were identified. Median age at diagnosis, sex, Charlson-Deyo comorbidity score (CDCS), and tumor histology (anaplastic oligodendroglioma, anaplastic astrocytoma, mixed) were assessed. Grade was defined by WHO grade. Summary statistics were performed on the percentage of grade II and III glioma patients receiving surgery alone, surgery + adjuvant RT, surgery +adjuvant chemo, and surgery + concurrent chemoRT. To assess overall survival (OS), Kaplan Meiers and log-rank tests were performed. Results: Using the National Cancer Data Base, 703 patients diagnosed between 1998 and 2012 with grade II or III gliomas with 1p19q co-deletion were identified. Median age at diagnosis, sex, Charlson-Deyo comorbidity score (CDCS), and tumor histology (anaplastic oligodendroglioma, anaplastic astrocytoma, mixed) were assessed. Grade was defined by WHO grade. Summary statistics were performed on the percentage of grade II and III glioma patients receiving surgery alone, surgery + adjuvant RT, surgery +adjuvant chemo, and surgery + concurrent chemoRT. To assess overall survival (OS), Kaplan Meiers and log-rank tests were performed. Conclusion: Contrary to other studies, our data with a large observational cohort demonstrates a significant difference in overall survival between grade II and grade III gliomas that are 1p19q co-deleted. Differences in survival outcomes were partially mitigated by adjuvant therapy, suggesting that treatment variables must be considered prior to assigning this molecular subtype into a single prognostic group.

MSRO25-07 Diffusion Tensor Imaging Characterization of Long-Term Neurotoxicity in Adult Survivors of Pediatric Brain Tumors

Participants
Silun Wang, MD, PhD, Atlanta, GA (Presenter) Nothing to Disclose
Jianming Ni, Wuxi, China (Abstract Co-Author) Nothing to Disclose
Liya Wang, MD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Tricia Z. King, Atlanta, GA (Abstract Co-Author) Nothing to Disclose
Hui Mao, PhD, Atlanta, GA (Abstract Co-Author) Nothing to Disclose

PURPOSE

Radiotherapy is known to causes central nerve system injury. However, the long term effect of structural injury in white matter (WM) and functional impairment in survivors of pediatric brain tumors has not been elucidated. Functional imaging and diffusion tensor imaging may provide sensitive detection of WM injury after radiotherapy and better understanding of the functional outcome of the survivors.

METHOD AND MATERIALS

14 adult survivors of pediatric brain tumors (with median radiation dose of 5400 cGy) and 27 demographically matched healthy controls (mean age: 22.7 ± 4.5 vs. 22.9 ± 4.3, p<0.05) were enrolled in the study. Anatomical MRI and DTI were performed on all participants using a 3T MRI scanner. Tract-based Spatial Statistics (TBSS) was used to determine structural changes in WM tracts. Correlation matrix of DTI indices, i.e., (FA, axial diffusivities (AxD) and radial diffusivities (RD), in whole brain WM tracts (n=50) were generated to identify the disruptions of connectivity. The correlations of DTI measurements with neurophysiological evaluations were derived from statistical analyses.
RESULTS
Significantly lower FA and AxD and higher RD values were observed in survivors comparing to the controls. However, AxD showed higher sensitivity than FA in detecting WM integrity changes, particularly in identifying changes in projection and association fibers. When WM tracts were examined with inter-tracts correlation matrices, the survivor group showed weaker correlation coefficient compared to the control group in the regions of brainstem, projection and association fibers. Significantly lower IQ scores was found in survivor group compared to controls (101 ± 5 vs. 109 ± 8, p<0.01). Changes of FA, AxD and RD were found to correlate with IQ scores, with RD changes in projection fibers and association fibers exhibiting stronger correlations with all IQ scores (all p<0.05).

CONCLUSION
AxD shows higher sensitivity to detect radiotherapy induced WM injury and may indicate diffused axonal degeneration. RD changes strongly correlated with neurophysiological results. Overall, weaker inter-tracts correlations in survivors may indicate heterogeneous injury of white matter function groups or disruptions in connectivity.

CLINICAL RELEVANCE/APPLICATION
We have identified promising imaging biomarkers, using DTI to characterize and localize radiotherapy induced white matter injury in adult survivors with pediatric brain tumors.

MSRO25-09 Targeting Glucose Metabolism in Brain Tumor Initiating Cells: An Novel Therapeutic Approach for Radiosensitization
Monday, Nov. 28 11:40AM - 11:50AM Room: S103CD

Participants
Kailin Yang, PhD, Cleveland, OH (Presenter) Nothing to Disclose
Xiuixing Wang, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Jeremy Rich, MD, Durham, NC (Abstract Co-Author) Nothing to Disclose

PURPOSE
Glioblastoma (GBM) is a deadly form of brain tumor for which conventional treatments including radiation therapy offer only palliation. Increasing evidence suggests that metabolic reprogramming, namely the Warburg effect, is not simply a passenger in tumorigenesis but may be an initiating event as recurrent somatic mutations of metabolic enzymes have been reported. Previously, brain tumor initiating cells (BTICs), a subset of tumor cells that exhibit radiation resistance, were found to hijack the process of high-affinity glucose uptake normally active in neurons to maintain energy demands in dynamic tumor microenvironments. Here, we aim to understand the molecular mechanism of aberrant glucose metabolism in BTICs and develop targeted approach to achieve
METHOD AND MATERIALS
BTICs were derived from patient GBM specimens. Metabolomics profiling was performed in matched pairs of BTICs and differentiated glioma cells (DGCs) labeled with U-13C-glucose. Genetic validation of identified metabolic pathways was performed using TCGA GBM dataset. Functional validation of target gene was performed in vitro for BTIC viability and self-renewal, and in vivo for tumorigenicity. Radiation treatment was delivered using Cs-137 irradiator.

RESULTS
Glucose influx, mediated by high-affinity glucose transporter GLUT3, regulates BTIC maintenance and tumorigenicity. Using unbiased metabolomics analysis, we traced carbon flow following glucose influx into BTICs, and discovered downstream glucose metabolism pathways including de novo purine synthesis were functionally upregulated, mediating glucose-sustained anabolic metabolism. Inhibiting purine synthesis through RNA interference and FDA-approved pharmacologic inhibitors such as mycophenolate mofetil or ribavirin attenuated BTIC viability after radiation, supporting metabolic reprogramming as a potential therapeutic point of fragility. Elevated expression of purine synthesis enzymes predicts poor prognosis in GBM patients.

CONCLUSION
A stem-like radioresistant state in GBM is associated with metabolic reprogramming to fuel tumor hierarchy, revealing potential BTIC cancer dependencies amenable to targeted therapy for radiation sensitization.

CLINICAL RELEVANCE/APPLICATION
This study provided scientific rationale to target aberrant glucose metabolism (such as using FDA-approved anti-purine synthesis medications) as potential adjuvant therapy to enhance efficacy of radiation treatment.
**SSC15**

**Radiation Oncology (Gynecologic)**

**Monday, Nov. 28 10:30AM - 12:00PM Room: S104A**

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

**FDA** Discussions may include off-label uses.

**Participants**

Jerry J. Jaboin, MD, PhD, St. Louis, MO (*Moderator*) Nothing to Disclose
Tracy M. Sherertz, MD, San Francisco, CA (*Moderator*) Nothing to Disclose

**Sub-Events**

**SSC15-01**  
**Evaluation of Therapeutic Response to Concurrent Chemoradiotherapy in Patients With Advanced Cervical Squamous Carcinoma Using Dynamic Contrast-Enhanced MR Imaging**

**Monday, Nov. 28 10:30AM - 10:40AM Room: S104A**

Participants

Yue Dong, Shen Yang, China (*Presenter*) Nothing to Disclose
Zao H. Zhang, Shen Yang, China (*Abstract Co-Author*) Nothing to Disclose
Shuai He, Shen Yang, China (*Abstract Co-Author*) Nothing to Disclose
Yahong Luo, Shenyang, China (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

To investigate the changes of dynamic contrast-enhanced MR imaging (DCE-MRI) parameters in the patients with advanced cervical squamous carcinoma before and after concurrent chemo-radiotherapy (CCRT), and to correlate the parameters with final tumour response to therapy.

**METHOD AND MATERIALS**

Forty-five patients with advanced cervical squamous cancer underwent DW-MRI before CCRT (preTx), 4 weeks (postT1) after initiating treatment and at 1 month (postT2) after the end of treatment. DCE-MRI was obtained using a 3D fast field echo sequence in the axial plane (TR/TE 3.6/1.8 ms, flip angle 15°, acquisition time 5 min). Images were obtained immediately after a bolus injection of gadolinium DTPA (Magnevis,GE) at a rate of 3 ml/s. Pharmacokinetic analysis was performed according to extended tofts model, and the following quantitative parameters were calculated: volume transfer constant (Ktrans), rate constant (kep) and fraction of extravascular extracellular volume (Ve). DCE-MRI parameters were calculated in the tumour and normal myometrium. Final response to treatment as determined by changes in tumour size and volume was correlated with pre-treatment DCE-MRI parameters at each point.

**RESULTS**

Before therapy, the mean values of Ktrans , kep and Ve in the tumors were significantly lower than those in the myometrium (P<0.05). DCE-MRI parameters in the tumors showed significantly increased changes in response to CCRT (P<0.05) and in particular Ktrans and Ve demonstrated early significant increase (postT1) (P<0.01), but those in normal myometrium did not show a significant difference (P>0.05). Ktrans of the tumors at (preTx) was statistically associated with tumour size or volume change at postT1 and postT2. Changes of of Ktrans and kep in tumor at postT1 had a significant correlation with tumor size and volume change at postT2.

**CONCLUSION**

DCE-MRI parameters may help evaluate early changes of cervical squamous cancer to CCRT.

**CLINICAL RELEVANCE/APPLICATION**

DCE-MRI parameters, as early biomarkers, have the potential to evaluate therapeutic responses to CCRT in advanced cervical squamous cancers.

**SSC15-02**  
**Prediction of Patient Outcome in Locally Advanced Cervical Carcinoma Following Chemo-radiation - Comparative Effectiveness of Qualitative Response Assessment Interpretation Criteria using MRI and 18F-FDG PET-CT**

**Monday, Nov. 28 10:40AM - 10:50AM Room: S104A**

Participants

Andrew F. Scarsbrook, FRCR, Leeds, United Kingdom (*Presenter*) Nothing to Disclose
Sriram Vaidyanathan, MD, FRCR, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Fahmid Chowdhury, MBBS, FRCR, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Sarah E. Swift, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Rachel Cooper, Leeds, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Chirag Patel, FRCR, Oxford, United Kingdom (*Abstract Co-Author*) Nothing to Disclose

**PURPOSE**

Evaluation of a qualitative response assessment scoring system at MRI and 18F-FDG PET-CT following chemo-radiation for locally advanced cervical carcinoma and correlation with patient outcome.

**METHOD AND MATERIALS**
77 patients with locally advanced cervical carcinoma treated with radical chemo-radiotherapy (CRT) in a single center (2011-2014) underwent MRI and 18F-FDG PET-CT 3 months post therapy. Tumor response at MRI was assessed using a 3-point scale based on residual T2-weighted signal intensity. Metabolic response at PET-CT was assessed using a 5-point scale ranging from background activity to progressive metabolic disease. Clinical and radiologic follow-up was performed in all patients (minimum 18 months). Progression-free (PFS) and overall survival (OS) was calculated using the Kaplan-Meier method (Mantel-Cox log-rank) and groups responses were correlated using Chi2 test.

RESULTS

Of 77 patients with median (range) age of 45 (24-75) years, 39 (51%) had complete response (CR) on MRI (Score M1), 10 relapsed (26%). Of 29 with complete metabolic response (CMR, Score P1/2) on PET, 2 (7%) recurred. Of 21 patients with CR on MRI and PET-CT, 2 relapsed (10%). Of 32 patients (42%) with partial response (PR) at MRI (Score M2), 15 relapsed (47%). All 8 patients with M2 and negative PET-CT remained disease free at follow-up. Of 38 patients (49%) with indeterminate uptake on PET (Score P3/4), 19 relapsed (50%). Recurrence was lower in patients with M1 (6/15, 40%) compared to M2 (11/21, 52%). 5/6 patients (83%) with significant signal intensity at MRI (Score M3) relapsed. PET-CT demonstrated progressive disease (PD, Score P5) in 9 patients (12%). Kaplan-Meier demonstrated a highly statistically significant difference in PFS and OS between patients with CMR, indeterminate uptake, PMR and PD (Log-rank, P < 0.0001). Chi2 test demonstrated a highly statistically significant association between increasing qualitative score and risk of recurrence or death (P<0.001).

CONCLUSION

MRI and PET-CT provide complementary information post CRT in locally advanced cervical cancer. Qualitative scoring systems in this clinical scenario predict outcome and may help guide further patient management.

CLINICAL RELEVANCE/APPLICATION

In the era of precision medicine, objective MRI and PET-CT response assessment criteria may help guide an individualized approach to subsequent patient management in locally advanced cervical cancer.

SSC15-03 Concurrent Chemoradiotherapy Using Daily Low-Dose Cisplatin for Extrapelvic Lymph Node Recurrences after Curative Treatment for Cervical Cancer: Clinical Outcomes and in Vitro Study

ABSTRACT

Purpose/Objective(s): To investigate the clinical outcomes of radiotherapy for extrapelvic lymph node recurrences after curative treatment for cervical cancer and discuss the results of our in vitro study on the effectiveness of concurrent chemoradiotherapy.

Materials/Methods: A total of 20 patients, aged 29-75, who underwent radiotherapy for lymph node recurrence from 2002 and 2015 were included. The location of recurrence was para-aortic lymph node in 7, supraclavicular in 8, mediastinal in 1, supraclavicular + mediastinal in 2, and supraclavicular + para-aortic in 2 patients. The histology was squamous cell carcinoma, adenocarcinoma, adenosquamous cell carcinoma in 12, 7, 1 patient. The median total radiation dose (EQD2) was 50 Gy. Thirteen patients received concurrent chemoradiotherapy with daily low-dose cisplatin (median 8 mg/m2 per day). In addition, in vitro study was conducted; HeLa-S3 cells after exposing radiation with different doses of cisplatin were cultured and 3H-thymidine uptake was measured. Results: Local responses immediately following radiotherapy were CR in 13 patients and PR in 3 (80%). Treatment was well tolerated, with no GI/mucosal toxicity, 35% grade 3-4 leukopenia, and 25% grade 3-4 thrombocytopenia. With median follow-up period of 17 months, the 2-year local control rate was 45% and the 3-year overall survival rate was 43%. Four patients are still alive without disease over 5 years. Recurrence was observed at the field margin in 3, in-field in 9, both in and out of field in 3 patients. Neither use of chemotherapy nor dose over 50 Gy affected overall survival. A shorter interval between initial treatment and first recurrence had marginal impact on patient's poor prognosis; patients with NED vs. others: 18 months vs. 6 months. In vitro study demonstrated that exposure to blood cisplatin levels of =2.5 mg/mL had a synergistic effect in the radiation and low-dose cisplatin. Conclusion: Radiotherapy for extrapelvic lymph node recurrences after curative treatment for cervical cancer could lead to long-term survival for some patients. In vitro study using HeLa-S3 cells supported the use of concurrent administration of low-dose cisplatin with radiation therapy.

SSC15-04 Metabolic Response on Post-treatment 18F-FDG PET/CT to Predict Local Control and Survival Outcomes in Vulvar Cancer

ABSTRACT

To investigate the response to therapy for vulvar carcinoma using post-therapy imaging with F-18 fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) and compare the metabolic response to local regional control and survival outcomes.

RESULTS

This was a retrospective study of 23 women with vulvar cancer. Radiation intent was definitive in 12 patients (52%), adjuvant radiation after surgery in 8 patients (35%), and neoadjuvant radiation prior to surgery in 3 patients (13%). All patients received intensity modulated radiation treatment to a mean dose of 55.6 Gy (range 49.6 to 70 Gy). Prior to any treatment, all patients received a staging FDG-PET/CT. Post-treatment whole body FDG-PET/CT was performed at 0.2 to 7 months (median 2.5 months) after completion of radiation therapy.
The post-treatment FDG-PET showed no evidence of disease (complete metabolic response) in 13 patients. Residual disease or progressive disease on FDG-PET was seen in 10 patients. A Cox proportional hazards model of clinical outcome indicated that post-treatment PET response was the most significant predictor of biopsy-proven local-regional control (HR=8.89, 95% CI 1.8-43.9, p=0.01) and overall survival (HR 9.16, 95% CI 1.05-79.6, p=0.045) compared to other prognostic parameters. The 2-year local-regional control rate was 90% for patients with no evidence of disease vs. 22.5% for patients with residual or progressive disease on post-treatment PET. The 2-year overall survival was 100% for patients with no evidence of disease vs. 42.8% for patients with residual or progressive disease.

CONCLUSION
In this single-institution study of women with vulvar cancer, the post-treatment FDG response on whole-body FDG-PET/CT was predictive of local regional control and survival.

CLINICAL RELEVANCE/APPLICATION
Post-treatment 18F-FDG PET/CT may help physicians identify a subset of patients diagnosed with vulvar cancer at a higher risk of recurrence who may benefit from salvage therapy, such as surgery or radiation.

SSC15-06 Pelvic Bone Marrow Sparing in Volumetric Modulated Arc Therapy Reduced the Hematologic Toxicity for Cervical Cancer
Monday, Nov. 28 11:20AM - 11:30AM Room: S104A

Participants
Yao Sun, Oak Brook, IL (Presenter) Nothing to Disclose
Zhiyong Yuan, Tianjin, China (Abstract Co-Author) Nothing to Disclose
zhao tao, tianjin, China (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): To determine if bone marrow sparing (BMS) in volumetric modulated arc therapy (VMAT) reduce the hematologic toxicity compared with VMAT without BMS.Materials/Methods: Two groups of 10+ patients with cervical cancer at our institution were enrolled respectively. All the patients received postoperative VMAT to 50.4Gy to the pelvic lymphatics and vagina. All plans were generated using our in-house-developed automatic inverse planning (AIP) algorithm. One group was treated with BMS-VMAT, while the other group was treated with VMAT without BMS. Planning objectives for PTV were minimum dose =95%, maximum dose = 107%+. The pelvic bone marrow (PBM) was limited to V5 t-test. The X2test was used to compare rates of hematologic toxicity.

RESULTS: The two groups resulted in equivalent homogeneity (1.07±1.2% vs 1.10±3.1%; P=0.210) and conformity index (0.84± 2.7% vs 0.827±1.2%; P=0.444). The PBM dose metrics showed a significant decrease in V5 (83.1%±3.2% vs 89.0%±0.8%; P=0.037) and V10 (74.8%±1.6% vs 82.3%± 2.1%; P=0.008) in the BMS-VMAT group compared to the VMAT group. However, V30 and V40 of PBM dose metrics were not significantly different between the two groups. The nadir for WCC (P=0.008) and ANC (P=0.004) were significantly reduced in the VMAT group compared to the BMS-VMAT group. In the BMS-VMAT group, 16.7% had grade 2 or higher hematologic toxicity (HT) compared with 56.7% in the VMAT group (P=0.036).Conclusion: BMS-VMAT reduced irradiation of PBM compared to VMAT without BMS, especially in the low dose radiation (V5 and V10). This analysis supports the hypothesis that low dose radiation of PBM is associated with acute HT during postoperative radiotherapy for cervical cancer. Techniques to limit pelvic bone marrow irradiation can reduce HT in cervical cancer patients.

SSC15-07 Incidence and Prognostic Value of NFkB-p65 Nuclear Versus Cytoplasmic Expression in Locally Advanced Cervical Cancer Patients Treated Definitively with Concurrent Chemoradiation
Monday, Nov. 28 11:30AM - 11:40AM Room: S104A

Participants
Darlene G. Attiah, MS, Chicago, IL (Presenter) Nothing to Disclose
Tamer Refaat Abdelrahman, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Irene Helenowski, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Jonathan B. Strauss, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
William Small JR, MD, Maywood, IL (Abstract Co-Author) Speakers Bureau, Carl Zeiss AG; Advisory Board, Varian Medical Systems, Inc
Eric D. Donnelly, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

PURPOSE
This study aims to report the incidence of NFkB-p65 nuclear versus cytoplasmic over-expression in locally advanced cervical cancer patients treated definitively with concurrent chemoradiation therapy (CRT) and their respective prognostic values on treatment outcomes.

METHOD AND MATERIALS
This IRB approved retrospective study included locally advanced cervical cancer patients, stages IB1 through IVA treated definitively with CRT. Evaluation of both nuclear and cytoplasmic immunoreactivity for NFkB-p65 was performed applying the same immunohistochemistry staining protocol reported by Garg et al. and scored quantitatively by 3 pathologists blinded to the treatment outcomes. Overall survival (OS), progression free survival (PFS), local regional control (LC), and distant metastases free survival (DMFS) rates were obtained via the Kaplan-Meier method and differences between groups were evaluated by the Log-Rank test.

RESULTS
The study evaluated 28 eligible patients with a median age of 51 ± 10 years. None of the patients expressed pretreatment NFkB-p65 nuclear immunoreactivity, whereas 15 (53.6%) and 13(46.4%) had cytoplasmic expression with a recurrence H-index ≥180 and <180, respectively. For patients with pretreatment cytoplasmic NFkB H-index ≥180, and <180, the 5-year OS were 49.45% and 64.10% (P-Value = 0.34), PFS were 39.29% and 57.69% (P-value = 0.21), LC were 78.57% and 69.23% (P-value = 0.86), and DMFS were 49.11% and 76.92% (P-value = 0.18), respectively.
CONCLUSION
This study demonstrated that NFkB-p65 have a significantly higher incidence of cytoplasmic versus nuclear expression. Cytoplasmic NFkB-p65 over-expression (H-index ≥180) was associated with a non-statistically significant trend towards poor clinical outcomes in locally advanced cervical cancer patients treated definitively with CRT.

CLINICAL RELEVANCE/APPLICATION
NFkB-p65 have a significantly higher incidence of cytoplasmic versus nuclear expression, and did not demonstrate significant association with treatment outcomes in locally advanced cervical cancer patients treated definitively with CRT.

SSC15-08 Outcomes of a Single Institution Study of Radiation Sandwiched between 6 Cycles of Chemotherapy for Surgically Staged High-Risk Endometrioid Adenocarcinoma

Awards
Student Travel Stipend Award

Participants
Sujith Baliga, MD, New York, NY (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): The optimal treatment modality for patients with high-risk endometrial cancers, including the sequencing of radiation and chemotherapy, is not yet well established. Here we report our experience of radiation "sandwiched" between 6 cycles of chemotherapy for patients with surgically staged high-risk endometrioid adenocarcinoma (EA). Materials/Methods: From April 2010 – June 2014, 27 patients with Stage IA-IVB histologically confirmed high-risk EA were treated with a combination of adjuvant sandwich chemoradiation. Inclusion criteria include patients with histologically documented EA defined by the following: IA Grade 3 with LVSI, IB G2 or IB G3, any surgical Stage II or Stage III disease, and any surgical Stage IV disease with no residual macroscopic tumor. Chemotherapy consisted of a combination of Carboplatin (AUC 6 pre-RT and AUC 5 post-RT) and Paclitaxel (175 mg/m2). Chemotherapy was administered every 21 days for 3 cycles, followed by a planned chemotherapy break during which external beam radiotherapy (EBRT) and 3 high dose rate (HDR) brachytherapy vaginal cylinder treatments were sequentially delivered. Chemotherapy was resumed after the completion of EBRT and typically overlapped with the HDR brachytherapy. Post-RT chemotherapy was administered for 3 cycles. EBRT consisted of 45 Gy to the pelvis utilizing IMRT, and extended field RT (EFRT), to include the para-aortic (PA) nodes, was used if 2 or more pelvic lymph nodes were involved or if there was PA disease. RT0G toxicity criteria were used to calculate the cumulative gastrointestinal (GI), genitourinary (GU), and hematologic toxicity. Results: Mean age of our cohort at diagnosis was 58 years. The median follow up was 25 months. 7 patients had Stage I disease (25%), 5 patients had Stage II disease (17.9%), 4 patients had Stage IIIA disease (14.3%), 6 patients had Stage IIIC1 disease (25%), 4 patients had Stage IIIC2 disease (14.3%) and 1 patient had Stage IVB disease (3.6%). There were no local or distant failures in our cohort. The rate of acute Grade 2 GI and GU toxicity was 10.7% and 0%, respectively. Acute grade 3 GI toxicity occurred in 1 patient (3.6%). The rate of late grade 3 GU or GI toxicity was 3.6% and 3.6%, respectively. The rate of acute grade 3 thrombocytopenia, anemia, and neutropenia were 7.1%, 3.6%, and 35.7%, respectively. 7.1% of patients required chemotherapy dose reduction and 17.9% of patients required cycle delay. Conclusion: In patients with high risk EA, adjuvant sandwich chemoradiation results in excellent loco-regional and distant control with acceptable toxicity.
PURPOSE
To study the radiological response of Cyber Knife Robotic Radiosurgery for treating intracranial tumors by tailored MRI sequences in providing maximum details

METHOD AND MATERIALS
653 patients were selected from December 2012 to June 2015 who were referred to the department of cyberknife from different hospitals within and outside Pakistan for the radiosurgery. Tumors with less than 6 cm size, post operative residual/recurrent tumor and surgically unresectable tumor were included. Patient was followed every three months with 3D T1 contrast MRI and added sequences according to need.

RESULTS
Out of 653 patients, Overall 35% of benign tumors showed reduction in size and 63% remain stable and 2% were resolved radiologically with clinical improvement in 80 % cases where as 47% of malignant tumors were reduced, 31% remain stable and 22% showed progression radiologically but 70% of patients showed clinical improvement. Considering Meningiomas, out of 135 cases 33% were reduced, 65% remained stable and 2% resolved with clinical improvement in 82%of cases. In 109 AVM, 82% were reduced, 13% remained stable and 5% were resolved with clinical improvement in 84%of cases. Out of 91 cases of metastatic lesions predominantly from breast 20% were reduced and 80% remained stable with clinical improvement in 85%. Out of 71 cases of pituitary adenomas 52% were reduced and 76% clinically improved. From 17 cases of craniopharyngioma 53% were reduced and 88% were clinically improved.

CONCLUSION
Our results clearly shows that cyberknife is highly effective in controlling benign tumors and a good palliative modality for recurrent malignant and metastatic brain tumors. T1 3D contrast is the sequence of choice for most of the intra cranial lesions after treatment follow up, while in cases of pituitary adenoma, acoustic neuroma, schwannoma we utilized BTFE for cranial nerve definition. Longer follow up with conventional MRI is mandatory.

CLINICAL RELEVANCE/APPLICATION
Cyberknife Robotic Radiosurgery showed promising results in patients with residual/recurrent or surgically unresectable intracranial neoplastic mass lesions.

ABSTRACT
Purpose/Objective(s): Ependymal tumors are rare CNS neuroectodermal neoplasm with a significant impact on patient mortality and quality of life. This study is to compare the effect of surgery and adjuvant radiation therapy (RT) on survival outcomes for various histological subtypes of ependymal tumors in the United States.Materials/Methods: All patients aged >=18 with ependymal tumors (myxopapillary ependymoma 9394/1, subependymoma 9383/1, ependymoma 9391/3, and anaplastic ependymoma 9392/3) were identified from the Surveillance, Epidemiology, and End Results registry (2000-2009). Patients with unknown status of RT or surgery
were excluded. Surgical treatment was categorized into gross total resection (GTR) and no GTR (including no surgery and subtotal resection). Demographic and clinicopathological predictors were analyzed using chi-square test and t-test. Log-rank test and multivariate Cox proportional hazard modeling were used to examine treatment effect on overall survival (OS).

**Results:** The primary analysis totaled 2091 patients, with 424 cases of myxopapillary ependymoma (20.3%), 211 subependymoma (10.1%), 1325 ependymoma (63.4%), and 131 anaplastic ependymoma (6.2%). On univariate analysis, GTR was associated with improved OS for ependymoma (89% vs. 81%, p<0.001). Ependymoma was the most common histological subtype among all ependymal tumors in the United States. Age at diagnosis was found to significantly contribute to patient long term survival for all 4 subtypes. Surgery in the format of GTR provided survival benefit particularly in ependymoma. Adjuvant RT was found to adversely impact on OS of ependymoma, which might reflect a selection bias of preferential offering of RT to patients with worse prognosis. More definitive study incorporating factors including disease severity and chemotherapy would be needed to validate our findings.

**Participants**
- Jason Lickliter, MBBS, PhD, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose
- Jeremy Ruben, MBCh, MD, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose
- David Wilson, Tucson, AZ (Abstract Co-Author) Shareholder, NuVox Pharma LLC
- Heling Zhou, Dallas, TX (Abstract Co-Author) Nothing to Disclose
- Ralph P. Mason, PhD, Dallas, TX (Abstract Co-Author) Nothing to Disclose
- Evan C. Unger, MD, Tucson, AZ (Presenter) Shareholder, NuvOx Pharma LLC; Shareholder, Microvascular Therapeutics

**Purposes**
- Tumor hypoxia limits the response of glioblastoma multiforme (GBM) to radiotherapy (RT). The purpose of this study is to evaluate the use of a novel oxygen therapeutic (OT), dodecafluoropentane emulsion (DDFPe) in chemoradiation treatment of GBM.

**METHOD AND MATERIALS**
Adult GBM patients with residual tumor post surgery enrolled in an open label Phase Ib/II clinical trial received doses of 0.05 mL/kg, 0.1 mL/kg or 0.17 mL/kg 2% w/vol DDFPe administered via IV infusion prior to each of 30 fractions of RT over a 6-week period. PK samples were obtained in five patients at the recommended dose. Patients were followed with serial MR scans and evaluated as per RANO criteria and also underwent TOLD MRI scans pre and post DDFPe on days 1 and 5 or 10 of dosing. Tumor DNA profiling (with methylation) analysis was performed on all patients.

**RESULTS**
Six patients have completed dosing; 3 more patients are presently being treated. There were no acute adverse events associated with administration of DDFPe. At the dose of 0.17 mL/kg a DLT was observed due to Grade III radiation necrosis confirmed by surgery 3 months post RT and 0.1 mL/kg was determined to be the therapeutic dose. One other patient treated at the 0.1 mL/kg dose had Grade III radiation necrosis confirmed by surgery at 9 months post RT. The first patient was predicted non responder to temozolomide (negative methylation of MGMT) survived 21-months post diagnosis. At this time all other patients are alive. Survival data will be presented. TOLD MRI showed significant decreases in T1 of tumor tissue with little appreciable change in contralateral brain.

**CONCLUSION**
Acute administration of DDFPe is well tolerated in association with chemoradiation but may increase risk of radiation necrosis. TOLD MRI confirms tumor re-oxygenation. Preliminary survival data suggests therapeutic benefit.

**CLINICAL RELEVANCE/APPLICATION**
DDFPe is the first OT with sufficient safety factor to enable administration during each fraction of RT. A randomized, prospective placebo controlled trial is planned.
Patterns of Failure in Glioblastoma Multiforme Following Standard (60 Gy) or Short-course (40 Gy) Radiation and Concurrent Temozolomide

Station #2

Participants
Tarita O. Thomas, MD, PhD, Chicago, IL (Moderator) Nothing to Disclose

Sub-Events

PURPOSE
To analyze the patterns of failure in patients with glioblastoma multiforme (GBM) that were treated with standard (St; 60 Gy/30 fractions) or short-course (Sc; 40 Gy/15 fractions) radiation therapy and concurrent temozolomide.

METHOD AND MATERIALS
Thirty-one consecutive patients with newly diagnosed glioblastoma that were treated at our hospital between 2007 and 2015, were included. All patients underwent complete surgical resection followed by St (n=15) or Sc (n=16) with concurrent temozolomide. We analyzed the failure pattern in 31 patients who underwent a radical course of radiotherapy and chemotherapy with gadolinium-enhanced post-operative magnetic resonance imaging. The chi-square test was used to analyze the associations between the tumor recurrence pattern and the type of treatment.

RESULTS
We found that after St recurrences occurred at the resection margin alone in 11 of 15 (73%) patients, only at distant sites in 1 of 15 (7%) patients, and at both the resection margin and distant sites in 3 of 15 (20%) cases. After Sc, recurrences occurred at the resection margin alone in 12 of 16 (75%) patients, only at distant sites in 1 of 16 (6%) patients, and at both the resection margin and distant sites in 3 of 16 (19%) cases.

CONCLUSION
There was no differences in the tumor recurrence pattern between the two protocols.

CLINICAL RELEVANCE/APPLICATION
Patterns of failure in glioblastoma multiforme following standard (60 Gy) or short-course (40 Gy) radiation is not different with concurrent temozolomide.

Analysis of Risk Factors and Treatment Outcome in Adult Patients with Brainstem Glioma

Station #4

Participants
Kailin Yang, PhD, Cleveland, OH (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Brainstem glioma (BSG) is much more rare and heterogeneous in adults compared to pediatric population. The maturation of MRI-guided biopsy has enabled more definitive diagnosis of BSG. Clinical outcome of this type of brain tumor remains poor despite aggressive treatment. We aim to analyze the effect of radiation therapy (RT) and surgery on survival outcome of BSG in an adult population. Materials/Methods: Adult patients of age 19 or older with the diagnosis of BSG were identified from the NCI Surveillance, Epidemiology, and End Results (SEER) database (1973-2012). Information for the status of radiation therapy was obtained. Surgical treatment was categorized into no surgery, subtotal resection (STR), and gross total resection (GTR). Demographic and clinicopathological predictors were analyzed using chi-square test, t-test, and logistic regression modeling. Kaplan-Meier analysis and multivariable Cox proportional hazard modeling were used to assess the impact of treatment on overall survival (OS). Results: 1667 adult patients with BSG were identified. 54.6% were males, and 83.1% were Caucasian. The median age was 45.5 years. 67.5% of patients received RT. Surgery was only performed in a small subset of patients with 7.4% receiving STR and 6.4% receiving GTR. 12.1%, 13.3%, 10.3%, and 18.1% were diagnosed with WHO grade I, II, III, and IV glioma respectively, with the rest of unknown grade status. OS at 10 years was 26.8%, with a median follow-up time of 9.7 years. Advanced age and high WHO grade were associated with poor OS, with 8.9% for age 75+ and 10.3% for grade IV at 10 years respectively. There was no significant OS benefit with RT for grade III (18.9% with RT vs. 18.4% without RT, p=0.94), but improved OS with RT for grade IV (12.1% with RT vs. 3.39% without RT, p=0.03). However, worse OS was observed with RT for grade I (50.0% with RT vs. 77.3% without RT, p=0.001).
without RT, the overall outcome of high-grade adult BSG remains poor though RT provides benefit on OS for grade IV tumors, keeping in mind possible bias in offering RT to patients with worse prognosis. GTR is associated with improved survival in a subset of patients. More definitive diagnosis and grading of adult BSG would guide improved management strategy. Given the unfavorable survival of high-grade BSG, more specific therapeutic regimen targeting the underlying genetic aberration is needed to improve patient outcome.

**ABSTRACT**

Purpose/Objective(s): Race and socioeconomic status (SES) are both independently associated with cervical cancer survival, with Hispanics and African Americans patients and patients in lower SES showing worse survival. This study aims to explore association between race and treatment outcomes among patients with cervical cancer treated in a public safety net hospital setting, where non-white patients comprises the majority.

Materials/Methods: We retrospectively reviewed 49 patients with locally advanced cervical cancer treated consecutively from April 2013 to December 2014 in a public safety net hospital. All patients received concurrent chemoradiation followed by high dose rate brachytherapy boost as a curative treatment. Median follow up was 10 months. The primary study outcome measures were locoregional failure (LF), distant failure (DF), and failure-free survival (FSS), which were calculated using Kaplan-meier method. Results: Median age was 51. 71% were squamous cell histology. Median tumor size was 6cm. Stage distribution were 16 patients with stage IB (33%); 19 patients with stage II (39%); 11 patients with stage III (22%), and 3 patients with stage IV (6%). 49% of patients had node positive disease. Racial distribution for the entire cohort were 3 black (6%), 30 Hispanics (61%), 15 Asians (31%), and 1 white (2%). There was no significant differences in stage distribution, node positivity, tumor histology, or tumor size among the different races. LF, DM, and any failure rates for the entire cohort were 18%, 20%, and 30%, respectively. There was more LF in Asians vs. Hispanics patients (33% v 10%, p=0.04). 1y LF free survival, DF free survival, and RFS for the entire cohort were 83%, 80%, and 70%, respectively. Asians vs Hispanics patients had a significantly worse 1y LF free survival and RFS: 72% v 91% (pConclusion: Our study shows that in our public safety net hospital, the Asian patients with locally advanced cervical cancer had a significantly higher LF and worse 1y LF free survival than Hispanic patients, despite a similar stage distribution and tumor characteristics. Longer follow up will be needed to see if this result would hold.
Participants
Mukesh G. Harisinghani, MD, Boston, MA (Presenter) Nothing to Disclose
Theodore S. Hong, MD, Boston, MA (Presenter) Nothing to Disclose
Lawrence Blaszkowsky, MD, Boston, MA (Presenter) Spouse, Stockholder, Pfizer Inc
Cristina Ferrone, MD, Boston, MA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Achieve a basic understanding of the anatomy pertinent to the pancreatico-biliary region and imaging appearance of pancreaticobiliary tumors. 2) Understand strengths and limitations of imaging techniques, including MRI, PET-CT and CT, as they are used in delineating primary tumor and staging involved regional nodes. 3) Identify reasons for local recurrence and recognize the imaging appearances of these recurrences. 4) Improve radiation therapy delivery through understanding the contouring recommendations for the gross tumor volume (GTV) and clinical target volumes (CTV) for anorectal tumors, both in the locally advanced and postoperative setting.

ABSTRACT
In this course cross sectional imaging will be used to contour normal pancreatico-biliary anatomy as well as tumors involving this anatomical region. Also patterns of spread of pathological lymph nodes will be shown, and cross sectional imaging will be used to contour the regional nodal lesions. Cases will be presented and the participants will be stimulated to do the contouring themselves, and will have feedback on their results.
Participants
Andrew S. Chi, MD, PhD, New York, NY (Presenter) Nothing to Disclose
Daniel P. Cahill, Boston, MA (Presenter) Consulting, Merck & Co, Inc
Whitney B. Pope, MD, PhD, Los Angeles, CA (Presenter) Research Consultant, F. Hoffmann-La Roche Ltd; Research Consultant, Amgen Inc; Research Consultant, Tocagen Inc;
Christina I. Tsien, MD, Saint Louis, MO (Presenter) Speaker, Merck & Co, Inc

LEARNING OBJECTIVES
1) Identify areas of controversy in the management of CNS tumors. 2) Apply cranial MR/PET information to answer challenging clinical management questions.

ABSTRACT
Feasibility of Vascular Matching for Pancreatic Stereotactic Body Radiotherapy

PURPOSE
Implanted fiducial markers (IFM) and biliary stents are established as targets for image-guidance during stereotactic body RT (SBRT) in treatment of pancreatic adenocarcinoma (PDAC). IFM are well tolerated, but may delay treatment. IFM/stent migration may also cause insufficient target coverage and normal tissue toxicity. This study evaluated vascular matching (VM), IFM and stent matching for image-guidance in delivery of SBRT for PDAC.

METHOD AND MATERIALS
Between April 2011- November 2015, 39 patients received SBRT for PDAC at our institution. Cone beam CT (CBCT) was performed for setup verification. 221 CBCT images were analyzed for setup shifts based on either IFM, stent or celiac and SMA vasculature contoured using Mosaiq, version 2.60 (IMPAC Medical Systems, Inc. Sunnyvale, CA). Kaplan-Meier calculations, analysis of variance, likelihood ratio, and Wilcoxon tests were used to evaluate local control and survival and compare groups.

RESULTS
15 patients were treated with IFM, 9 with stents, and 15 with VM. Waiting times from consult to treatment in the IFM, stent, and VM groups were 24 days (range 2-91 days), 14 days (range 9-56 days), and 19 days (range 5-39 days), respectively. The average magnitude for superior/inferior shifts was 0.45 ± 0.42 mm (IFM), 0.48 ± 0.46 mm (stent), and 0.37 ± 0.33 mm (VM) (p = 0.24), lateral shifts 0.42 ± 0.99 mm, 0.29 ± 0.35 mm, and 0.26 ± 0.22 (p = 0.26), and anterior/posterior shifts were 0.33 ± 0.40 mm, 0.34 ± 0.28 mm, and 0.37 ± 0.28 mm (p = 0.70). Vector magnitudes were 0.85 ± 1.04 mm, 0.74 ± 0.53 mm, and 0.67 ± 0.36 mm, respectively (p = 0.24). There were no complications from IFM or stent placement or significant differences in GI toxicities (p = 0.25), but there was one Grade 3 toxicity in the stent group. There were no significant differences in tumor resectability (p = 0.70), margin status (p = 0.43), local control (p = 0.31), or overall survival (p = 0.88).

CONCLUSION
There was no difference in positional shifts, toxicity, or outcomes for patients planned with implanted fiducial markers, stents, or vascular matching. VM may be preferable over more invasive methods of target localization.

CLINICAL RELEVANCE/APPLICATION
Vascular matching is a feasible, less invasive image-guidance technique that allows for reproducible and convenient SBRT delivery to PDAC and shorter treatment delays.

Repeat Stereotactic Body Radiation Therapy for Liver Tumors

PURPOSE
Stereotactic body radiation therapy (SBRT) for liver tumors has high rates of local control (LC) and acceptable toxicity. Some patients develop recurrent hepatic disease and additional SBRT can be considered; however, outcomes after repeat SBRT are not well described.
METHOD AND MATERIALS

383 patients treated with liver SBRT at a single institution from 2006-2016 were reviewed; 16 patients underwent multiple SBRT courses. 7 patients were re-treated for hepatocellular carcinoma (HCC), 1 for cholangiocarcinoma, and 8 for metastases (LM). 2 patients with HCC were excluded; 1 for incomplete radiation plans and 1 who had routine liver transplant after 1 fraction of repeat SBRT without toxicity. 2 patients received a 3rd course of SBRT.

RESULTS

Median dose for patients with primary liver tumors (PLT) was 48 Gray (Gy) / 3 fractions for the 1st SBRT and 40 Gy / 5 fractions for 2nd SBRT, compared to 54 Gy / 3 fractions and 50 Gy / 5 fractions for LM for the 1st and 2nd SBRT, respectively. Median follow up was 18.2 months in living patients. Crude LC for the 1st and 2nd treatment was 78.6% and 85.7%, respectively. For the whole cohort, mean progression free survival (PFS) and overall survival (OS) from the 2nd SBRT were 11.9 and 28.1 months, respectively. PFS was significantly shorter in patients with LM compared to PLTs with median values of 4.3 vs 18.4 months, respectively (p=0.01), but there was no difference in OS between the two groups (median 20.7 vs. 26.6 months, p=0.18). Change in liver volume between the 1st and 2nd SBRT courses was predictive of PFS and OS (p<0.05 and p<0.02, respectively). Median OS in patients with liver volume loss between SBRT courses was 13.1 vs 42.5 months in patients without volume loss (p=0.01, HR 5.17 [0.83-32.37]). 2nd SBRT was well tolerated, but severe liver decompensation was seen in both patients receiving a 3rd SBRT course.

CONCLUSION

A 2nd course of liver SBRT is safe and associated with high LC; however, PFS differs between patients with PLT and LM. Patients with liver volume loss appear to have worse outcomes. Significant toxicity occurred in both patients undergoing a 3rd SBRT. Weaknesses of this study include its retrospective nature and low patient numbers.

CLINICAL RELEVANCE/APPLICATION

Although a 2nd course of liver SBRT appears safe, caution should be used when considering re-treating patients with liver volume loss; more than 2 SBRT courses were not well tolerated.

SSE24-04 The Dosimetric Impact of Inter-fractional Organ-at-Risk Movement during Liver Stereotactic Body Radiation Therapy

Monday, Nov. 28 3:30PM - 3:40PM Room: S104A

Participants
Ryan Schmid, BS, Milwaukee, WI (Presenter) Nothing to Disclose
An Tai, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Khali Ramahi, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Taylor Giordano, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Slade Klawikowski, PhD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
X. A. Li, PhD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose
Jared R. Robbins, MD, Milwaukee, WI (Abstract Co-Author) Nothing to Disclose

PURPOSE

The use of stereotactic body radiation therapy (SBRT) for treating liver malignancies is increasing. The impact of inter-fractional variation of organs-at-risk (OAR) during SBRT is not well studied. We examine the dose variations due to inter-fractional organ movement in patients treated with liver SBRT.

METHOD AND MATERIALS

Ten subjects treated with liver SBRT were analyzed. Most patients were treated with five fraction regiments with gated treatment delivery. Daily image-guidance with diagnostic quality CT-on-rails imaging was performed prior to each fraction. OARs were delineated on daily CTs including the liver, heart, right kidney, esophagus, stomach, duodenum and large bowel. Contouring and planning was performed using Monaco planning software (Stockholm, Sweden). Dose distribution on each daily CT was generated by templating the original plan to the daily CT using the daily shifts to replicate the daily treatment isocenter. Daily doses to all 7 OARs were recorded including the maximum dose to the 5cc, 3cc, 1cc, 0.3cc and 0.1cc and other clinically relevant metrics.

RESULTS

Although the doses to the OARs varied daily, only one organ in one patient on one day exceeded a clinically relevant threshold for a rate of error <1/300. For all OARs the dose to the liver was most consistent between fractions. For the liver dose parameters, the composite average percent change ranged from -5.92% to 1.2% with standard deviations of 0.11 to 0.74. Doses to the other OARs varied more between fractions depending on the proximity of the OAR to the target volume and organ motion. There were some large variations between the planned and delivered doses with up to two-fold differences for some OARs, but these did not exceed clinically meaningful levels.

CONCLUSION

With our current standard using CT-on-rails and respiratory gating, inter-fractional variations in liver doses were fairly consistent, while more variation was observed for other OARs. While inter-fractional variations of daily dose could be large, it was rarely clinically relevant. Dose accumulation measurement may help further evaluate the clinical significance of these changes, but currently no extra planning parameters seem necessary in most patients and scenarios.

CLINICAL RELEVANCE/APPLICATION

There can be significant inter-fractional variation in radiation doses to OARs during liver SBRT, but in this study the variation did not lead to clinically significant risks to patients.
Purpose/Objective(s): To investigate the clinical and pathological features and evaluate the survival rate of patients with gastric carcinoma receiving postoperative chemoradiotherapy.

Materials/Methods: Two hundred and four patients who have had postoperative chemoradiotherapy for the diagnosis of gastric cancer in our clinic between 1999 and 2014 have been evaluated retrospectively. Clinical prognostic factors affecting survival were studied.

Results: One hundred and twenty nine (63%) of the patients were male, 75 (37%) were female and median age was 57 years (range 28-81). According to the stage distribution; 4 (2%) patients were on stage I, 61 (30%) patients were on stage II and 139 (68%) patients were on stage III. Applied surgery type: subtotal gastrectomy on 128 (62.7%) patients and total gastrectomy on 76 (37.3%) patients. Histopathologically, 73% of the patients were adenocarcinoma, 24% were signet-ring cell and 3% were other histopathological diagnosed. Tumor differentiation was evaluated in 197 patients and 11.2% of them were well-differentiated, 33% were moderately differentiated and 55.8% were poorly differentiated. Surgical margin status was positive or close in 33 (16.7%) out of 204 patients. Lymphatic dissection type was D1 on 159 (78%) patients, D2 on 28 (14%) patients; however, it was unknown in 17 (8%) patients. The median number of the dissected lymph node was 16 (range 0-90), which was 10 or less in 63 (31%) patients, more than 10 in 141 (69%) patients. 166 (81.4%) of the patients had lymph node metastasis. 92% of the patients received 5-fluorouracil (5-FU) -based chemotherapy during radiotherapy (RT). Doses of RT ranged from 40 to 54 Gy with a median dose of 46 Gy in 1.8-2 Gy fractions. RT technique was two-dimensional conventional on 98 (48%) patients and three-dimensional conformal RT on 106 (52%) patients. During chemoradiotherapy, it was monitored that 14.3% of the patients had hematologic, 5% of the patients had gastrointestinal grade 3 and more toxicity. The median follow-up was 29 months (range 3-147). The overall survival rates for 2, 5 and 10 years were 52%, 37% and 32% respectively. Stage, lymphatic dissection type (D1 or D2), presence of lymph node metastasis, dissected lymph node number (10 or less) and RT technique (two-dimensional conventional or three-dimensional conformal) have been found as significant prognostic factors in terms of overall survival. The 2, 5 and 10-year progression-free survival rates were 59%, 51% and 46%, respectively. Stage and presence of nodal metastasis are significant prognostic factors of progression-free survival.

Conclusion: Postoperative chemoradiotherapy should be considered for all patients with high risk of recurrence after gastrectomy. Beside well-known prognostic factors such as stage, lymph node metastasis, lymphatic dissection type; RT technique was an important prognostic factor in our study. These results suggest that there is a long-term survival benefit for patients treated with three-dimensional conformal radiotherapy.
Participants
Theodore S. Hong, MD, Boston, MA (Presenter) Nothing to Disclose
LEARNING OBJECTIVES

1) Understand breast and regional lymph node anatomy. 2) Be familiar with how the basic anatomic structures 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 contouring knowledge to inform radiation treatment planning for breast cancer.

ABSTRACT

Review breast and axillary anatomy.
LEARNING OBJECTIVES

1) Review the Radiologist’s approach to thoracic anatomy that impacts treatment decision making in the treatment of lung cancer regarding tumors and proximity to great vessels/heart; involvement of airway/esophagus/chest wall; involvement of diaphragm/pericardium/phaenic nerve; involvement of vertebral column; and mediastinal and hilar nodes. 2) Understand the terminology used by Radiation Oncologists when defining targets for treatment and normal structures for avoidance including a) review the contouring of gross tumor volume (GTV), clinical target volume (CTV), and planning target volume (PTV) for stereotactic body radiotherapy for medically inoperable early stage non-small cell lung cancer; b) review the contouring of gross tumor volume (GTV), clinical target volume (CTV), and planning target volume (PTV) for conventional external beam radiotherapy for non-metastatic non-small cell lung cancer and small cell lung cancer. c) review the contouring of, and standardized definitions for, critical organs at risk (OARs) in the thorax: e.g. esophagus, brachial plexus, heart, airways, lungs, as they relate to definitive radiotherapy.

ABSTRACT

Lung Cancer is a challenging disease to treat. It typically presents in advanced stage and even in the curative setting, the normal structures in the thorax make it challenging to treat with radiotherapy because of their inherent sensitivity. In this course, the Radiologist’s perspective will inform a review the normal anatomy of the chest and how its structures relate to, and can predict, the acute and late manifestations of radiotherapy on these organs and tissues. Then, the parameters by which Radiation Oncologists design their treatment targets in order to maximize treatment of cancer and minimize injury to organs-at-risk will be reviewed.
Challenges in Hodgkin's Lymphoma Management Across the Age Spectrum

Tuesday, Nov. 29 8:30AM - 10:00AM Room: S102C

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

Participants
Stephanie A. Terezakis, MD, Baltimore, MD (Moderator) Nothing to Disclose
Satish P. Shanbhag, MBBS, MPH, Baltimore, MD (Presenter) Nothing to Disclose
Bradford Hoppe, MD, Jacksonville, FL (Presenter) Nothing to Disclose
Chelsea C. Pinnix, MD, PhD, Houston, TX (Presenter) Nothing to Disclose
Stacy L. Cooper, MD, Baltimore, MD, (scoope30@jhmi.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Compare pediatric and adult adaptive therapy trials in Hodgkin Lymphoma. 2) Examine the pattern of relapse amongst pediatric and adult patients with Hodgkin Lymphoma. 3) Critique radiation doses used in pediatric and adult patients with Hodgkin Lymphoma.

ABSTRACT
**Managing Anatomical Change and Respiration during Radiotherapy**

Participants
Carri Glide-Hurst, Detroit, MI (Moderator) Research Consultant, Koninklijke Philips NV; Research agreement, Koninklijke Philips NV; Research agreement, Modus Medical Devices 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.

**Functional Targeting and Adaptation**

Participants
Carri Glide-Hurst, Detroit, MI (Presenter) Research Consultant, Koninklijke Philips NV; Research agreement, Koninklijke Philips NV; Research agreement, Modus Medical Devices 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.
SURVEILLANCE mammography for breast conservation therapy (BCT) is frequently conducted within 6 months upon completion of adjuvant radiation therapy (XRT). We retrospectively analyzed the effect of post-XRT mammographic timing and radiation technique in relation to additional downstream workup for 569 BCT patients treated with adjuvant XRT following their initial surveillance mammogram (MMG).

METHOD AND MATERIALS
From January 2011 to December 2014, 1959 consecutive breast cancer patients were reviewed, 569 of whom had breast conservation surgery and adjuvant XRT with a follow-up MMG. Patients between the ages 31 and 91 (median 63) with stages 0(Tis) to IIIA of ductal, lobular, mixed, and metaplastic histologies were included. Patients were stratified by the time interval until their first post-XRT MMG, and by XRT technique – whole breast (472), accelerated partial breast (96), conventional fractionation (373), hypofractionation (94), surgical cavity boosts (407) or no boost (66). The primary endpoint was further imaging after the initial MMG. P values were generated from Chi square testing via MedCalc. IRB approval was received for this retrospective study.

RESULTS
Additional workup for those receiving a MMG within 3 months of completing XRT was 51% (73/143), compared to 40% (84/210) with MMG between 3 to 6 months, and 34.5% (75/217) with MMG after 6 months (P = 0.04). Two of ten biopsies were positive for recurrence among those with surveillance MMG within 6 months, compared to 1 of 2 patients with MMG after 6 months. Accelerated partial breast irradiation, hypofractionation, and surgical cavity boosts did not correlate with further downstream imaging.

CONCLUSION
BCT patients who underwent screening MMG prior to 6 months after completion of XRT were more likely to undergo downstream workup, including additional biopsies. Comparatively aggressive radiation techniques were not associated with the need for supplementary workup. Further study is needed to assess appropriate selection of high risk patients and possible negative implications of earlier post-radiotherapy screening MMG such as healthcare costs and quality of life.

CLINICAL RELEVANCE/APPLICATION
Premature surveillance mammography relative to adjuvant radiation in breast conservation therapy is common and likely results in excessive downstream workup, costs, and patient discomfort.
ABSTRACT

Purpose/Objective(s): Hypo-fractionated breast radiotherapy is widely accepted as an alternative treatment option for early stage breast cancer. However, long term clinical outcome of late toxicity is relatively scarce compared to conventional radiotherapy regime. To evaluate whether hypo-fractionated breast radiotherapy can cause more late lung toxicity, instead of using subjective grading system, we have directly measured volume of fibrotic lung tissues in the region of tangential radiation fields.

Materials/Methods: Fifty-three early stage breast cancer patients who were treated with hypo-fractionated radiotherapy and the same number of early stage breast cancer patients with conventional radiotherapy were retrospectively analyzed. All patients had multiple follow up chest CT images for more than three years. With deformable registration with radiation treatment planning data, lung fibrosis tissues within radiotherapy fields were segmented and 3 dimensional volumes of lung fibrosis were directly measured. Radiation therapy techniques and protocols were the exactly same, but only dose scheme was different.

Results: The volume of lung fibrosis appeared to be slightly larger in the group of hypo-fractionated breast radiotherapy. Mean volume of lung fibrosis in patients with hypo-fractionated radiotherapy arm was 14.1 cc, and the volume in patients with conventional radiotherapy arm was 12.3 cc. We compared histogram of volume distribution of each patient group. Conventional radiotherapy group appeared to show slightly smaller volume of lung fibrosis compared to hypo-fractionated radiotherapy group, however, which was not statistically significant (p

Conclusion: Even though the lung fibrosis in this study was subclinical, hypofractionated radiotherapy may cause slightly more lung fibrosis, caution is needed when patient irradiation lung volume is significantly exceeded as usual.

ABSTRACT

Purpose/Objective(s): Standard breast conserving therapy consists of lumpectomy followed by whole breast irradiation. Alternative strategies in appropriately selected patients (pts) include endocrine therapy (ET) alone, accelerated partial breast irradiation (APBI), and hypofractionated radiation therapy (HFRT), which can limit treatment duration, and potentially reduce morbidity and cost. However, limited data are available on the percentage of pts eligible for these alternative treatments; therefore, a Surveillance Epidemiology and End Results (SEER) analysis was performed to assess candidacy for these alternative options in women with early stage breast cancer according to current consensus guidelines and trial eligibility criteria.

Materials/Methods: Women treated for breast cancer between the years of 2010-2012 were identified in the SEER database. Pts with metastatic disease, T3/T4 disease, and node positive disease were excluded. Pts were defined as eligible for ET alone according to the CALGB 9343 inclusion criteria (Age =70 years; T1; Estrogen receptor positive [ER+]) and PRIME II inclusion criteria (Age =65 years; T1/T2; ER+ and/or Progesterone receptor positive [PR+]). Pts were defined as eligible for HFRT according to ASTRO consensus guidelines (Age =50 years; T1/T2). Pts eligible for APBI were evaluated based on ASTRO consensus guidelines (Age =60 years; T1; ER+), American Brachytherapy Society (ABS) and the GEC-ESTRO consensus guidelines (Age =50 years; T1/T2), and the GEC-ESTRO APBI trial criteria (Age =40 years; Tis-T2). Additional pathologic features, dosimetric data, and chemotherapy receipt were not available.

Results: 110,858 women with early stage breast cancer who met aforementioned inclusion criteria were identified. Of these pts, 23,286 (21.0 %) were eligible for ET alone according to CALGB 9343 criteria and 43,278 (39.0%) according to PRIME II criteria. Based on ASTRO consensus guidelines, there were 91,492 (82.5%) pts eligible for HFRT. There were 44,528 (40.2%) pts who were eligible for APBI according to ASTRO consensus guidelines, 88,945 (80.2%) pts eligible according to ABS consensus guidelines, and 88,945 (80.2%) pts eligible according to the GEC-ESTRO consensus guidelines. There were 107,235 (96.7%) pts who were eligible for APBI according to the GEC-ESTRO APBI trial criteria. Conclusion: This SEER analysis demonstrates there is a substantial proportion of women with early stage breast cancer who may be eligible for ET alone, HFRT, and/or APBI following breast conserving surgery according to consensus guidelines and prospective trial criteria. Moving forward, with incorporation of additional pathologic, dosimetric, and chemotherapy data, quality assurance pathways may use such data to help ensure pts are receiving appropriate risk stratified treatment recommendations.
Dynamic Contrast-Enhanced Perfusion MRI vs Dynamic Contrast-Enhanced Area-Detector CT vs FDG-PET/CT: Capability for Therapeutic Outcome Prediction in NSCLC Patients with Chemoradiotherapy

**PURPOSE**

To directly compare the capability for therapeutic outcome prediction between dynamic first-pass CE-perfusion area-detector CT (ADCT) and MRI assessed by same mathematical method and FDG-PET/CT in non-small cell lung cancer (NSCLC) patients treated with chemoradiotherapy.

**METHOD AND MATERIALS**

43 consecutive Stage IIIB NSCLC patients (25 male, 18 female; mean age 67 year old) underwent PET/CT, dynamic CE-perfusion ADCT and MRI, chemoradiotherapy, and follow-up examination. In each patient, therapeutic outcomes were assessed as therapeutic effect based on RECIST guideline, disease free interval and overall survival. Then, all patients were divided into two groups as follows: 1) CR+PR (n=23) and 2) SD+PD (n=20) groups. In each patient, total tumor perfusion (TP) and tumor perfusions from pulmonary (TPP) and systemic (TPS) circulations calculated by dual-input maximum slope method from dynamic ADCT and MRI data and SUVmax on PET/CT were assessed at each targeted lesion, and averaged to determine final values. To compare the capability for distinguishing two groups, ROC analyses were performed. Then, disease free and overall survivals between responders and non-responders assessed by each index were compared by Kaplan-Meier method followed by log-rank test.

**RESULTS**

Area under the curves (AZs) of TP (MRI: Az=0.90, ADCT: Az=0.87) and TPS (MRI: Az=0.84, ADCT: Az=0.84) were significantly larger than that of TPP (MRI: Az=0.72, p<0.05; ADCT: Az=0.72, p<0.05). Disease free survivals of responder were significantly longer than that of non-responder by TP (MRI: p=0.01, ADCT: p=0.03) and TPS (MRI: p=0.01, ADCT: p=0.001). Overall survivals of responder were also significantly longer than that of non-responder by TP (MRI: p=0.007, ADCT: p=0.004), TPS (MRI: p=0.001; ADCT: p=0.0001) and SUVmax (p=0.04).

**CONCLUSION**

Dynamic first-pass CE-perfusion ADCT and MRI has equal to or better potential to predict therapeutic outcome than PET/CT in NSCLC patients treated with chemoradiotherapy. Perfusion parameters from dynamic first-pass CE-perfusion ADCT and MRI may be applicable as new biomarkers in this setting.

**CLINICAL RELEVANCE/APPLICATION**

Dynamic first-pass CE-perfusion ADCT and MRI has equal to or better potential to predict therapeutic outcome than PET/CT in NSCLC patients treated with chemoradiotherapy. Perfusion parameters may be applicable as new biomarkers in this setting.
However, tumor delineation induced differences in predicting EGFR mutations warrants further investigation.

Radiomic delta-features are able to be used as potential imaging biomarkers to predict the gene mutational status of patient.

**CONCLUSION**

respectively. A same feature can have different prediction power if calculated from different tumor ROIs. For example, the AUCs of the three radiologists' were 0.91 (3), 0.85 (5), and 0.79 (0), respectively. Tumor ROIs delineated by different radiologists resulted in different performance on the prediction of the EGFR mutational status.

**RESULTS**

on predicting the EGFR mutational status of patients.

Delta-features were the differences between baseline and follow-up features. The area under the curve (AUC) of the receiver operator characteristic (ROC) was calculated to assess the power of radiomic delta-features.

METHOD AND MATERIALS

This was a retrospective analysis on clinical trial data of 46 early stage NSCLC patients with a total of 46 tumors (one tumor per patient) whose EGFR mutation status were known (EGFR+:EGFR-=20:26). All of the patients had non-contrast enhanced, 1.25mm slice CT scan images which were acquired before and after gefitinib treatment. The majority of patients determined to be surgically inoperable due to pulmonary dysfunction. The majority of patients (75%) were diagnosed with AJCC prognostic stage IA NSCLC. Patients were treated using robotic SBRT to a median total dose of 50 Gy with a median BED of 112.5 Gy (range, 100 to 180 Gy). Thirty-one patients were treated with a BED greater than 105 Gy and the remaining 30 with a BED below 105 Gy. Five year local control, locoregional control, and overall survival were calculated using the Kaplan-Meier method and comparisons between BED above and below 105 Gy were performed using the generalized Wilcoxon test. Results: Sixty-one patients with a median age of 75 years were included. The majority of patients determined to be surgically inoperable due to pulmonary dysfunction. The majority of patients (75%) were diagnosed with AJCC stage IA NSCLC. Patients were treated using robotic SBRT to a median total dose of 50 Gy with a median BED of 112.5 Gy (range, 100 to 180 Gy). Thirty-one patients were treated with a BED greater than 105 Gy and the remaining 30 with a BED below 105 Gy. Five year local control, locoregional control, and overall survival for those patients treated above and below a BED of 105 Gy were observed.

**PURPOSE**

Radiomic delta-features describe the change of tumor imaging phenotype between baseline and follow-up scan images. Prior to computation of radiomic delta-features, tumor regions-of-interest (ROI) on baseline and follow-up images need to be delineated by radiologist. This study was to explore the effect of different tumor ROIs drawn by different radiologists on the performance of using radiomic delta-features to predict the epidermal growth factor receptor (EGFR) gene mutational status in non-small cell lung cancers (NSCLC) patient with gefitinib treatment.

**METHOD AND MATERIALS**

This was a retrospective analysis on clinical trial data of 46 early stage NSCLC patients with a total of 46 tumors (one tumor per patient) whose EGFR mutation status were known (EGFR+:EGFR-=20:26). All of the patients had non-contrast enhanced, 1.25mm slice CT scan images which were acquired before and after gefitinib treatment. The majority of patients determined to be surgically inoperable due to pulmonary dysfunction. The majority of patients (75%) were diagnosed with AJCC prognostic stage IA NSCLC. Patients were treated using robotic SBRT to a median total dose of 50 Gy with a median BED of 112.5 Gy (range, 100 to 180 Gy). Thirty-one patients were treated with a BED greater than 105 Gy and the remaining 30 with a BED below 105 Gy. Five year local control, locoregional control, and overall survival were calculated using the Kaplan-Meier method and comparisons between BED above and below 105 Gy were performed using the generalized Wilcoxon test. Results: Sixty-one patients with a median age of 75 years were included. The majority of patients determined to be surgically inoperable due to pulmonary dysfunction. The majority of patients (75%) were diagnosed with AJCC stage IA NSCLC. Patients were treated using robotic SBRT to a median total dose of 50 Gy with a median BED of 112.5 Gy (range, 100 to 180 Gy). Thirty-one patients were treated with a BED greater than 105 Gy and the remaining 30 with a BED below 105 Gy. Five year local control, locoregional control, and overall survival for those patients treated above and below a BED of 105 Gy were 90.5% vs. 82.6% (p = 0.26), 78.6% vs. 64.8% (p = 0.03), and 38.7% vs. 42.9% (p = 0.97). Conclusion: Statistically significant improvements in locoregional control were observed in patients treated with a BED greater than 105 Gy, although this did not translate into an improvement in overall survival. Treatment of stage I NSCLC with fiducial-based robotic SBRT using advanced respiratory motion management does not preclude the necessity of delivering an adequate BED to the tumor target.
CLINICAL RELEVANCE/APPLICATION

With the rapid growth of the field of radiogenomics, our findings are valuable because they increase awareness of variations in the performance of predicting EGFR mutations using radiomic features.

MSRO35-09 Multiparametric Imaging of the Tumor Response in Non-small Cell Lung Cancer to Stereotactic Ablative Radiation Therapy

Tuesday, Nov. 29 11:50AM - 12:00PM Room: S103CD

Participants
Dae-Myoung Yang, MSc, London, ON (Presenter) Nothing to Disclose
David Palma, MD, FRCPC, London, ON (Abstract Co-Author) Nothing to Disclose
Ting-Yim Lee, MSc, PhD, London, ON (Abstract Co-Author) License agreement, General Electric Company

PURPOSE

To determine whether metabolism as measured with dynamic fluorine-18 fluorodeoxyglucose (FDG) positron emission tomography (PET) and perfusion as measured with dynamic contrast-material enhanced (DCE) computed tomography (CT) scanning can help predicting and assessing the integration and true pathological rate of stereotactic ablative radiation therapy (SABR) in non-small cell lung cancer (NSCLC).

METHOD AND MATERIALS

After Research Ethics Board approval was obtained, 13 patients who have histologically confirmed early stage T1 or T2a NSCLC that has a tumour diameter ≤ 5 cm and no nodal metastases (T1T2N0) underwent dynamic FDG-PET and DCE-CT pre- and post-SABR since September 2014. The post scans were acquired 8 weeks after SABR. Dynamic FDG-PET measures maximum standardized uptake values (SUVmax) in the tumour. DCE-CT imaging allows quantitative mapping of blood flow (BF) and blood volume (BV) in the tumours. Since free-breathing was allowed during DCE-CT scanning, breathing motion was minimized by non-rigid image registration before the BF and BV functional maps were generated. Lobectomy surgery was performed 10 weeks after SABR, to allow sufficient time for reactive response to SABR to subside.

RESULTS

Analysis of dynamic FDG-PET and DCE-CT scans of the first 10 patients showed difference from pre- to post-SABR. Following SABR, there were a reduction in BF (41.3%, P = 0.001), BV (27.8%, P = 0.062) and SUVmax (46.0%, P = 0.005). The included 3D scatter plot shows the distinct characteristic response of NSCLC to SABR.

CONCLUSION

Dynamic FDG-PET and DCE-CT can assess and measure the response of NSCLC to SABR. In future analysis, sensitivity and specificity of this imaging technique and quantitative measurements of glucose kinetics can be calculated.

CLINICAL RELEVANCE/APPLICATION

Novel combination of neoadjuvant SABR plus surgery is being evaluated as a cure for T1T2N0 NSCLC. Dynamic FDG-PET and DCE-CT are a useful adjunct to standard follow-up in assessing true response rate.
PARTICIPANTS
Martin Colman, MD, Houston, TX (Moderator) Nothing to Disclose
Abhishek A. Solanki, MD, Maywood, IL (Moderator) Nothing to Disclose

SUB-EVENTS

SSG15-01 Margin-Positive (M+) Radical Prostatectomy (RP): Differential Risk of PSA Relapse by Extent of Margin Involvement

PURPOSE
M+ is an established risk factor for PSA failure following RP; however, often this is identified in the context of other high-risk feature(s). The objective of the current study was to expand upon our previous single-institution findings in the multi-institutional setting, with longer follow-up, in order to optimally delineate the margin extent (ME) for stratification by Gleason score (GS).

METHOD AND MATERIALS
Retrospective analysis of patient- and tumor-specific factor association with PSA relapse-free survival (bRFS). Eligible patients underwent RP at the study institutions for biopsy-proven prostate adenocarcinoma, without adjuvant radiotherapy (RT) or hormone therapy (HT). Patients with evidence of metastatic disease or PSA >30 at diagnosis, or pathologic involvement of seminal vesicles or lymph nodes at RP were excluded. RP specimen slides were reviewed by pathology, and M+ details (foci, ME) were recorded.

RESULTS
Between 2002 and 2010, 644 patients underwent RP at the study institutions, of whom 429 were eligible for the present analysis. The median age at diagnosis was 61 years (range 43-76), and pre-RP PSA was 5.6 (0.9-26). Of 154 patients with confirmed M+, 146 had slides available for review. At a median follow-up of 80 months (range 16-155), 100 patients had experienced PSA relapse at a median of 22 months post-RP (1-124), of whom 64 had involved surgical margins. On multivariate analysis, pre-RP PSA, pathologic GS, and margin status were significantly associated with bRFS. Subset evaluation by GS and ME identified a group at lower risk of failure: GS =7 with any extent M+ have poor early bRFS.

CONCLUSION
Within the present study, GS =7 with any extent M+ have poor early bRFS.

CLINICAL RELEVANCE/APPLICATION
Reporting of ME in RP pathology reports should be considered, as this may influence consideration of adjuvant therapy versus surveillance.

SSG15-02 Stereotactic Body Radiotherapy (SBRT) for Primary Renal Cell Carcinoma (RCC): Intrafraction Target Movement and Patient Outcomes

ABSTRACT
Purpose/Objective(s): Renal cell carcinoma (RCC) is traditionally considered to be radioresistant. The current standard treatment for clinically localized disease is partial or radical nephrectomy; in patients unfit for surgery, cryotherapy or HIFU are recommended. Little has been published on the use of SBRT for primary RCC. Materials/Methods: This is an IRB-approved retrospective study. All patients were treated using a robotic-arm stereotactic system with fiducial tracking; target motion during treatment was extracted from motion models from actual treatment sessions. Patient records were reviewed for toxicity and cancer control outcomes. Results: Between the years 2010 and 2016, 6 patients who were non-surgical candidates were treated with SBRT for primary RCC with curative intent; all were treated to 39 Gy in 3 fractions given daily. Median age was 68.5 years (range: 61-77). All patients had two kidneys, with one kidney involved with primary localized RCC with a mean size of 5 cm (range: 4.2-6.5) and a mean PTV 124 cc (range: 72-210). Mean intrafraction tumor motion available for 4 patients was: superior/inferior 4.2 mm, left/right
5.7 mm, anterior/posterior 3.0 mm. Median follow-up was 23 months (range 14-49). All patients were followed with imaging every 6 months after treatment. Acute toxicity (Conclusion: SBRT to 39 Gy in 3 fractions is well-tolerated and provided durable local control in patients with primary RCC who were not surgical candidates. Initial imaging after treatment can show slight tumor enlargement. Tumor motion is an important technical issue for this treatment.

SSG15-03 Intraprostatic Polymer Based Fiducial Marker (FM) Placement allows for Accurate Co-registration of mpMRI and Planning CT Images

Participants
Neelayan Sen, MD, Chicago, IL (Presenter) Nothing to Disclose
Dan Wang, MD, PhD, Columbus, OH (Abstract Co-Author) Nothing to Disclose
James C. Chu, PhD, Chicago, IL (Abstract Co-Author) Research Grant, Varian Medical Systems, Inc
Julius Turian, Chicago, IL (Abstract Co-Author) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Multiparametric magnetic resonance imaging (mpMRI) allows for reliable detection of adverse pathologic features (ie, high-grade tumor, extracapsular extension, and seminal vesicle involvement) which are indications for dose-escalated radiotherapy (RT). Accurate co-registration of the mpMRI and planning CT images using FMs is essential to enhance tumor target delineation and to deliver focal high-dose RT to intraprostatic lesions defined by mpMRI while sparing normal adjacent structures. However, it is unknown whether intraprostatic polymer based FMs may affect radiologic interpretation of the mpMRI. Additionally, it is unknown whether FMs can be reliably utilized for co-registration of the MRI with the planning CT images. To answer these questions, we have examined a cohort of patients with mpMRI and planning CT performed after FM placement. Materials/Methods: This analysis was limited to patients with histologically proven prostate cancer. All eligible patients had three polymer-based FMs (1 mm diameter and 3 mm in length, PolyMarkTM Fiducial Markers, CIVCO Medical Solutions, Coralville IA), implanted into the prostate using transrectal ultrasound guidance (one FM placed to apex, one into base and a third one into contralateral lobe). Patients subsequently underwent mpMRI within 12-40 days (median 19) and CT simulation. Results: 18 patients met inclusion criteria. 8 had palpable disease by digital rectal examination (range T2a – T3a). Median PSA was 11.5 (range 5-144). Median Gleason sum was 8 (range 7-10), median % core involvement was 59 (range 8-100%), and 11 patients were high risk by NCCN criteria. 11 patients had at least one lesion identified on mpMRI (range 1-4) with median PI-RADS 4 (range 1-5). Of the patients with mpMRI positive lesions, 4 had pre-fiducial mpMRI available for comparison. According to expert radiology review, none of these patients had evidence of new lesions after FM placement. FM were clearly identified in both mpMRI and planning CT, allowing for accurate co-registration. Conclusion: It is feasible to accurately co-register mpMRI and CT planning images using polymer based FMs implanted into the prostate. Furthermore, the placement of three intraprostatic FMs has not generated any false positives or otherwise altered mpMRI interpretation.

SSG15-04 Preliminary Evaluation of Seed Migration in Coated vs Non-coated Seeds for LDR Prostate Brachytherapy using the Mick Applicator Implant Technique

Participants
Bryan J. Traughber, MD, Cleveland Heights, OH (Presenter) Spouse, Employee, Koninklijke Philips NV
Tarun K. Podder, Greenville, NC (Abstract Co-Author) Nothing to Disclose
Yan Xing, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Valdir Colussi, PhD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Elisha Fredman, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Lee E. Ponsky, MD, Cleveland, OH (Abstract Co-Author) Nothing to Disclose
Rodney J. Ellis, MD, Pepper Pike, OH (Abstract Co-Author) Nothing to Disclose

PURPOSE
Low dose rate (LDR) brachytherapy is a highly effective modality for the treatment of prostate cancer. However, incorrect placement of seeds can lead to suboptimal outcomes and treatment related sequelae such as urethral and rectal toxicities. Even secondary lung cancers due to seed migration have been reported in the literature. The purpose of this study is to evaluate the incidence of seed migration and resultant dosimetric impact using coated vs. uncoated seeds with a Mick applicator implant technique.

METHOD AND MATERIALS
Twenty patients with prostate cancer treated at a high-volume single institution status post LDR brachytherapy were retrospectively analyzed and compared for seed slippage when using coated vs. uncoated seeds with a Mick applicator implant technique. All patients were planned with pre-treatment multi-parametric MRI and evaluated with intraoperative ultrasound, real-time intraoperative dosimetry, and a Day 0 CT-based dosimetric analysis. All dosimetric calculations were based on TG-43 formulation. The incidence of seed slippage was compared between patients treated with coated vs. uncoated seeds.

RESULTS
Eight patients were treated with coated seeds and twelve patients with uncoated seeds, representing 699 and 1099 total seeds placed respectively. The total migration rate was 3.2% vs. 10.2% for coated vs. uncoated seeds. Intra-prostatic migration was 1.2% for coated seeds, and 5.1% for uncoated seeds. Importantly, the seed non-visualization rate from intraoperative monitoring with ultrasound and Day 0 CT was 2.0% and 5.1% respectively, likely representing extra-prostatic seed migration. Dosimetric consequences were also evaluated but data not shown due to space limitations.

CONCLUSION
The use of coated seeds with a Mick applicator implant technique reduces seed migration by nearly ½ rd, including extra-prostatic slippage not identified on real-time intraoperative ultrasound or post-implant CT. Further sector based analyses including regional dosimetric impact relative to gross disease identified on multi-parametric MRI and adjacent organs-at-risk are warranted.

CLINICAL RELEVANCE/APPLICATION
Prostate seed migration following LDR brachytherapy can compromise local tumor control in addition to unintended consequences...
such as extra-prostatic seed migration to the lungs and abdomen-pelvis.

**SSG15-08** Comparison of Intraoperative MRI/US Fusion in Relation to Standard CT/US Based Planning for LDR Prostate Brachytherapy

Tuesday, Nov. 29 11:40AM - 11:50AM Room: S104A

**Awards**

**Student Travel Stipend Award**

Participants
Paul Renz, DO, Pittsburgh, PA (Presenter) Nothing to Disclose
Stephen Abel, BS, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Mark G. Trombetta, MD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Olivier Gayou, PhD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose
Jie Tang, MSc, Steubenville, OH (Abstract Co-Author) Nothing to Disclose
E. Day Werts, PhD, Pittsburgh, PA (Abstract Co-Author) Nothing to Disclose

**PURPOSE**

Intraoperative planning with transrectal ultrasound (US) is used for accurate seed placement and optimal dosimetry in prostate brachytherapy. However, prostate MRI has shown superiority in delineation of prostate anatomy. Accordingly, MRI/US fusion may be useful for accurate intraoperative planning. We analyzed planning with MRI/US fusion to compare differences in dosimetry to that derived from postoperative CT.

**METHOD AND MATERIALS**

Twenty patients underwent preoperative prostate MRI which was fused intraoperatively with US during prostate brachytherapy using a MiM Symphony treatment planning system (MiM Software; Cleveland, Ohio, USA). Following implantation, dose comparisons were made between data derived from MRI/US and that from post-operative CT scans. Plan parameters analyzed included the D90 (dose to 90% of the prostate), rectal D30, and the rectal V30 (volume of the rectum receiving 30 percent of dose), and the prostate V100.

**RESULTS**

The median number of seeds implanted per patient was 76 with mean activity of 0.381mCi per seed. The MRI measured prostate volume was on average 4.47cc smaller than the CT measured prostate volume. In 9 patients, the apex of the prostate was better identified under MRI and an average of 4 fewer seeds were required to be placed in the apex/urinary sphincter region. Both MRI and US individually showed reduced intraoperative prostate D90 in comparison to postoperative CT-based prostate D90 with a larger mean difference for MRI in comparison with US (9.71 vs. 4.31Gy, p=0.007). This was also true for the prostate V100 (5.18 vs. 2.73cc, p=0.009). Post-operative CT underestimated rectal D30 and V30 in comparison to both MRI and US with MRI showing a larger mean difference than US for D30 (40.64 vs. 35.92Gy, p=0.04) and V30 (50.20 vs. 44.38cc, p=0.009).

**CONCLUSION**

The MRI/US fusion demonstrated lower prostate volume compared with standard CT/US based planning likely due to the better resolution of the prostate apex. Furthermore, rectal dose was underestimated with CT vs. MRI based planning. Additional study is required to assess long term clinical implications of disease control and effects on the rectum and urinary sphincter.

**CLINICAL RELEVANCE/APPLICATION**

MRI/US intraoperative fusion may improve prostate dosimetry and sparing of the rectum, potentially impacting disease control and late toxicity.

**SSG15-09** Impact Factors on Acute Hematologic Toxicity in Prostate Cancer Patients Treated with Radiation Therapy

Tuesday, Nov. 29 11:50AM - 12:00PM Room: S104A

Participants
Xiaoying Li, Beijing, China (Abstract Co-Author) Nothing to Disclose
Ke Wang, MD, Beijing, China (Presenter) Nothing to Disclose

**ABSTRACT**

Purpose/Objective(s): To determine factors predictive for hematologic toxicity (HT) in patients with prostate cancer treated with radiotherapy.Materials/Methods: The medical records of 47 men receiving radiation therapy for prostate cancer were reviewed. Hematologic toxicity was defined by use of Common Terminology Criteria for Adverse Events(version 4.0). Pelvic bone marrow (PBM) was contoured for each patient and divided into three subsites: lumbosacral spine(LSS), ilium(IBM), and lower pelvis(LP). The volume of each region receiving 5, 10, 15, 20, 25, 30, 35 and >40 Gy (V10, V15, V20, V25, V30, V35and V40, respectively) was calculated. Endpoints included any grade hematologic event (HE), Logistic regression was used to test associations between HT and dosimetric/clinical parameters. Results: 24 (51.1%)patients experienced leukopenia, 20(42.6%) were Grade I, 4 (8.5%)were Grade II. Pelvic radiation was associated with an increased worse leukopenia. No association was found with age, ADT therapy, radiation dose and other clinical factors. Multivariate logistic regression analysis shows PBM V5(OR, 1.046;95% CI, 1.006–1.088; p =0.024), IBM V10(OR, 1.032; 95% CI, 1.006–1.059; p =0.023)ALS V25(OR, 6.967; 95% CI, 1.336–36.338; p =0.015) was associated with an increased worse leukopenia. ROC curve shows, LS V25 is the best predictor of leukopenia(AUC 0.718 p=0.01), Patients with LS V25>71.38%, leukopenia significantly increased(65.7% Vs 8.3%, p=0.001). 21 patients experienced(44.7%) anemia during treatment. Univariate analysis shows age(P=0.03) and ADT therapy (P=0.021) was associated with incidence of anemia, Multivariate logistic regression analysis shows ADT therapy is the only factor associated with anemia(OR, 6.967; 95% CI, 1.336–36.338; p =0.021). ADT therapy increases by a factor (odds ratio) of 6.967. No association was found with ADT time, bone radiation dose and other clinical factors. No patient experienced thrombocytopenia.Conclusion: Leukopenia and anemia are the most common hematologic toxicity (HT) events happened during radiation therapy of prostate cancer patients. Pelvic radiation was associated with an increased worse leukopenia, LS V25 is the best predictor of leukopenia. When Patients’ LS V25 is greater than 71.38%, leukopenia significantly increased. ADT therapy is the only factor associated with anemia during radiation therapy.
ABSTRACT

Purpose/Objective(s): It is well established that women with large breast size undergoing lumpectomy and radiation therapy (RT) are at increased risk for side effects due to the larger field size required. Pulmonary, cardiac and hepatic effects from RT can be reduced by limiting radiation exposure to these tissues. Short term morbidities caused by skin folds can lead to interruptions of the RT course, possibly compromising local outcomes. The purpose of this IRB-approved pilot study is to assess whether a novel garment (“Bra”) for support of the breast during RT will reduce the exposure of non-target tissues, reduce RT side effects and improve quality of life (QOL). We report on the technical details of the Bra and preliminary results of the first 6 patients enrolled.

Materials/Methods: The patented Bra was developed and is manufactured by a U.S.-based company. Materials neither absorb radiation nor are they altered by it. It has adjustments in the shoulder, rear and lateral regions. Irritability, sensitivity, cytotoxicity tests, and Radiologic Test Reports have been completed and FDA 510K Clearance has been received. All patients in the study had a self-reported bra size of 36B or larger and were provided the Bra at no charge. All underwent lumpectomy for DCIS or invasive breast cancer and were scheduled for postoperative RT. Treatment plans were devised with and without the Bra and the various parameters were compared using paired t-tests. Physician and patient assessments of comfort, tolerance, QOL, and toxicity were performed throughout the treatment course and at first follow-up.

Results: Patients received a mean RT dose of 48.0 Gy (range 45-50.4 Gy). The Bra was well tolerated by all 6 patients, and there were no garment-related adverse events. Based on dosimetric comparisons, the Bra reduced the global maximum field dose by a mean of 122.3 cGy, the global maximum breast dose by 45.7 cGy, and other parameters in a similar fashion (Table), although none of the comparisons reached statistical significance likely due to the small number of patients. Table Comparison of Dosimetric Parameters With vs Without the Bra

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Without Bra</th>
<th>With Bra</th>
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<tr>
<td>Global maximum field (cGy)</td>
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<td>575.2</td>
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<tr>
<td>Global maximum breast (cGy)</td>
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<td>-0.80</td>
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<td>V20% (cGy)</td>
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<tr>
<td>Lung mean dose (cGy)</td>
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<td>672.0</td>
<td>-4.23</td>
</tr>
</tbody>
</table>

Conclusion: The Bra resulted in a decrease in RT dose to non-target organs in this pilot study and was well-tolerated by the patients. With more patients and follow up, we will additionally be able to assess morbidity, QOL and cosmesis.
Participants

PROGRAM INFORMATION

This session will focus on best practices of managing both radiation and contrast dose. This course does not offer CME credit.
Purpose/Objective(s): Patients undergoing proton beam radiotherapy (PBRT) with hydrogel spacer (HS) should experience low rates of acute toxicity. HS will likely have an impact on the reduction of late gastrointestinal (GI) toxicity by reducing the risk of proctitis. This single institution review evaluates acute toxicity outcomes in prostate cancer (CaP) patients treated with PBRT with HS placement. Materials/Methods: From April 2015 to February 2016, 63 men with CaP had placement of HS and were treated with PBRT. All patients completed PBRT, receiving 79.2 Cobalt Gray Equivalent (CGE) in 44 fractions. Toxicity was prospectively assessed weekly during PBRT and scored according to CTCAE v4.0 in 12 categories, including Fatigue (F), Urinary Tract Pain (UT), Urinary Frequency (UF), Urinary Retention (UR), Urinary Incontinence (UI), Urinary Urgency (UU), Hematuria (H), Fecal Incontinence (FI), Rectal Hemorrhage (RH), Erectile Dysfunction (ED), Proctitis (PR), and Diarrhea (D). Of the 63 patients receiving HS, PBRT was delivered for low risk (N=15), intermediate risk (N=33) and high risk (N=15) disease. PBRT targets were prostate (P) only (N=14), P plus seminal vesicles (SV) in 66.7% of the patients and prostate and proximal SV in 32.7%. The pelvic lymph nodes were not treated. Androgen deprivation therapy (ADT) using leuprolide was given to 152 pts (95.6%) for a median duration of 14.4 months (range: 2-44). Some patients are still receiving ADT as of last follow-up, which underestimates the reported duration. The median follow-up was 2.8 years. Three-year OS, bPFS and DMFS rates were 97%, 93% and 97%, respectively. Cumulative acute grade =3 genitourinary (GU) and gastrointestinal (GI) toxicity rates were 2% and 0%, respectively. Three-year cumulative rates of late grade =3 GU and GI toxicity rates were 3% and 1%, respectively. Conclusion: This prospective single institution cohort of high-risk prostate cancer patients treated with PBRT demonstrates the efficacy and safety of this treatment approach. These results need to be confirmed with longer follow-up and compared with competing treatment options.

Participants
Jesse Conterato, Warrenville, IL (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Patients undergoing proton beam radiotherapy (PBRT) with hydrogel spacer (HS) should experience low rates of acute toxicity. HS will likely have an impact on the reduction of late gastrointestinal (GI) toxicity by reducing the risk of proctitis. This single institution review evaluates acute toxicity outcomes in prostate cancer (CaP) patients treated with PBRT with HS placement. Materials/Methods: From April 2015 to February 2016, 63 men with CaP had placement of HS and were treated with PBRT. All patients completed PBRT, receiving 79.2 Cobalt Gray Equivalent (CGE) in 44 fractions. Toxicity was prospectively assessed weekly during PBRT and scored according to CTCAE v4.0 in 12 categories, including Fatigue (F), Urinary Tract Pain (UT), Urinary Frequency (UF), Urinary Retention (UR), Urinary Incontinence (UI), Urinary Urgency (UU), Hematuria (H), Fecal Incontinence (FI), Rectal Hemorrhage (RH), Erectile Dysfunction (ED), Proctitis (PR), and Diarrhea (D). Of the 63 patients receiving HS, PBRT was delivered for low risk (N=15), intermediate risk (N=33) and high risk (N=15) disease. PBRT targets were prostate (P) only (N=14), P plus seminal vesicles (SV) (N=36) and P plus SV with elective inclusion of pelvic lymph nodes (N=13). In this group, median age was 65 (49 – 80), median IPSS score was 5 (0 – 33), and median prostate size was 63.9 cc (35.0 – 253.0 cc). Results: Change From Baseline F UT UF UR UI UU H FI RH ED PR D Number of Patients No Change 36 25 16 46 26 58 60 56 50 62 56 1 Grade Increase 25 29 28 27 12 27 5 2 7 12 1 6 2 Grade Increase 2 7 19 22 5 10 0 1 0 1 0 1 3 Grade Increase 0 2 0 0 0 0 0 0 0 0 0 0 0 2% of patients experienced an increase of 2 grades in FI from baseline. 11% of patients experienced an increase of 1 grade in RH from baseline. 2% of patients experienced an increase of 1 grade in PR from baseline. 2% of patients experienced an increase of 2 grades in D from baseline. 2% of patients experienced an increase of 2 grades in F from baseline. 14% of patients experienced an increase of 2-3 grades in UT from baseline. 30% of patients experienced an increase of 2 grades in UF from baseline. 35% of patients experienced an increase of 2 grades in UR from baseline. 8% of patients experienced an increase of 2 grades in UI from baseline. 16% of patients experienced an increase of 2 grades in UF from baseline. 8% of patients experienced an increase of 1 grade in H from baseline. 2% of patients experienced an increase of 2 grades in ED from baseline. Conclusion: HS placement for CaP patients has acceptably low rates of acute GI and urinary toxicity. Longer follow up is needed to assess effects of HS placement on late toxicity.
Participants
Melissa L. Pilewskie, MD, New York, NY (Presenter) Nothing to Disclose
Shari Goldfarb, MD, New York, NY (Presenter) Nothing to Disclose
Karen Y. Oh, MD, Portland, OR (Presenter) Nothing to Disclose
Jean L. Wright, MD, New York, NY (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.
Participants

Simon S. Lo, MD, Seattle, WA, (simonslo@uw.edu) (Moderator) Research support, Elekta AB; Travel support, Accuray Incorporated; Speaker, Accuray Incorporated;

Jing Zeng, MD, Seattle, WA, (jzeng13@uw.edu) (Presenter) Nothing to Disclose

Jyoti D. Patel, MD, Chicago, IL (Presenter) Nothing to Disclose

Ben J. Slotman, MD, PhD, Amsterdam, Netherlands, (bj.slotman@vumc.nl) (Presenter) Research Grant, Varian Medical Systems, Inc; Speakers Bureau, Varian Medical Systems, Inc;

Philip A. Linden, Cleveland, OH, (philip.linden@uhhospitals.org) (Presenter) Nothing to Disclose

Gregory Kicska, MD, PhD, Seattle, WA, (kicskag@uw.edu) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand the role of radiation therapy in management of lung cancer, and areas of controversy.

ABSTRACT

Active Handout: Ben J. Slotman

SSJ24-01 Cosmesis after Early Stage Breast Cancer Treatment with Breast Conserving Surgery and Radiotherapy: Experience of Patients Treated In A Chilean Radiotherapy Center

Tuesday, Nov. 29 3:00PM - 3:10PM Room: S104A

Participants
Lorena Vargas, Oak Brook, IL (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The aim of this study is to analyze the overall cosmetic outcome according to patient self assessment and evaluate differences according to the fractionation received. Materials/Methods: A questionnaire was drawn up on the basis of subjective rating scales of cosmesis and it was applied at the start of treatment, at discharge and/or at follow-up visits to patients with early stage breast cancer who received radiotherapy (RT) with tangentials fields between June/2014 and July/2015. Self-perception of cosmesis, pain, changes in the treated breast, and fractionation used (hypofractionation (HF) or conventional fractionation (CF)) were evaluated. Surgical bed boost and use of field in field technique (FIF) were also recorded. A descriptive analysis was performed to calculate proportions, frequencies and medians. Chi square and Kruskal Wallis tests were used when appropriate. Results: 352 questionnaires were obtained: 71 at enrollment, 80 at discharge and 201 at follow up visits (281 were considered as evaluation of RT effect). Median age was 58 yo. Forty percent of patients reported "excellent" cosmesis, 53% (147/279) "acceptable", and 2% (6/279) "poor" cosmesis. Cosmesis was considered "acceptable/excellent" by 98% (273/279) of patients. According to fractionation received, no statistically significant difference was found in overall cosmesis (p = 0.6), pain (p=0.9), boost use or FIF. The alteration that occurred more frequently was "difference between the two breasts" (77%), followed by "alteration in shape of the breast" (56%) and then for "induration" (53%). Change in breast normal color was reported in 48%. Fifteen percent of patients younger than 58 yo reported new appearance of normal breast color affecting cosmesis compared to 9% of patients older than 58 yo (p = 0.04). Patients under 58 yo had a greater frequency of breast induration (61% versus 49%, p=0.03). Nineteen percent of patients with stage I-II referred complications affecting breast cosmesis compared with 2% with cancer in situ (DCIS) (p = 0.04). Fourteen percent in stage I-II referred color change affecting cosmesis compared with 6% of those with DCIS (p = 0.03). Pain was reported by 68% of patients, and in most of them it was occasional (62%), whereas only 6.4% reported permanent pain. When considering only the questionnaires before the start of RT and at the end of it, in both times the most frequent response was acceptable cosmesis (53.5% and 63.8% respectively), while 3% and 4% reported poor cosmesis at the beginning and at discharge respectively. Ninety-four percent of patients stated that they would accept treatment again. Conclusion: No difference was found between HF and CF in our patients in terms of cosmetic results. Great satisfaction regarding cosmetic outcome of cancer treatment is reported, given by 98% of excellent/acceptable cosmesis, and 94% of patients who would receive treatment again.

SSJ24-02 Cost Minimizing Analysis of Intraoperative Radiotherapy (IORT) in Conservatively Treated Early Breast Cancer

Tuesday, Nov. 29 3:10PM - 3:20PM Room: S104A

Participants
Pedro Lara, Oak Brook, IL (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Accelerated Partial Breast Irradiation (APBI) by IORT is becoming an attracting alternative to external beam radiotherapy (EBRT) in early breast cancer treated by conservative surgery (BCS). One of the major issues for implementing a new treatment is the cost related to health results. Materials/Methods: The Breast IORT programme started in our center in January 2013. Since then, 195 patients received BCS for early breast cancer until December 2014. The cost analysis was performed after the completion of the treatment of every patient. The full cost of the surgical procedure included: Operating Room (OR), physicians and other personnel, pharmacy, pathology, nuclear medicine, recovery and days in bed at hospital. Cost of the IORT administration were also calculated and included in the analysis: first consultation, preplanning CT scan, disposables, time of radiation oncologist, physicist, technician, annual equipment cost per number of patients treated. EBRT treatment included the whole (consultation, simulation, planning and treatment delivery) process for 25 fractions. Results: Two patients were treated of bilateral cancer with IORT and were excluded from the analysis. Of the 193 remaining cases, 108 were referred to IORT although only 81 received the treatment. 27 cases do not fit for IORT due to the big size of the cavity after removal of the tumor (24 cases) or device technical problems at OR (3 patients). The mean cost of surgery for the whole 193 cases was 4,610.31±1,591.67€ (median 4,346.91€). Surgery was slightly more expensive for those cases that received IORT treatment (4,777.75±1,650.00€; median: 4,430.86€) compared with those not referred to IORT (4,376.54±1,443.90€; median: 4,206.11€) (5.2% incremental cost; pThe total cost of the BCT for the whole series of patients was 9,091.09±2,016.28€ per case. Cost comparison of BCS+IORT (6,800.79±1,658.17€; median:6,463.98€) vs BCS+EBRT (10,090.97±1,443.70€; median 9,920.54€) showed a strong advantage in total cost for IORT treatment (incremental cost 53.47%;pHealth results showed a 100% actuarial local control at 3 years for IORT (follow-up closed at Feb 2016) and no CTCAE 4.0 toxicity score over 2 were observed. Results non-inferior to those observed in the EBRT arm for BCT. Conclusion: IORT slightly increases the cost of the surgical procedure of BCS (5.2%) but saves up to a 53.47% of the total cost of a Breast Conserving Treatment, when compared with standard EBRT in 25 fractions, showing equivalent health results in terms of clinical outcome and toxicity. Indirect cost and patient convenience are further advantages to be taking into account.
SSJ24-03  VMAT as Treatment Technique in Complex Radiotherapy Breast including IMC, L3 and L4 Nodes

Tuesday, Nov. 29 3:20PM - 3:30PM Room: S104A

Participants
Antonia Lavorato, Oxford, United Kingdom (Presenter) Nothing to Disclose
Asadulla Khan, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Sileida Oliveros, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): The aim of the present study is to demonstrate the validity of the volumetric modulated arc therapy technique (VMAT) for the whole breast, internal mammary nodal chain (IMC) and medial supraclavicular fossa (SCF) in deep inspiration and compare its dosimetric results to the standard tangential field-in-field (FinF) combined with an anterior beam technique. Materials/Methods: A complex case was chosen for this study. A 31 years old lady presented with a self-detected lesion in the medial aspect of the left breast. She was diagnosed with an invasive ductal carcinoma of the left breast grade 3, ER 3/8, PR negative (0/8), HER-2 negative. BRCA 1 and 2 negative as well as panel gene testing negative. CT showed no evidence of metastatic disease or enlarged internal mammary nodes. The patient had undergone a total of six cycles of chemotherapy and left breast wide local excision with complete pathological response. Adjuvant breast radiotherapy and boost to the tumour bed was recommended (Px 40Gy/15#, 16Gy in 8#). Risks versus benefits of irradiating the IMC and SCF were evaluated by the oncologist who concluded that in this clinical case the benefits would outweigh the risks providing an optimised plan could be achieved minimising, as much as possible, the dose to the ipsilateral lung and to the heart. The oncologist delineated the relevant CTVs following the ESTRO consensus guideline. The patient central lung dose for tangential beams was 4.5cm. A total of three plans were generated for this patient: two VMAT partial arcs with different gantry angles and a standard tangential FinF with a combined anterior beam. The plans were created with Pinacle, treatment planning system. Results: Treatment Technique Left Lung V20Left Lung V10Left Lung V5Heart V25Heart V10Heart Mean Gy Spinal Canal Max Gy Tangential FinF + Ant Beam 34.9% 43.6% 54.3% 60.6% 238.4VMAT Gantry 150-300 degrees 23% 42.2% 64.3% 80.1% 5229.9VMAT Gantry 178-300 degrees 25.4% 35.7% 46.9% 426.9% Both VMAT plans better V20 and V10 to the Left (Ipsilateral) Lung was achieved; also better coverage and dose homogeneity were achieved with VMAT when compared with FinF techniques. There was no significant difference to the mean contralateral breast between the two VMAT techniques. The dose coverage (V38Gy) to the breast and L3 and L4 nodes was quite comparable across the techniques but IMC coverage using tangential beams was inferior. Conclusion: The results support the hypothesis that VMAT technique is feasible and in this specific case perhaps the only solution. The results showed that the dose to the ipsilateral lung can be reduced and the dose homogeneity can be improved without increasing the dose to the contralateral breast or lung.

SSJ24-04  Effect of Adjuvant Radiotherapy on Survival in Male Breast Cancer: A Population-Based Analysis

Tuesday, Nov. 29 3:30PM - 3:40PM Room: S104A

Awards
Trainee Research Prize - Resident

Participants
Matthew J. Abrams, MD, Boston, MA (Presenter) Nothing to Disclose
Paul Koffer, MD, Boston, MA (Abstract Co-Author) Nothing to Disclose
Jaroslaw Hepel, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose

PURPOSE

There are no randomized trials providing evidence for or against adjuvant radiation for male breast cancer because of its rarity. This study examines the impact of post-lumpectomy (PLRT) and post-mastectomy radiation (PMRT) in male breast cancer patients in the National Cancer Institute’s Surveillance Epidemiology and End Results (SEER) database.

METHOD AND MATERIALS

The SEER database 8.3.1 was queried for men ages 20+ diagnosed with localized or regional non-metastatic grade I-III invasive ductal/lobular carcinoma from 1998-2011. Included patients were treated with a lumpectomy or modified radical mastectomy (MRM) with or without post-surgical external beam radiation. Univariate and multivariate analyses evaluated predictors for PMRT use after MRM. Overall survival (OS) curves were calculated by the Kaplan-Meier method and compared by the log-rank test. Cox-regression was used for multivariate survival analyses.

RESULTS

A total of 1,980 patients were followed for a maximum of 10 yrs (median follow up = 56 months). 349 patients underwent lumpectomy while 1,631 underwent MRM. Of those who underwent lumpectomy, PLRT improved 10 yr OS (68% vs. 57% p=0.001). Of those who underwent MRM, PMRT had no impact on either the entire group 10 yr OS (54% PMRT vs. 53% no PMRT) p=0.585 nor on the subset of node negative patients 10 yr OS (60% PMRT vs. 62% no PMRT) p=0.736. However, there was a benefit in 10 yr OS for 1-3 nodes positive (55% PMRT vs. 46% no PMRT, p=0.033) and for 4+ nodes positive (49% vs. 21%, p=0.001). Using cox-regression analysis, increasing number of nodes positive, larger size and older age were all associated (p<0.001) with a survival detriment while the use of PMRT (p<0.001) was associated with improved survival (HR=0.62 [0.49-0.77]). Using binary logistic regression, predictors for the use of PMRT were unknown/borderline ER status, grade III disease, increasing nodes positive, and larger primary tumor size.

CONCLUSION

The use of post-lumpectomy radiation is associated with a survival benefit. After a modified radical mastectomy, PMRT improves survival in those with positive nodes. There may be a subset of node negative patients who derive a survival benefit and more study of this group is needed.

CLINICAL RELEVANCE/APPLICATION

After a diagnosis of male breast cancer, post-lumpectomy radiation should be considered for all patients and post-mastectomy radiation should be considered for node positive patients.

SSJ24-05  Assessment of Cosmetic Outcome Following Intra-operative Radiation Therapy during Breast

Tuesday, Nov. 29 3:40PM - 3:50PM Room: S104A

Abstract Co-Author

Presenter

Participants

Oliveros, Oxford, United Kingdom (Presenter) Nothing to Disclose
Asadulla Khan, Oxford, United Kingdom (Abstract Co-Author) Nothing to Disclose
Hepel, MD, Providence, RI (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): It is well known that intra-operative radiation therapy (IORT) has been employed for the treatment of breast cancer with the primary intent to provide better local control. Several retrospective studies have suggested a favorable cosmetic outcome with IORT and the technique is being increasingly used in clinical practice. However, these reports are limited to breast cancers of low volume and small size. The purpose of this study was to report the cosmetic outcome of IORT, as assessed by patients and radiation oncologists, for a population of patients with larger breast tumors. Materials/Methods: A complex case was chosen for this study. A 31 years old lady presented with a self-detected lesion in the medial aspect of the left breast. She was diagnosed with an invasive ductal carcinoma of the left breast grade 3, ER 3/8, PR negative (0/8), HER-2 negative. BRCA 1 and 2 negative as well as panel gene testing negative. CT showed no evidence of metastatic disease or enlarged internal mammary nodes. The patient had undergone a total of six cycles of chemotherapy and left breast wide local excision with complete pathological response. Adjuvant breast radiotherapy and boost to the tumour bed was recommended (Px 40Gy/15#, 16Gy in 8#). Risks versus benefits of irradiating the IMC and SCF were evaluated by the oncologist who concluded that in this clinical case the benefits would outweigh the risks providing an optimised plan could be achieved minimising, as much as possible, the dose to the ipsilateral lung and to the heart. The oncologist delineated the relevant CTVs following the ESTRO consensus guideline. The patient central lung dose for tangential beams was 4.5cm. A total of three plans were generated for this patient: two VMAT partial arcs with different gantry angles and a standard tangential FinF with a combined anterior beam. The plans were created with Pinacle, treatment planning system. Results: Treatment Technique Left Lung V20Left Lung V10Left Lung V5Heart V25Heart V10Heart Mean Gy Spinal Canal Max Gy Tangential FinF + Ant Beam 34.9% 43.6% 54.3% 60.6% 238.4VMAT Gantry 150-300 degrees 23% 42.2% 64.3% 80.1% 5229.9VMAT Gantry 178-300 degrees 25.4% 35.7% 46.9% 426.9% Both VMAT plans better V20 and V10 to the Left (Ipsilateral) Lung was achieved; also better coverage and dose homogeneity were achieved with VMAT when compared with FinF techniques. There was no significant difference to the mean contralateral breast between the two VMAT techniques. The dose coverage (V38Gy) to the breast and L3 and L4 nodes was quite comparable across the techniques but IMC coverage using tangential beams was inferior. Conclusion: The results support the hypothesis that VMAT technique is feasible and in this specific case perhaps the only solution. The results showed that the dose to the ipsilateral lung can be reduced and the dose homogeneity can be improved without increasing the dose to the contralateral breast or lung.
ABSTRACT

Purpose/Objective(s): Intra-operative radiation therapy during breast-conserving surgery is increasingly being used as a treatment for early breast cancer. A variety of techniques are used, and many have been shown to be safe and effective. Another important aspect is the long-term cosmetic (aesthetic) results of treatment, as most women will survive for decades. In order to determine the variety and extent of methods currently being used to assess cosmetic outcome, a review of the literature was performed. In particular, the results obtained from objective assessment methods were sought.

Materials/Methods: PubMed was searched using the terms (ioert[All Fields] OR IORT[All Fields] OR intraoperative[All Fields]) AND (“breast”[MeSH Terms] OR “breast”[All Fields]) AND (cosmesis[All Fields] OR cosmetic[All Fields] OR (“esthetics”[MeSH Terms] OR “esthetics”[All Fields]) OR (“esthetic”[MeSH Terms] OR “esthetic”[All Fields] OR “esthetics”[All Fields] OR “esthetic”[All Fields])). Abstracts of all articles were read to eliminate those not relevant to this study. Review articles were read in their entirety to determine if any articles were missed from the initial PubMed search. From the final set of articles, the methods used for intra-operative radiation therapy cosmetic assessment, and results obtained from the assessment, were tabulated. The proportion of patients determined to have Excellent or Good outcome (EG), and the 95% confidence intervals, were calculated.

Results: A total of 184 items were identified by the search, of which 145 were determined from the abstract to be not relevant. 39 publications were read in detail, and included 10 reviews and editorials, 2 studies where either no assessment was made or no radiation therapy given. Of the remaining studies, only 4 reported the use of an objective method of assessment of cosmetic outcome, the others using either subjective or poorly specified methods. One study used a LINAC-based method of delivering the intra-operative radiation therapy, the other three used Intrabeam (the TARGIT technique). Results are shown in the Table.

Conclusion: A minority of reports assessing cosmetic outcomes following intra-operative radiation therapy use objective methods. Such methods should be required as they provide unbiased estimates of outcome.

Publication Method

<table>
<thead>
<tr>
<th>Participant</th>
<th>Publication</th>
<th>Method</th>
<th>Proportion EG (95% CI)</th>
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<tbody>
<tr>
<td>Cracco et al (2015)</td>
<td>LINAC-IORT</td>
<td>81</td>
<td>84 (8) % EBRT 588 (6)</td>
</tr>
<tr>
<td>Keshtgar et al (2013)</td>
<td>Intrabeam</td>
<td>18</td>
<td>18 (7) %</td>
</tr>
<tr>
<td>Grobmyer et al (2013)</td>
<td>Intrabeam-IORT 17186</td>
<td>5</td>
<td>17 (5) %</td>
</tr>
<tr>
<td>Kraus-Tiefenbacher et al (2006)</td>
<td>Intrabeam-IORT (as boost) plus EBRT</td>
<td>93</td>
<td>93 (6) %</td>
</tr>
</tbody>
</table>

SSJ24-06 Evaluation of Axillary Dose Coverage following Whole Breast Radiotherapy: Variation with the Different Radiotherapy Field

ABSTRACT

Purpose/Objective(s): To evaluate dose distribution and coverage of the axilla levels I–III , superior axillary vein lymph nodes(Sup-AV) and inferior axillary vein lymph nodes(infer-AV) area, according to AMAROS field(A), high tangent field(HT), standard tangent field (ST).

Materials/Methods: We retrospectively delineated the axillary levels I–III, Sup-AV and Infer-AV on planning CT-images of 10 patients who treated with breast conservation and whole breast radiotherapy along 2015 in our institution. Every patients were treated using the AMAROS(A), high tangent field(HT), standard tangent field (ST). Mean dose levels and V90(volume receiving at least 90% of the prescribed dose) of every axillary lymph nodes , Su-AV and Infer-AV were evaluated.

Results: The median dose delivered to level I using A, HT and ST were 42.96Gy , 37.3Gy , 27.9Gy. The median dose delivered to level II using A , HT and ST were 46.4Gy, 26.6Gy, 18.5Gy. The median dose delivered to level III using A , HT and ST were 50.9Gy, 19.1Gy, 10.3Gy. The median dose delivered to Sup-AV using A , HT and ST were 47.3Gy, 19.4Gy, 6.16Gy. The median dose delivered to Inf-AV using A , HT and ST were 43.8Gy, 41.4Gy, 33.4Gy. The dose of lung V20% using A , HT and ST were 38.8Gy, 16.7Gy and 16.14Gy.

Conclusion: AMAROS provide high coverage of axilla I–III but high lung dose coverage. For level I , A and HT had similar dose distribution higher than ST; For level II , AMAROS and HT provide high dose coverage than ST.
LEARNING OBJECTIVES

1) Discuss the role of surveillance imaging in identification of radiation induced changes in normal tissue, so that these changes are not misinterpreted as evidence of persistent or recurrent tumor. 2) Describe imaging characteristics of radiation injury to various tissues including visceral mucosal space, salivary glands, bones and vascular structures in the neck as well as surrounding organs such as brain, skull base and lungs. 3) Discuss the advantage of early identification of these using case-based approach.

ABSTRACT

Radiation therapy for head and neck cancers can cause adverse effects and toxicity to the normal tissues in the irradiated regions. This does not only lead to a variety of comorbidities, but also present a challenging and complex appearance on surveillance imaging studies. Timely identification of some of these adverse effects can improve patient survival and quality of life.

LEARNING OBJECTIVES

1) Review and demonstrate the imaging findings of gynecologic malignancies following radiation therapy. 2) Review the imaging modalities used to assess response.

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’s 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 multimodality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**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’s 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 multimodality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**Sub-Events**

**RC422A IGRT and Anatomical Adaptation**

**Participants**

Kristy K. Brock, PhD, Houston, TX (Presenter) License agreement, RaySearch Laboratories AB; Development agreement, Varian Medical Systems, Inc;

**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’s 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 multimodality imaging for treatment planning, image guidance at treatment, and functional and anatomical adaption. Clinical concepts will include functional targeting, clinical goals, and toxicity risks.

**RC422B Functional Targeting, Clinical Goals, and Toxicity Risks**

**Participants**

Cullen M. Taniguchi, MD, PhD, Houston, TX (Presenter) Nothing to Disclose

**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
Jean L. Wright, MD, New York, NY (Presenter) Nothing to Disclose
Atif J. Khan, MD, New Brunswick, NJ (Presenter) Consultant, Elekta AB; Consultant, Vertex Pharmaceuticals Incorporated; Speaker, Elekta AB; Speaker, Vertex Pharmaceuticals Incorporated; Research funded, Elekta AB; Research funded, Cianna Medical, Inc

LEARNING OBJECTIVES
1) Know where to locate the available resources for optimal contouring of breast cancer radiation targets. 2) Understand the contouring guidelines in contemporary breast radiation protocols and know standard contouring nomenclature currently used in these studies. 3) Understand how contouring represents a critical component for optimal planning in breast cancer. 4) Carry out contouring on representative CT images for two scenarios: intact breast, and chest wall and regional nodes.
**Participants**

**Sub-Events**

**MSRO41A  Imaging of the Lymph Nodes of the Head & Neck: Applied Anatomy**

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

**LEARNING OBJECTIVES**

1) Review the normal anatomy of the lymph nodes of the head and neck. 2) Define the size criteria used to identify metastatic lymph nodes. 3) Review the classification of the cervical lymph nodes.

**ABSTRACT**

This lecture will review the normal anatomy of the lymph nodes of the head and neck. The talk will also define the size criteria used to identify metastatic lymph nodes and review the classification of the cervical lymph nodes.

**MSRO41B  Current Concepts and Controversies in Radiation Planning of the Head & Neck Lymph Nodes**

Participants
Sung Kim, MD, New Brunswick, NJ (sk1375@cinj.rutgers.edu) (Presenter) Nothing to Disclose

**MSRO41C  Question & Answer**

Participants

**MSRO41D  Imaging of the Brachial Plexus: Applied Anatomy**

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

**LEARNING OBJECTIVES**

1) Review the normal anatomy of the brachial plexus. 2) Describe common tumors that involve the brachial plexus. 3) Review the post-radiation therapy appearance of the brachial plexus.

**ABSTRACT**

This lecture will review the normal anatomy of the brachial plexus. The lectures will also describe common tumors that involve the brachial plexus and review the post-radiation therapy appearance of the brachial plexus.

**MSRO41E  Current Concepts and Controversies in Contouring and Treatment of the Brachial Plexus and Surrounding Structures**

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

**MSRO41F  Question & Answer**

Participants
Molecular and Functional Imaging/Surrogate Markers in Radiation Oncology

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S403B

AMERICA PRA Category 1 Credits: 1.50
ARRT Category A+ Credits: 1.50

Participants
Nina A. Mayr, MD, Seattle, WA (Moderator) Nothing to Disclose

Sub-Events

RCS20A Imaging Surrogate Markers in Liver Cancer

Participants
Mary U. Feng, MD, San Francisco, CA (Presenter) Nothing to Disclose

RCS20B Imaging Surrogate Markers in Lymphoma

Participants
John P. Plastaras, MD, PhD, Philadelphia, PA (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1) Understand how PET/CT scans after chemotherapy are used to make decisions about lymphoma treatment. 2) Describe how pre-chemotherapy PET/CT scans are used to define target volumes in involved site radiotherapy paradigm. 3) Propose prescription doses for lymphoma treatments based on PET/CT as an imaging biomarker.

ABSTRACT

RCS20C Imaging Surrogate Markers in Esophageal Cancer

Participants
Steven H. Lin, MD, PhD, Houston, TX, (shlin@mdanderson.org) (Presenter) Research Grant, STCube Pharmaceuticals, Inc; Research Grant, F. Hoffmann-La Roche Ltd; Research Grant, Elekta AB; Research Grant, Peregrine Pharmaceuticals, Inc; Research Grant, Hitachi, Ltd; Speaker, AstraZeneca PLC; Speaker, ProCure Treatment Centers, Inc; Speaker, McKesson Corporation

LEARNING OBJECTIVES

1) Assess the critical role of imaging in the diagnosis and treatment of esophageal cancer. 2) Critically appraise the utility of FDG-PET imaging as a predictive and prognostic marker in esophageal cancer. 3) Describe the novel imaging approaches for improved imaging biomarkers for preoperative therapy.

RCS20D Imaging Surrogate Markers in Head and Neck Cancer

Participants
Min Yao, MD, PhD, Cleveland, OH (Presenter) Nothing to Disclose

LEARNING OBJECTIVES

1. Review the application of FDG PET in head and neck cancer
2. Review how to use FDG PET in treatment planning
3. Review new tracers PET in head and neck cancer
**RC522**

**Imaging for Personalized Medicine: Head and Neck**

Wednesday, Nov. 30 8:30AM - 10:00AM Room: S102D

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

**Participants**
Robert Jeraj, Madison, WI (*Moderator*) Founder, AIQ Services

**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 rationale for plan adaptation in 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 2016 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.

**RC522A IGRT and Anatomical Adaptation**

**Participants**
Marija Popovic, PhD, Montreal, QC, (marija.popovic@mcgill.ca) (*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.
**Intravoxel Incoherent Motion Diffusion Weighted Imaging (IVIM-DWI) in Evaluating the Hypoxia and Radiosensitivity of Nasopharyngeal Carcinoma Xenografts**

**METHOD AND MATERIALS**
Two different radiosensitive NPC cell lines (CNE-1 and CNE-2) were transplanted on sixty nude mice (30 of each group) to raise xenografts, which received the fractional radiations (30Gy, each fraction of 10Gy) at the alternative days. Each group was then subcategorized into the following five groups: non-radiation group (G0), radiation group of 10Gy (G1), 20Gy (G2), 30Gy (G3), and 3 days after 30Gy radiation (G4). On a 3.0T MR system, IVIM-DWI with 14 b-factors (0~1000 s/mm²) were performed on G0 xenografts directly and G1~G4 xenografts after irradiations. IVIM-parameters of xenografts were calculated with IDL6.3 software. The cell density, necrosis proportion and HIF-1α of xenografts were analyzed histopathologically. The general changes of IVIM-parameters and pathological features after irradiations were tested with One-way ANOVA, their difference were compared by Student t test and/or Mann-Whitney U test. The correlations between different variables were analyzed with Spearman test.

**RESULTS**
After fractional radiations, the general changes of D, f and D* values in CNE-2 xenografts were statistically significant than those of CNE-1 xenografts (P<0.01). D increased while D* and f decreased more significantly in CNE-2 xenografts (P<0.01). D and necrosis proportion of G3 and G4 in CNE-2 xenografts were higher than those of CNE-1 xenografts (P<0.05), while D* and f of G4 as well as cell density of G2, G3 and G4 in CNE-2 xenografts were lower than those in CNE-1 xenografts (P<0.005). However, the general change of HIF-1α expression in CNE-1 xenografts was more significant than that of CNE-2 xenografts (P<0.005). On the other hand, D correlated negatively with cell density (rs=-0.861, P<0.001) and HIF-1α expression (rs=-0.814, P<0.001), while it behaved a positive correlation with necrosis proportion (rs=0.952, P<0.001). Furthermore, f correlated positively with cell density (rs=0.627, P<0.001) but negatively with necrosis proportion (rs=-0.649, P<0.001).

**CONCLUSION**
High-radiosensitive CNE-2 xenografts behaved more significant changes in IVIM-parameters than low-radiosensitive CNE-1 xenografts after fractional radiations, which correlated significantly with microstructure features and hypoxia of xenografts. Thus, IVIM-DWI can be potentially valuable in predicting the radio-sensitivity of NPC xenografts.

**CLINICAL RELEVANCE/APPLICATION**
Animal studies of IVIM-DWI can help demonstrate the mechanism on hypoxia and radiosensitivity of NPC.
Participants
Caryn Anderson, MD, Iowa City, IA (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Ketogenic diet (KD) combined with chemoRT reduced tumor growth and improved survival in pre-clinical models. We hypothesized stage III-IVB HNSCC patients would be able to remain compliant with KD because of PEG tube requirement during chemoRT. Research supported by NIH U54TR001356 and KetoCal® 4:1 provided by Nutricia Pharmaceuticals.

Materials/Methods: This phase I clinical trial enrolled stage III-IVb definitive and post-op HNSCC patients receiving concurrent platinum-based chemorT. PEG placement was required, but subjects were encouraged to continue KD by mouth. KD recipes and KetoCal® shakes were provided for daily consumption for 5 weeks starting 2 days prior to chemoRT. Fingerstick ketones (FK) were checked Mon-Fri, and serum beta-hydroxybutyrate (BHB), glucose, and uric acid were checked weekly. Lipid panel was checked at week 3. Serum oxidative stress parameters were assessed prior to, during, and after completing KD. Adverse events were graded utilizing CTCAE version 4.0. Results: Median follow-up for all enrolled subjects (n=12) from completion of RT was 4.9 mo (range: 0-16.6). 4/12 subjects successfully completed 5 weeks of KD as prescribed. Successful subjects used scheduled anti-emetics, consumed shakes via PEG tube as opposed to orally and had strong social support. Median days on KD for those who discontinued was 5.5 (range: 2-8). Of the first 4 subjects treated, 2 completed, 1 withdrew due to fatigue (gr. 3), and 1 had a dose limiting toxicity (DLT) (hyperuricemia, grade 4; 12.7 nd/dL; nl ref 2.4-7.0). The protocol was amended to address diet-related hyperuricemia and allow for increased protein intake. Subsequently, 8 eligible subjects enrolled with 2 completing therapy and 2 experiencing DLTs (acute pancreatitis grade 3; hyperuricemia with complicating nausea and vomiting, grade 3). The remaining 4 subjects withdrew due to diet intolerance prior to beginning chemoRT (n=1), and nausea with vomiting (n=3). Serious adverse events included hospitalizations for parotiditis (n=1), acute pancreatitis (n=1), neutropenic fever (n=1), and nausea with vomiting (n=1). Both the acute pancreatitis and nausea with vomiting SAEs were considered related to study diet and were deemed DLTs. In those who completed KD, the median days FK were elevated and weeks the BHB levels were above baseline were 24.5 days (range: 19-25) and 5 weeks (range: 4-6), respectively. Median uric acid levels were 4.9 nd/dL (range: 3.4-5.4). Lipids remained normal. Serum oxidative stress markers, as assessed by protein carbonyls, increased linearly with increasing days on KD. Conclusion: While challenging despite PEG availability, KD compliance is possible when combined with concurrent chemorT for HNSCC. Enrollment continues.

MSRO42-05 Unilateral versus Bilateral Intensity Modulated Radiation for Surgically-treated Squamous Cell Carcinoma of the Palatine Tonsil Staged with FDG-PET/CT

Wednesday, Nov. 30 11:10AM - 11:20AM Room: S103CD

Awards
Student Travel Stipend Award

Participants
Re-I Chin, BA, Saint Louis, MO (Presenter) Nothing to Disclose
Yuan J. Rao, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Michael Y. Hwang, Newark, NJ (Abstract Co-Author) Nothing to Disclose
Christopher R. Spencer, MD, MS, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Todd DeWees, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Pranav Patel, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Parul Sinha, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Hiram A. Gay, MD, Greenville, NC (Abstract Co-Author) Nothing to Disclose
Brian Nussenbaum, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Douglas Adkins, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
James S. Lewis Jr, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Wade L. Thorstad, MD, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose
Michael Pierro, BS, Saint Louis, MO (Abstract Co-Author) Nothing to Disclose

PURPOSE

We report long-term outcomes of unilateral (UL) vs. bilateral (BL) radiation therapy (RT) for tonsil cancer in the era of FDG-PET/CT (PET). We hypothesize that staging with PET aids in patient selection for ULRT, especially in patients with multiple ipsilateral lymph nodes (stage N2b), for which there is controversy on whether ULRT is appropriate.

METHOD AND MATERIALS

The population included 159 patients treated with IMRT for tonsil cancer from 1997-2013. The primary tumor was treated to a median dose of RT was 66 Gy. PET was used in 113 (71%) patients. Fifty-two patients received ULRT for lateralized (>1cm from midline) tonsil cancer. Twenty-nine patients with N2b disease received ULRT and 56 received BLRT. All patients received surgery to the tonsil primary and 154 (97%) received neck dissection. We evaluated acute toxicity and patient-reported quality of life (PROQOL). We also reviewed cases of contralateral failures (CLF) in N2b patients receiving ULRT on PubMed, and correlated these outcomes to utilization of PET staging.

RESULTS

Median follow-up was 6.1 years. The 5 and 10-year rates of local-regional control (LRC) among patients treated with unilateral RT vs bilateral RT were 98% and 98% vs 96% and 96% respectively (p=0.41). There were no CLF. P16+ was associated with improved LRC on univariate and multivariate analysis (HR 0.11, p=0.02). Unilateral RT reduced use of reactive gastrostomy tube, xerostomia, and bilateral radiation. In this study with high utilization of PET, we observed no CLF. FDG-PET staging may be useful when considering unilateral radiation in patients with stage N2b disease.

CLINICAL RELEVANCE/APPLICATION

Unilateral neck radiation reduces acute toxicity and improves quality of life compared to bilateral radiation, and results in high LRC. For properly selected patients with well lateralized tumors (>1cm from midline), there was no difference in LRC between unilateral and bilateral radiation. In this study with high utilization of PET, we observed no CLF. FDG-PET staging may be useful when considering unilateral radiation in patients with stage N2b disease.
The equality of means.

A. These differences between the groups were statistically significant, p=.008 and p=.001, respectively, using T-test analysis for PET/CT, mean clival incline difference was 12.61° in Group B (SD, 5.62°; SEM, 1.78°), and 1.48° (SD, 1.03°; SEM, 0.32°) in Group error mean (SEM), 2.62°), while clival incline for Group A was 72.25° (SD, 7.78°; SEM, 2.46°). Comparing the simulation CT to the mean clival incline value obtained on the PET/CT images in Group B was 61.44° (standard deviation (SD), 8.30°; standard error of the mean (SEM), 2.62°), while clival incline for Group A was 72.25° (SD, 7.78°; SEM, 2.46°). Failures were classified into five types: A (fd95 higher than pd95, centroid within CTV1), B (fd95 higher, centroid in CTV2 or CTV3), C (fd95 lower, in CTV1), D (fd95 lower, in CTV2 or CTV3), E (centroid outside all target volumes), and F (centroid from matching low-neck supraclavicular field).

RESULTS

289 patients were reviewed. Local and locoregional control at 5-years was 83% and 76%, respectively. Of 62 patients with documented local/regional failure, 51 had available rCT and pCT for analysis. 1-, 2- and 4-year overall survival was 74%, 30%, and 4%, respectively. Mean time to recurrence diagnosis post-radiation treatment was 6.4 months. Primary tumor sites were: 22 oral tongue, 10 alveolar ridge, 6 buccal mucosa, 6 retromolar trigone, 4 hard palate, and 3 floor of mouth. 83 rGTVs were identified in the results.

CONCLUSION

Over half of failures following PO-IMRT in oral cavity cancer were not those that had originated from high-dose target volumes and that had received adequate dosimetric coverage. A standardized typology incorporating volumetric and dosimetric metrics adds value to failure characterization over simplistic binary “loco-regional failure” categories.

CLINICAL RELEVANCE/APPLICATION

A standardized typology for failure classification incorporating volumetric and dosimetric metrics can be utilized to infer mechanisms of failure and identify interventions to reduce failure rates.

MSRO42-06 Patterns of Loco-Regional Failure Following Post-Operative IMRT to Oral Cavity Cancer: Quantitative Dose-Volume Analysis Using a Standardized Pattern-of-Failure Typology

Wednesday, Nov. 30 11:20AM - 11:30AM Room: S103CD

Participants
Andrew Wong, BS, Houston, TX (Presenter) Nothing to Disclose
Abdallah S. Mohamed, MD, MSc, Houston, TX (Abstract Co-Author) Nothing to Disclose
Clifton D. Fuller, MD, PhD, Houston, TX (Abstract Co-Author) Nothing to Disclose
David I. Rosenthal, Houston, TX (Abstract Co-Author) Advisory Board, Bristol-Myers Squibb Company Advisory Board, Merck KGaA Research support, Merck KGaA
Brandon Gunn, MD, Galveston, TX (Abstract Co-Author) Nothing to Disclose
Adam S. Garden, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

Loco-regional failure is traditionally coded as a binary variable. For oral cavity cancer patients receiving post-operative intensity modulated radiotherapy (PO-IMRT), we seek to localize and identify volumetric/dosimetric patterns of failure with quantitative dose maps, using a standardized typology.

METHOD AND MATERIALS

Oral cavity cancer patients receiving PO-IMRT at our institution between 2001-2011 were identified. Diagnostic CT documenting recurrence (rCT) was co-registered with the original planning CT (pCT) with previously validated deformable image registration method. Manually segmented recurrent gross disease (rGTV) on the rCT was deformed to co-registered pCTs. Dose to 95% failure volume (fd95) was compared to 95% dose to target volume the failure centroid originated from (pd95). Failures were classified into five types: A (fd95 higher than pd95, centroid within CTV1), B (fd95 higher, centroid in CTV2 or CTV3), C (fd95 lower, in CTV1), D (fd95 lower, in CTV2 or CTV3), E (centroid outside all target volumes), and F (centroid from matching low-neck supraclavicular field).

RESULTS

289 patients were reviewed. Local and loco-regional control at 5-years was 83% and 76%, respectively. Of 62 patients with documented local/regional failure, 51 had available rCT and pCT for analysis. 1-, 2- and 4-year overall survival was 74%, 30%, and 4%, respectively. Mean time to recurrence diagnosis post-radiation treatment was 6.4 months. Primary tumor sites were: 22 oral tongue, 10 alveolar ridge, 6 buccal mucosa, 6 retromolar trigone, 4 hard palate, and 3 floor of mouth. 83 rGTVs were identified as follows: 21 (25%) type B, 6 (7%) type C, 5 (6%) type D, 13 (16%) type E, and 3 (4%) type F.

CONCLUSION

Over half of failures following PO-IMRT in oral cavity cancer were not those that had originated from high-dose target volumes and that had received adequate dosimetric coverage. A standardized typology incorporating volumetric and dosimetric metrics adds value to failure characterization over simplistic binary “loco-regional failure” categories.

CLINICAL RELEVANCE/APPLICATION

A standardized typology for failure classification incorporating volumetric and dosimetric metrics can be utilized to infer mechanisms of failure and identify interventions to reduce failure rates.

MSRO42-07 PET/CT in CT Simulation: Significance of a Standardized Positioning Protocol for Head and Neck Radiotherapy Planning

Wednesday, Nov. 30 11:30AM - 11:40AM Room: S103CD

Participants
George Tolekdis, Chicago, IL (Presenter) Nothing to Disclose
Miranda L. Thoma, ARRt, BS, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Mehdi Choi, MD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Aidnaz D. Diaz, MD, San Antonio, TX (Abstract Co-Author) Nothing to Disclose

PURPOSE

Diagnostic imaging scans are a valuable tool for head and neck (H&N) cancer radiotherapy treatment planning (RTP). Information from diagnostic scans can be incorporated into the RTP process by performing a dedicated diagnostic scan in the treatment position or by co-registering an existing scan with the simulation scan. The purpose of this study was to use the clival incline to quantify differences in H&N positioning between patients undergoing diagnostic PET/CTs positioned with vs. without the RTP immobilization mask.

METHOD AND MATERIALS

Oral cavity cancer patients receiving PO-IMRT at our institution between 2001-2011 were identified. Diagnostic CT documenting the location or shape of Gross disease (GTV) on the PET/CT images in Group B was 61.44° (standard deviation (SD), 8.30°; standard error mean (SEM), 2.62°), while clival incline for Group A was 72.25° (SD, 7.78°; SEM, 2.46°). Comparing the simulation CT to the PET/CT, mean clival incline difference was 12.61° in Group B (SD, 5.62°; SEM, 1.78°), and 1.48° (SD, 1.03°; SEM, 0.32°) in Group A. These differences between the groups were statistically significant, p=.008 and p=.001, respectively, using T-test analysis for the equality of means.

RESULTS

Mean clival incline measured on the CT from the PET/CT images in Group B was 61.44° (standard deviation (SD), 8.30°; standard error mean (SEM), 2.62°), while clival incline for Group A was 72.25° (SD, 7.78°; SEM, 2.46°). Comparing the simulation CT to the PET/CT, mean clival incline difference was 12.61° in Group B (SD, 5.62°; SEM, 1.78°), and 1.48° (SD, 1.03°; SEM, 0.32°) in Group A. These differences between the groups were statistically significant, p=.008 and p=.001, respectively, using T-test analysis for the equality of means.
CONCLUSION

Based on these results we reach two conclusions. 1) When no mask is used for PET/CT, there is a different approach to positioning: PET/CT technologists favor a neutral to flexion position, while we favor a neutral to extended position. 2) Using the simulation mask for PET/CT greatly reduces the difference in head position when compared to its respective simulation scan. This allows for more robust registration. When possible, patients should have PET/CT performed using the immobilization mask created for simulation. However, as this is not always feasible, a standardized neck positioning protocol for both H&N simulation and PET/CT scans should be explored.

CLINICAL RELEVANCE/APPLICATION

We hypothesize that simulating patients with their RTP mask will 1) increase patient comfort 2) allow for a superior registration and 3) not significantly affect plan quality.

MSRO42-09 Inter-Scan Positional Variability of Head and Neck Soft Tissue on a Dedicated 1.5T MR Simulator with Open-Face Immobilization

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S103CD

Participants
Oi Lei Wong, PhD, Happy Valley, Hong Kong (Presenter) Nothing to Disclose
Gladys G. Lo, MD, Happy Valley, Hong Kong (Abstract Co-Author) Nothing to Disclose
Jing Yuan, PhD, Hong Kong, Hong Kong (Abstract Co-Author) Nothing to Disclose

PURPOSE

With the advancement in radiotherapy treatment delivery techniques, quality of soft-tissue delineation for RT planning becomes increasingly important. Owing to the superior soft tissue contrast in MR images, MR-sim is superior to CT-sim. In this study, the inter-scan positional repeatability on MR-sim is quantitatively evaluated based on the concordance index (CI) and centroid position.

METHOD AND MATERIALS

Four healthy volunteers were scanned (4 scans for each on different days) using a T2w CUBE sequence with identical coverage, voxel-size(0.8x0.8x1.0mm³) and receiver-bandwidth(62.5kHz) on a 1.5T MR-sim with open-face thermoplastic cast for immobilization. Image distortion was minimized using the system provided geometric correction function. VOIs of the parotid gland(PGs), intervertebral discs(C23,C67), brainstem(BS), pituitary gland(PIT) and eyeballs(EBs) were carefully drawn. For each volunteer, volume and centroid position of each VOI were calculated. CI and centroid shift of the delineated VOIs, all referencing to the first scan, were subsequently calculated.

RESULTS

The calculated CI (mean±SD) of C23, C67, PIT, EBL, EBR, PGL, PGR and BS were 0.13±0.04, 0.10±0.07, 0.25±0.13, 0.66±0.04, 0.68±0.03, 0.62±0.07, 0.66±0.06 and 0.72±0.08, respectively. For PGs, our CI was similar to the published CI for an interobserver study using CT-sim. The observed low CI in C23, C67 and PIT corresponded to the small intersection between the delineated VOI of different scan sessions. The mean 3D shift of C23, C67, PIT, EBL, EBR, PGL, PGR and BS were 3.73±1.41, 9.11±10.45, 3.69±1.17, 3.46±1.74, 3.64±1.11, 3.50±2.61, 4.30±4.18mm. Small CI and large 3D shift indicated a large positional variability in C67 since C67 was located at the posterior end of the cast. For BS, the large CI and large 3D shift were noted. Large CI corresponded to a large VOI intersection, which was affected by multiple factors such as positional variability, shape and size of the delineated VOI.

CONCLUSION

Except for C67, acceptable 3D shift was obtained for all VOIs (3.2-4.3mm) using MR-sim.

CLINICAL RELEVANCE/APPLICATION

Measurement of the inter-scan positional variability of MR-sim is important as it is related to the normal tissue sparing and hence the treatment outcome.
A Dual-Labeled Anti-CD 146 Monoclonal Antibody for PET/NIRF Detection of Liver Malignancies

**PURPOSE**
Due to hepatic clearance of the majority of contrast agents, molecular imaging of liver malignancies is challenging. However, overexpression of CD146 has been associated with aggressiveness and metastatic potential in liver cancer. Herein we develop a CD146-targeted probe for high contrast positron emission tomography (PET) and near-infrared fluorescence (NIRF) imaging of liver cancer.

**METHOD AND MATERIALS**
In vitro expression levels of CD146 were characterized in the liver cancer cell lines HepG2 (+) and Huh7 (-) via several in situ methods. YY146, an anti-CD146 monoclonal antibody, was conjugated to the NIRF dye ZW800-1 and to deferoxamine (Df) for radiolabeling with 89Zr. Sequential PET and NIRF imaging were performed after intravenous injection of 3.7 – 7.4 MBq of 89Zr-Df-YY146-ZW800 in athymic nude mice bearing HepG2 or Huh7 subcutaneous (s.c.) xenografts. Orthotopic tumors were generated by injection of luciferase-transfected HepG2 cells into the liver, allowing progression monitoring by bioluminescent imaging. Multimodality imaging was carried out in mice with confirmed orthotopic liver tumors as described for s.c. tumors. At 168 h p.i., tissues were collected for ex vivo NIRF imaging, biodistribution, and histological studies.

**RESULTS**
PET and NIRF imaging unveiled a prominent and persistent uptake of 89Zr-Df-YY146-ZW800 in HepG2 tumors that peaked at 31.7±7.2 %ID/g 72 h p.i. Owing to such marked accumulation, the detection of orthotopic HepG2 tumors was successful despite the relatively high liver background. CD146-negative Huh7 and CD146-blocked HepG2 tumors exhibited significantly lower 89Zr-Df-YY146-ZW800 accretion (6.1±0.5 and 8.1±1.0 %ID/g at 72 h p.i., respectively), demonstrating the CD146-specificity of the tracer in vivo. Ex vivo studies verified the accuracy of the imaging data and correlated 89Zr-Df-YY146-ZW800 uptake with in situ CD146 expression.

**CONCLUSION**
Overall, 89Zr-Df-YY146-ZW800 showed excellent properties as a PET/NIRF imaging agent, including high specificity for CD146-expressing liver cancer. Molecular imaging using dual-labeled YY146 had great potential for noninvasive detection and image-guided resection of liver malignancies.

**CLINICAL RELEVANCE/APPLICATION**
Liver malignancies are often difficult to distinguish from background tissue. Thus, we present a dual near-infrared- and radio-labeled antibody targeting CD146 for detection of these malignancies.
histologic confirmation. The aim of this study is to evaluate the additional value of Dual Tracer (DT) PET with 11C Acetate (Ac) and 18F FDG for detection and characterization of HCC.

METHOD AND MATERIALS

Consecutive patients who had histological confirmation of HCC and underwent CT/MR and DT in our centres from 2014-16 were identified. CE and PET uptake patterns were reviewed. Typical CE pattern on CT/MR was arterial hyperenhancement followed by portovenous/delayed phase washout. All other CE patterns were considered atypical. On PET, a lesion was deemed positive by visual inspection of lesion above background liver uptake on Ac and/or FDG. Results were compared with tumor size and grade on histology. Tumour size were separated into <3 cm, 3-5 cm and >5 cm groups as each has different treatment option. Grading was based on Edmondson and Steiner system. Pearson's Chi-Square tests were applied to compare the sensitivities and ANOVA-test for subgroup analysis.

RESULTS

Thirty-two HCC lesions from 24 patients were identified (mean size ± SD 34 ± 27 mm). The sensitivity of CT/MR by CE pattern was 53%, FDG alone 56%, Ac alone 94%, DT 97% and combined CT/MR with DT 100% (p<0.0001). Two lesions were non-Ac avid. Enhancement pattern were not affected by tumour size whereas FDG sensitivities increase with tumour size from 39% to 67% and 75% for lesions <3 cm, 3-5 cm and >5 cm respectively. Histological grade available in 30 lesions were well differentiated HCC (n=7), moderately-differentiated HCC (n=22) and poorly differentiated HCC (n=1). Atypical enhancement pattern was more common in well-differentiated compared to moderately-differentiated lesions (71% vs 45%). No trend was observed for tracer avidities in different grades of HCC.

CONCLUSION

DT combined with CT/MR increases the sensitivity of HCC detection compared to CT/MR alone, providing 100% sensitivity and hence, being most helpful in equivocal liver lesions with atypical contrast enhancement.

CLINICAL RELEVANCE/APPLICATION

The use of DT obviates tissue sampling for diagnosing HCC in patients with liver lesions with atypical CT/MR contrast enhancement.

SSK11-03 64Cu-Labeled Ipilimumab for Determination of CTLA-4 Levels in Lung Cancer

Wednesday, Nov. 30 10:50AM - 11:00AM Room: S504CD

Participants

Emily B. Ehlerding, Madison, WI (Presenter) Nothing to Disclose
Christopher England, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Stephen Graves, Madison, WI (Abstract Co-Author) Nothing to Disclose
Glenn Liu, Madison, WI (Abstract Co-Author) Nothing to Disclose
Robert J. Nickles, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Weibo Cai, PhD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE

CTLA-4 is expressed on the surface of activated T cells and some cancer cells, and is the target of the clinically-approved monoclonal antibody Ipilimumab. Ipilimumab is only successful in a small subset of patients, making neoadjuvant patient selection crucial. In this study, we employ radiolabeled 64Cu-DOTA-Ipilimumab to monitor CTLA-4 expression levels in subcutaneous (s.c.) lung cancer xenografts using positron emission tomography (PET).

METHOD AND MATERIALS

Ipilimumab was conjugated with the chelator 1,4,7,10-tetraazacyclododecane-1,4,7,10-tetraacetic acid (DOTA) for radiolabeling with 64Cu (T1/2 = 12.7 h). Western blot, ELISA, flow cytometry, and live cell imaging were employed to determine the CTLA-4 expression levels of three lung cancer cell lines: A549, H460, and H358. Longitudinal PET studies following intravenous injection of 64Cu-DOTA-Ipilimumab into mice bearing s.c. xenografts of the aforementioned lung cancer cells allowed for tracer uptake to be quantified up to 48 h p.i. Ex vivo biodistribution and histological studies were employed to verify PET results.

RESULTS

By in situ analysis, A549 was found to have the highest CTLA-4 expression level, and H358 the lowest. PET quantification verified these results, with A549 tumor uptake peaking at 13.1 ± 3.9 %ID/g, H460 at 10.5 ± 1.9 %ID/g, and H358 at 8.3 ± 1.3 %ID/g, 48 h p.i. A549-blocked mice also displayed decreased tracer uptake values at 8.1 ± 1.0 %ID/g. Ex vivo analysis following the terminal imaging timepoint also corroborated these findings.

CONCLUSION

Radiolabeled 64Cu-DOTA-Ipilimumab is able to differentiate tumors based on their CTLA-4 expression levels noninvasively using PET. Thus, this antibody holds promise to be employed in small doses prior to immunotherapy treatment to predict the success of such anti-CTLA-4 therapy and aid in patient selection.

CLINICAL RELEVANCE/APPLICATION

Anti-CTLA-4 immunotherapies are effective in a small subset of patients. Thus, we use 64Cu-DOTA-Ipilimumab to determine tumors which have high expression levels and may respond well to such therapy.

SSK11-04 Molecular Optical Imaging in Radiofrequency Heating-Enhanced Direct Intratumoral HSV-TK Gene Therapy of Cholangiocarcinoma

Wednesday, Nov. 30 11:00AM - 11:10AM Room: S504CD

Participants

Yin Jin, MD, Seattle, WA (Presenter) Nothing to Disclose
Feng Zhang, MD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
Jun Gao, MD, PhD, Seattle, WA (Abstract Co-Author) Nothing to Disclose
POURPOSE
To evaluate the feasibility of using molecular optical imaging to monitor radiofrequency heating (RFH)-enhanced herpes simplex virus thymidine kinase (HSV-TK)/ganciclovir (GCV) therapy of cholangiocarcinomas.

METHO AND MATERIALS
This study included in-vitro confirmation experiments with luciferase/mCherry-labelled human cholangiocarcinoma cells (Mz-Cha-1) and in-vivo validation experiments using mouse models with luciferase/mCherry-cholangiocarcinomas. Both in-vitro and in-vivo experiments were divided into four groups with treatments of: (i) combination therapy (green fluorescent protein (GFP)/HSV-TK/plasmid gene transfection plus RFH at 42°C, and followed by ganciclovir administration; (ii) gene therapy alone; (iii) RFH alone; and (iv) saline. GFP optical imaging was first performed to detect successful expression of GFP/HSV-TK genes, while bioluminescent optical imaging used to follow up tumor responses to various treatments among different groups, which were correlated with subsequent histologic confirmation.

RESULTS
Of in-vitro experiments, MTS assay demonstrated the lowest cell proliferation in combination therapy compared with three control groups (24.1±7.2% vs 41.6±4.9% vs 72.3±7.9% vs 100%, p<0.05). Of in-vivo experiments, GFP optical imaging detected greater green fluorescent signal from GFP/HSV-TK/plasmid-transfected tumors than non-gene transfected tumors (200.73±37.85 VS 52.80±17.36, p<0.05), which indicated successful expression of GFP/HSV-TK genes. Bioluminescent optical imaging demonstrated decreases of both bioluminescence signals and tumor sizes in combination therapy, compared to other control groups (0.68±0.11 vs 1.47±0.19 vs 2.01±0.33 vs 2.33±0.41, p<0.05), which were confirmed by histologic correlation (Figure).

CONCLUSION
We have established the "proof-of-principle" of using molecular optical imaging to monitor RFH-enhanced GFP/HSV-TK/plasmid gene expression and HSV-TK/GCV gene therapy of cholangiocarcinoma. This concept may pave a new avenue for management of pancreaticobiliary malignancies by simultaneous integration of molecular optical imaging, radiofrequency technology, interventional oncology, and direct intratumoral gene therapy.

CLINICAL RELEVANCE/APPLICATION
This concept may pave a new avenue for management of cholangiocarcinoma by simultaneous integration of molecular optical imaging, radiofrequency technology, interventional oncology, and gene therapy.

SSK11-05 89Zr-Labeled Pembrolizumab for Neoadjuvant Imaging and Human Dosimetry Estimation
Wednesday, Nov. 30 11:10AM - 11:20AM Room: S504CD

Participants
Emily B. Ehlerding, Madison, WI (Presenter) Nothing to Disclose
Christopher England, PhD, Madison, WI (Abstract Co-Author) Nothing to Disclose
Reiner Hernandez, MSc, Madison, WI (Abstract Co-Author) Nothing to Disclose
Stephen Graves, Madison, WI (Abstract Co-Author) Nothing to Disclose
Todd Barnhart, Madison, WI (Abstract Co-Author) Nothing to Disclose
Weibo Cai, PhD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

POURPOSE
Pembrolizumab is a clinically-available humanized monoclonal antibody that targets programmed cell death protein (PD-1) on the surface of activated T and B cells. In order to potentially identify patients who would benefit from such therapy, herein we evaluate the pharmacokinetics, biodistribution, and dosimetry of 89Zr-labeled pembrolizumab in vivo using positron emission tomography (PET).

METHO AND MATERIALS
Pembrolizumab was conjugated with the chelator desferrioxamine (Df) for radiolabeling with 89Zr (t1/2 = 3.3 days). Whole-body tracking of the radiolabeled antibody was compared in two murine models, including NSG and PBL mice (NSG mice reconstituted with human peripheral blood mononuclear cells). Mice were injected with 5-10 MBq of radiolabeled antibody. Timepoints from 0.5 h to 168 h p.i. were utilized in the PET study to fully capture the pharmacokinetics of Pembrolizumab. Biodistribution data obtained from PET scans were extrapolated to predict radiation dose estimates in humans.

RESULTS
In all groups, 89Zr-Df-Pembrolizumab stayed in circulation throughout the study and accumulated greatest in liver and spleen. Notable biodistribution differences between PBL and NSG mice included significant uptake in salivary glands in PBL mice, indicating the specificity of Pembrolizumab for human T-cells, which localize here following an autoimmune response. Peak uptake values for the liver of 14.40 ± 1.55 %ID/g for PBL and 12.93 ± 1.96 %ID/g for NSG mice, and for the spleen of 7.33 ± 1.53 %ID/g for PBL and 5.48 ± 0.71 %ID/g for NSG were found 0.5 h p.i. with values steadily declining thereafter. Even with relatively high uptake in these clearance organs, the estimated doses remained well within safe limits, with a total body effective dose of 0.515 ± 0.005 mGy/MBq calculated.

CONCLUSION
The low total body and major organ doses found in this study indicate the potential use of 89Zr-Df-Pembrolizumab for the clinic selection of patients that may benefit from anti-PD-1 therapy. The techniques in this study may be further applied to other antibodies for better understanding of the pharmacokinetics, biodistribution, and dosimetry for future clinical applications.

CLINICAL RELEVANCE/APPLICATION
Herein we evaluate a radiolabeled, clinically-approved antibody, 89Zr-Df-Pembrolizumab, targeting PD-1, that could potentially screen for patients who would respond to such anti-PD-1 immunotherapy.
**Enhanced Sensitivity and Specificity**

*Wednesday, Nov. 30 11:20AM - 11:30AM Room: S504CD*

**Participants**
- Kartik M. Sundaram, MD, PhD, Nashville, TN (Presenter) Nothing to Disclose
- Brian B. Roman, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
- Joseph A. Piccirilli, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose
- Ernst Lengyel, MD, PhD, Chicago, IL (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
To develop a highly sensitive, specific, and clinically amenable molecular imaging agent for ovarian cancer diagnosis that enables (i) detection of tumors when they are still small, confined to the pelvis, and curable and (ii) differentiation between benign and malignant ovarian tumors.

**METHOD AND MATERIALS**
We used tissue microarray analysis to identify the prolactin receptor (PRLR) as a high specificity biomarker for malignant OvCa. We conjugated gadolinium-chelates and near-infrared fluorescence imaging probes to human placental lactogen (hPL), a specific and high affinity PRLR ligand, and evaluated internalization by PRLR (+) and PRLR (-) ovarian cancer cells. We further evaluated that capacity of hPL-conjugates and reduced binding hPL analog conjugates to imaging mouse xenografts of human ovarian cancer by magnetic resonance imaging and near-infrared fluorescence imaging.

**RESULTS**
Our results indicate that > 98% of OvCas over-express PRLR regardless of stage, grade, and type. Furthermore, we show both hPL-gadolinium conjugates and hPL-near-infrared probes conjugates internalize specifically and efficiently into PRLR (+) cancer cells in OvCa mouse models. This enables detection of xenograft PRLR (+) tumors in mice with substantially greater specificity and sensitivity than currently used clinical contrast agents.

**CONCLUSION**
Using prolactin receptor-mediated internalization, hPL-conjugates demonstrate the specificity to distinguish PRLR (+) from PRLR (-) tumors in mouse models of ovarian cancer. Given that > 98% of OvCas over-express PRLR, we believe our ability to image PRLR will enhance specificity and sensitivity of ovarian cancer diagnosis.

**CLINICAL RELEVANCE/APPLICATION**
Given the difficulties of currently used methods for ovarian cancer diagnosis, we believe molecular PRLR imaging using hPL-conjugates will engender a new paradigm for targeted molecular imaging of OvCa. Coupled with magnetic resonance imaging, molecular PRLR imaging holds the potential to achieve a more precise and earlier diagnosis of OvCa, thereby reducing the number of unnecessary surgeries and increasing patient survival.

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**Designed Multifunctional Gold Nanocomposites for Targeted Tri-Mode CT/MR/Optical Imaging of Human Non-Small Cell Lung Cancer Cells**

*Wednesday, Nov. 30 11:30AM - 11:40AM Room: S504CD*

**Participants**
- Jingwen Chen, Shanghai, China (Presenter) Nothing to Disclose
- Qian Chen, Shanghai, China (Abstract Co-Author) Nothing to Disclose
- Gui-Xiang Zhang, MD, Shanghai, China (Abstract Co-Author) Nothing to Disclose
- Xiang-Yang Shi, Shanghai, China (Abstract Co-Author) Nothing to Disclose
- Han Wang, MD, PhD, Shanghai, China (Abstract Co-Author) Nothing to Disclose

**PURPOSE**
The high incidence and mortality rate of non-small cell lung cancer (NSCLC) prompts exhaustive efforts to develop new effective methods for its diagnosis at the early-stage to improve the survival rate. We are developing multifunctional gold nanocomposites to use as the nanoprobes for targeted tri-mode CT/MR/optical imaging of human non-small cell cancer cells both in vitro and in vivo.

**METHOD AND MATERIALS**
Amine-terminated generation 5 poly(amidoamine) dendrimers were used as a nanoplatform to be covalently modified with Gd chelator, Cy5.5, and FA. Then the multifunctional dendrimers were used as templates to entrap gold nanoparticles, followed by chelating Gd(III) ions and acetylation of the remaining dendrimer terminal amines. The thus-formed multifunctional Au DENPs (in short, Cy5.5-Gd-Au DENPs-FA) were characterized via different techniques, and then were used for both in vitro and in vivo targeted CT/MR/NIR optical tri-mode imaging of human NSCLC cells (NCI-H460 cells) and the xenograft tumor model.

**RESULTS**
CT/MR/optical images show that NCI-H460 cells can be detected after incubation with the Cy5.5-Gd-Au DENPs-FA in vitro and the xenograft tumor model can be imaged after intravenous administration of the particles. Combine the inductively coupled plasma-atomic emission spectroscopy (ICP-AES) measurements with the transmission electron microscopy (TEM) data confirm that the Cy5.5-Gd-Au DENPs-FA is able to be uptaken by the treated cells. MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay show that the Cy5.5-Gd-Au DENPs-FA has a good biocompatibility at the given concentration range.

**CONCLUSION**
The findings of this study suggest that the developed Cy5.5-Gd-Au DENPs-FA may be used as a promising tri-mode nanoprobe for targeted CT/MR/optic imaging of human NSCLC and other folate receptor (FR) over-expressing cancers.

**CLINICAL RELEVANCE/APPLICATION**

In consideration of the special structural characteristic, the dendrimer based nanocomposites may be further modified with therapeutic antibodies or small interfering RNA (siRNA) to be expectably developed for the personalized theranostics of cancers at early-stage with the high accuracy and sensitivity.

SSK11-09  Differential Uptake of CD146-Specific Antibody in Solid Lung Malignancies

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S504CD

Participants
Christopher England, PhD, Madison, WI (Presenter) Nothing to Disclose
Haify Sun, Da Lian, China (Abstract Co-Author) Nothing to Disclose
Ralph Cesar, Madison, WI (Abstract Co-Author) Nothing to Disclose
Weibo Cai, PhD, Palo Alto, CA (Abstract Co-Author) Nothing to Disclose

PURPOSE
Recent studies have revealed that a cell surface protein called CD146 is a marker of epithelial-to-mesenchymal transition (EMT) in cancer cells whose overexpression has also been found to correlate with cancer progression, invasion, and metastasis. Additionally, CD146 has low background levels in normal tissue as well as differential expression in metastases and advanced primary tumors, showing its significant potential in cancer therapies. This study evaluates the utilization of YY146, an anti-CD146 monoclonal antibody, for molecular imaging of solid lung malignancies.

METHOD AND MATERIALS
The anti-CD146 antibody (YY146) was conjugated to 1,4,7-triazacyclononane-triacetic acid (NOTA) and radiolabeled with 64Cu. CD146 expression was evaluated in six human lung cancer cell lines (A549, NCI-H358, NCI-H522, HCC4006, H23, and NCI-H460) by flow cytometry and quantitative Western blot studies. The biodistribution and tumor uptake of 64Cu-NOTA-YY146 was assessed by sequential PET imaging in athymic nude mice bearing subcutaneous lung cancer xenografts. The correlation between CD146 expression and tumor uptake of 64Cu-NOTA-YY146 was evaluated by graphical software while ex vivo biodistribution and immunohistochemistry studies were performed to validate the accuracy of PET data and spatial expression of CD146.

RESULTS
Flow cytometry and Western blot studies showed similar findings with H460 and H23 cells highly expressing CD146. Small differences in CD146 expression levels were found between A549, H4006, H522, and H358 cells. Tumor uptake of 64Cu-NOTA-YY146 was highest in CD146-expressing H460 and H23 tumors, peaking at 20.1 ± 2.86 and 11.6 ± 2.34 %ID/g at 48 h post-injection (n=4). Tumor uptake was lowest in the H522 model (4.1 ± 0.98 %ID/g at 48 h post-injection; n=4), while H4006, A549 and H358 exhibited similar uptake of 64Cu-NOTA-YY146. A positive correlation was found between tumor uptake of 64Cu-NOTA-YY146 (%ID/g) and relative CD146 expression (r²=0.98, p<0.01). Ex vivo biodistribution corroborated the accuracy of PET data.

CONCLUSION
The strong correlation between tumor uptake of 64Cu-NOTA-YY146 and CD146 expression demonstrates the potential use of this radiotracer for imaging tumors that elicit varying levels of CD146.

CLINICAL RELEVANCE/APPLICATION
This imaging tracer may promote enhanced monitoring of therapeutic response and improved patient stratification.

SSK11-09  Smartphone based Diagnostics (D3) Enable Molecular Characterization of Lymphoma in Resource-limited Countries

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S504CD

Awards
Student Travel Stipend Award

Participants
Aoife Kilcoyne, MBCh, Boston, MA (Presenter) Nothing to Disclose
Divya Pathania, Boston, MA (Abstract Co-Author) Nothing to Disclose
Hyungsun Im, Boston, MA (Abstract Co-Author) Nothing to Disclose
Cesar Castro, Boston, MA (Abstract Co-Author) Nothing to Disclose
Ralph Weissleder, MD, PhD, Boston, MA (Abstract Co-Author) Investor, T2 Biosystems, Inc

PURPOSE
A major hurdle in cancer therapy is its timely diagnosis and treatment. This is of particular concern in resource-limited settings. For example, aggressive forms of non-Hodgkins lymphoma are major health concerns in sub-Saharan Africa. A substantial number of cases evade comprehensive evaluation and are not appropriately classified due to the lack of proper tissue specimens, diagnostic reagents and specialists. Although a good proportion of cases are curable even in low and middle income countries, windows of therapeutic opportunity are often missed due to delay in diagnosis. This necessitates the need for a low-cost, rapid and accurate detection technology to expedite the diagnosis of aggressive lymphomas (and other prevalent cancers) in the resource-limited environment.

METHOD AND MATERIALS
We have developed a digital diffraction diagnostic (D3) platform that allows modern smartphones to be used for molecular cancer diagnostics of scant clinical samples (fine needle aspirates). Fine Needle Aspirate (FNA) samples are immunolabeled with microbeads in a microfluidic module and then holographically detected by the smartphone camera.

RESULTS
Diffraction patterns generated by the antibody-microbeads were detected with the smartphone camera using bright-field settings.
Digital signal processing was used to reconstruct images to count bead-bound cells. We optimized the assay so that thousands of cells could be analyzed without washing steps in near real-time. The D3 profiling results on lymphoma cell lines demonstrated excellent agreement with those by flow cytometry (gold standard). We further analyzed scant clinical samples (FNAs) from 8 patients. The D3 assay generated readouts within an hour and demonstrated agreement (100%) with standard pathology.

CONCLUSION

The D3 approach of molecular analysis could have far reaching applications. The major advantages are the simplicity of the method, the accuracy and it's ability to be used in resource-limited settings.

CLINICAL RELEVANCE/APPLICATION

Leveraging smartphones as a mobile diagnostic terminal could empower resource-poor communities with complex laboratory tests. This work addresses the practical diagnostic needs of low and middle income countries and reflects the type of technologies that may gain sustainable traction in such settings.
PURPOSE

The standard of care for patients with unresectable stage III non-small cell lung cancer (NSCLC) is definitive radiation with concurrent chemotherapy. For these patients, consolidation chemotherapy is frequently given, although several randomized trials have failed to show a benefit. We explored the association of consolidation chemotherapy with outcomes using a population-based comparative effectiveness approach.

METHOD AND MATERIALS

Surveillance, Epidemiology, and End Results (SEER)-Medicare was used to identify patients aged ≥65, diagnosed 2002-2009, and treated with definitive radiation. We identified the various platinum-based doublet chemotherapy agents used. Chemoradiotherapy regimens were given as either sequential, concurrent only, concurrent with induction, or concurrent with consolidation. Outcomes were overall survival (OS) and cancer specific survival (CSS). Survival was estimated using the Kaplan-Meier method, with comparisons being made using log-rank tests, Cox proportional hazards models, and Royston-Parmar flexible parametric models.

RESULTS

2,006 patients were identified. Median OS was 18 months, with 1- and 2-year survival estimates of 68% (66-70%) and 39% (37-41%). The majority of patients (97%) received carboplatin-paclitaxel/docetaxel/gemcitabine/etoposide or cisplatin-etoposide. The use of consolidation chemotherapy was associated with improved OS and CSS compared to concurrent chemotherapy alone, with a multivariate adjusted OS HR of 0.82 (p = 0.0098) and CSS HR of 0.82 (p = 0.03). Propensity score adjusted analyses demonstrated similar results. In subset analyses, the benefit of consolidation chemotherapy was found only for patients treated with carboplatin-based doublets and not with cisplatin-etoposide.

CONCLUSION

For elderly patients in the US with NSCLC being treated with definitive concurrent chemoradiation, we found that patients receiving cisplatin during radiation do not appear to benefit from additional chemotherapy. However, for patients receiving carboplatin, consolidation chemotherapy appears to result in improved survival.

CLINICAL RELEVANCE/APPLICATION

For elderly patients with stage III non-small cell lung cancer treated with concurrent chemotherapy and radiation, additional consolidation chemotherapy should be given when carboplatin is used.
ABSTRACT
Purpose/Objective(s): During external beam radiation therapy (EBRT) of lung cancer, cone beam computed tomography (CBCT) is routinely performed for image guidance. This study was conducted in order to determine the prognostic potential of CBCT for evaluating treatment outcome in terms of GTV reduction and to determine the difference of tumor reduction based on different histology. Materials/Methods: Forty-one NSCLC patients treated with definitive radiotherapy at one institution who received daily CBCT were randomly selected. Patients received mean EBRT of 60.7 Gy (range: 50.7-71.4 Gy) at 1.8 or 2 Gy per fraction. Initial mean gross tumor volume (GTV) was 197.3 cc (range: 3.4-1815.0 cc). Six sets of CBCT at an interval of one week were chosen, starting from the first fraction of treatment. The CBCTs were transferred to MIM Software (v.6.0) and single physician manually contoured the GTV on each slice. The change in GTV was recorded. Patient's clinical information was obtained from the institution electronic medical record. All statistical analysis was conducted on MedCalc (v.16.2). Univariate survival analysis was done using the Kaplan-Meier method with log-rank test. Median overall GTV reduction was used as a cutoff value (DGTVDGTV=45%). A univariate regression analysis was done to explore the correlation between histology and GTV reduction. A p

RESULTS
Fifty patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT were included. The MPM subtypes on histology included: 41 epithelioid (82%), 2 sarcomatoid (4%), and 7 biphasic (14%). 25 patients (50%) had residual disease after surgery on the baseline CT prior to IMRT. 39 patients (78%) had recurrent disease on CT: 21 local, 13 distant and 5 local and distant. Of the 26 patients with local recurrence, the most common CT appearance of pleural recurrence were new/ increased focal mass or pleural thickening, nodular pleural thickening or multiple new pleural nodules. In the 25 patients without local recurrence, the most common appearance included stable or decreased pleural thickening or new/increased diffuse smooth pleural thickening. In the 18 patients with distal recurrence, the most common sites were in the lung parenchyma or peritoneum.

CONCLUSION
In patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT local recurrence presented as new/increased focal pleural mass/thickening, diffuse nodular pleural thickening, or multiple pleural nodules. The most common sites for distant recurrence were lung parenchyma and peritoneum.

CLINICAL RELEVANCE/APPLICATION
Familiarity with the patterns of recurrence on CT in patients with MPM treated with IMRT is important in the follow up of these patients.

SSK18-05 Prognostic Value of Pretreatment PET Parameters in Stereotactic Ablative Radiotherapy (SABR) for Metastatic Non-Small Cell Lung Cancer

Awards
Trainee Research Prize - Resident

Participants
Alexander L. Chin, MD, MBA, Stanford, CA (Presenter) Nothing to Disclose
Kiran A. Kumar, Chicago, IL (Abstract Co-Author) Nothing to Disclose
Henry Guo, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Peter G. Maxim, PhD, Stanford, CA (Abstract Co-Author) Nothing to Disclose
Maximilian Dehn, MD, PhD, San Carlos, CA (Abstract Co-Author) Consultant, F. Hoffmann-La Roche Ltd; Consultant, Quanticel Pharmaceuticals Inc; Research Grant, Varian Medical Systems, Inc

PURPOSE
The purpose of this study is to assess patterns of recurrence in patients with malignant pleural mesothelioma (MPM) treated with hemithoracic pleural intensity-modulated radiation therapy (IMRT) after lung-sparing pleurectomy/decortication.

METHOD AND MATERIALS
The institutional review board approved this study. Consecutive patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT between February 21, 2005 and December 1, 2015 were included. Only patients who had chest CTs pre and post IMRT were included and imaging was retrospectively reviewed by two radiologists in consensus. Features assessed included: presence or development of single or multiple pleural or parenchymal nodules or consolidation, focal or diffuse pleural thickening, pleural effusion, chest wall mass or peritoneal disease.

RESULTS
Fifty patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT were included. The MPM subtypes on histology included: 41 epithelioid (82%), 2 sarcomatoid (4%), and 7 biphasic (14%). 25 patients (50%) had residual disease after surgery on the baseline CT prior to IMRT. 39 patients (78%) had recurrent disease on CT: 21 local, 13 distant and 5 local and distant. Of the 26 patients with local recurrence, the most common CT appearance of pleural recurrence were new/ increased focal mass or pleural thickening, nodular pleural thickening or multiple new pleural nodules. In the 25 patients without local recurrence, the most common appearance included stable or decreased pleural thickening or new/increased diffuse smooth pleural thickening. In the 18 patients with distal recurrence, the most common sites were in the lung parenchyma or peritoneum.

CONCLUSION
In patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT local recurrence presented as new/increased focal pleural mass/thickening, diffuse nodular pleural thickening, or multiple pleural nodules. The most common sites for distant recurrence were lung parenchyma and peritoneum.

CLINICAL RELEVANCE/APPLICATION
Familiarity with the patterns of recurrence on CT in patients with MPM treated with IMRT is important in the follow up of these patients.

SSK18-03 Prognostic Potential of CBCT for Tracking Tumor Regression in Stage II-III Non-Small Cell Lung Cancer

Awards
Student Travel Stipend Award

Participants
Kylie Kang, BS, Cleveland, OH (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): During external beam radiation therapy (EBRT) of lung cancer, cone beam computed tomography (CBCT) is routinely performed for image guidance. This study was conducted in order to determine the prognostic potential of CBCT for evaluating treatment outcome in terms of GTV reduction and to determine the difference of tumor reduction based on different histology. Materials/Methods: Forty-one NSCLC patients treated with definitive radiotherapy at one institution who received daily CBCT were randomly selected. Patients received mean EBRT of 60.7 Gy (range: 50-71.4 Gy) at 1.8 or 2 Gy per fraction. Initial mean gross tumor volume (GTV) was 197.3 cc (range: 3.4-1815.0 cc). Six sets of CBCT at an interval of one week were chosen, starting from the first fraction of treatment. The CBCTs were transferred to MIM Software (v.6.0) and single physician manually contoured the GTV on each slice. The change in GTV was recorded. Patient's clinical information was obtained from the institution electronic medical record. All statistical analysis was conducted on MedCalc (v.16.2). Univariate survival analysis was done using the Kaplan-Meier method with log-rank test. Median overall GTV reduction was used as a cutoff value (DGTVDGTV=45%). A univariate regression analysis was done to explore the correlation between histology and GTV reduction. A p

RESULTS
Fifty patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT were included. The MPM subtypes on histology included: 41 epithelioid (82%), 2 sarcomatoid (4%), and 7 biphasic (14%). 25 patients (50%) had residual disease after surgery on the baseline CT prior to IMRT. 39 patients (78%) had recurrent disease on CT: 21 local, 13 distant and 5 local and distant. Of the 26 patients with local recurrence, the most common CT appearance of pleural recurrence were new/ increased focal mass or pleural thickening, nodular pleural thickening or multiple new pleural nodules. In the 25 patients without local recurrence, the most common appearance included stable or decreased pleural thickening or new/increased diffuse smooth pleural thickening. In the 18 patients with distal recurrence, the most common sites were in the lung parenchyma or peritoneum.

CONCLUSION
In patients with MPM treated with lung-sparing pleurectomy/decortication and IMRT local recurrence presented as new/increased focal pleural mass/thickening, diffuse nodular pleural thickening, or multiple pleural nodules. The most common sites for distant recurrence were lung parenchyma and peritoneum.

CLINICAL RELEVANCE/APPLICATION
Familiarity with the patterns of recurrence on CT in patients with MPM treated with IMRT is important in the follow up of these patients.
Purpose/Objective(s): In stereotactic body radiotherapy (SBRT) for stage I non-small cell lung cancer (NSCLC), it was found that the outcomes of stage IB patients were worse than those of stage IA patients when treated with the same dose. We have performed SBRT since 2004 using different prescribed doses depending on tumor size. The clinical outcomes treated with our protocol are hereinafter reported. In addition, radiation doses were re-evaluated by the algorithm comparable to the superposition method.

Materials/Methods: Between February 2004 and November 2008, 124 patients with stage I NSCLC underwent SBRT; 87 had stage IA and 37 had stage IB disease. Total doses of 44, 48, and 52 Gy were administered to the isocenter for tumors with a longest diameter of 3 cm, respectively. All doses were delivered in 4 fractions twice a week. Pencil beam convolution with Batho method was a significant difference in RP incidence. In the revised protocol, dose was prescribed at the PTV D95 using superposition-AAA plans both in the isocenter dose and the PTV D95.

Conclusion: In our protocol, there were no significant differences between PBC-BPL plans and AAA plans both in the isocenter dose and the PTV D95.

SSK18-06 Long-term Outcomes of Stereotactic Body Radiotherapy for Stage I Non-small Cell Lung Cancer using Different Doses Depending on Tumor Size: Re-evaluation by Superposition-Comparable Dose Calculation Algorithms

Wednesday, Nov. 30 11:20AM - 11:30AM Room: S104A

Participants
Fumiya Baba, MD, Nagoya, Japan (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): In stereotactic body radiotherapy (SBRT) for stage I non-small cell lung cancer (NSCLC), it was found that the outcomes of stage IB patients were worse than those of stage IA patients when treated with the same dose. We have performed SBRT since 2004 using different prescribed doses depending on tumor size. The clinical outcomes treated with our protocol are hereinafter reported. In addition, radiation doses were re-evaluated by the algorithm comparable to the superposition method. Materials/Methods: Between February 2004 and November 2008, 124 patients with stage I NSCLC underwent SBRT; 87 had stage IA and 37 had stage IB disease. Total doses of 44, 48, and 52 Gy were administered to the isocenter for tumors with a longest diameter of 3 cm, respectively. All doses were delivered in 4 fractions twice a week. Pencil beam convolution with Batho power law correction (PBC-BPL) was used as the dose calculation algorithm. These plans were recalculated by anisotropic analytical algorithm (AAA) with the same monitor units. Results: The median follow-up period for living patients was 69 months (range: 24 to 124). For all 124 patients, overall survival (OS) was 55%, cause-specific survival (CSS) was 75%, progression-free survival (PFS) was 61%, and local control (LC) was 80%, at 5 years. The 5-year OS was 58% for stage IA patients treated with 48 Gy and 49% for 37 stage IB patients treated with 52 Gy (p = 0.16). At 5 years, CSS was 76% versus 73% (p = 0.45), PFS was 60% versus 56% (p = 0.31), and LC was 83% versus 73% (p = 0.21). At 5 years, the cumulative incidence of grade 2 or 3 radiation pneumonitis (RP) was 15% for all patients; it was 9% in stage IA patients and 29% in stage IB patients (p = 0.0086). Median doses to the isocenter recalculated using AAA were 47.58 Gy (range: 42.70-48.59) in 48 Gy prescription, and 51.54 Gy (range: 49.28-52.34) in 52 Gy prescription. Median PTV D95 doses of PBC-BPL plans were 45.79 Gy (range: 38.64-47.28) in 48 Gy prescription, and 49.35 Gy (range: 41.76-50.39) in 52 Gy prescription. Median recalculated PTV D95 doses of AAA plans were 42.00 Gy (range: 34.03-44.99), and 46.16 Gy (range: 40.64-48.71) in the two prescriptions, respectively. There were significant differences between PBC-BPL plans and AAA plans both in the isocenter dose and the PTV D95. Conclusion: In our protocol, there were no significant differences in OS, CSS, PFS and LC between stage IA and IB tumors despite the difference in tumor size. On the other hand, there was a significant difference in RP incidence. In the revised protocol, dose was prescribed at the PTV D95 using superposition-comparable dose calculation algorithms, taking these results into account.

ABSTRACT
Purpose/Objective(s): In stereotactic body radiotherapy (SBRT) for stage I non-small cell lung cancer (NSCLC), it was found that the outcomes of stage IB patients were worse than those of stage IA patients when treated with the same dose. We have performed SBRT since 2004 using different prescribed doses depending on tumor size. The clinical outcomes treated with our protocol are hereinafter reported. In addition, radiation doses were re-evaluated by the algorithm comparable to the superposition method. Materials/Methods: Between February 2004 and November 2008, 124 patients with stage I NSCLC underwent SBRT; 87 had stage IA and 37 had stage IB disease. Total doses of 44, 48, and 52 Gy were administered to the isocenter for tumors with a longest diameter of 3 cm, respectively. All doses were delivered in 4 fractions twice a week. Pencil beam convolution with Batho power law correction (PBC-BPL) was used as the dose calculation algorithm. These plans were recalculated by anisotropic analytical algorithm (AAA) with the same monitor units. Results: The median follow-up period for living patients was 69 months (range: 24 to 124). For all 124 patients, overall survival (OS) was 55%, cause-specific survival (CSS) was 75%, progression-free survival (PFS) was 61%, and local control (LC) was 80%, at 5 years. The 5-year OS was 58% for stage IA patients treated with 48 Gy and 49% for 37 stage IB patients treated with 52 Gy (p = 0.16). At 5 years, CSS was 76% versus 73% (p = 0.45), PFS was 60% versus 56% (p = 0.31), and LC was 83% versus 73% (p = 0.21). At 5 years, the cumulative incidence of grade 2 or 3 radiation pneumonitis (RP) was 15% for all patients; it was 9% in stage IA patients and 29% in stage IB patients (p = 0.0086). Median doses to the isocenter recalculated using AAA were 47.58 Gy (range: 42.70-48.59) in 48 Gy prescription, and 51.54 Gy (range: 49.28-52.34) in 52 Gy prescription. Median PTV D95 doses of PBC-BPL plans were 45.79 Gy (range: 38.64-47.28) in 48 Gy prescription, and 49.35 Gy (range: 41.76-50.39) in 52 Gy prescription. Median recalculated PTV D95 doses of AAA plans were 42.00 Gy (range: 34.03-44.99), and 46.16 Gy (range: 40.64-48.71) in the two prescriptions, respectively. There were significant differences between PBC-BPL plans and AAA plans both in the isocenter dose and the PTV D95. Conclusion: In our protocol, there were no significant differences in OS, CSS, PFS and LC between stage IA and IB tumors despite the difference in tumor size. On the other hand, there was a significant difference in RP incidence. In the revised protocol, dose was prescribed at the PTV D95 using superposition-comparable dose calculation algorithms, taking these results into account.

SSK18-07 Image-Guided Hypofractionated Proton Therapy in the Management of Centrally Located Early Stage NSCLC

Wednesday, Nov. 30 11:30AM - 11:40AM Room: S104A

Participants
Bradford Hoppe, MD, Jacksonville, FL (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Stereotactic body radiotherapy (SBRT) has proven to be an excellent way to manage patients with small and peripheral early-stage non-small cell lung cancer (NSCLC). Unfortunately, concern exists regarding the management of early-stage centrally located NSCLC with SBRT because of reports of toxicity. We investigated outcomes from delivering hypofractionated proton therapy (PT) among patients with centrally located stage I NSCLC. Materials/Methods: From 2009 through 2015, 16 patients were treated for medically inoperable centrally located de novo (n = 12) or relapsed (n = 4) stage I NSCLC (IA, n = 5; IB, n = 11) with image-guided hypofractionated PT on an IRB-approved outcomes tracking protocol (median age, 69 years). Centrally located tumors were those within 2 cm of the proximal bronchial tree or heart. Patients underwent 4D CT simulation following fiducial marker placement and an IGTV was contoured per the 10 phases of the scan (median, 15.5 cc; range, 6-56 cc). Initially, a 5-mm margin was added to make an ITV but was eliminated in 2014, followed by a 5-mm margin for the PTV (median, 78.5 cc; range, 32-211 cc). Daily image-guidance was done using fiducial markers and double exposure of orthogonal kv imaging at the peaks of inspiration and expiration. Patients were all treated with 60 Gy (RBE) (6 Gy (RBE)/fraction x 10 fractions) utilizing pre-defined dose
constraints. Patients were evaluated by a physician and assessed for CTCAE v4 toxicities weekly during treatment, at 1 month after treatment, then every 3 months for 2 years, and then every 6 months until 5 years with a CT or PET/CT. Overall survival, progression-free survival, local control, regional control, and control of distant metastases were evaluated using the Kaplan-Meier method. Results: Median follow-up for the cohort was 44 months (range, 4–67). The 3-year progression-free survival and overall survival rates were 41% and 84%. The median progression-free and overall survival were 28 and 60 months. The 3-year local (ipsilateral lobe), regional, and distant control rates were 89%, 77%, and 74%. Four patients died with disease and 1 from complications of pneumonia 52 months after treatment. Seven patients developed a recurrence, including 5 distant, 3 regional, and 1 in the ipsilateral lobe at the edge of the treatment field. Five received salvage radiation for the recurrences using either SBRT ($n=2$) or standard fractionated proton therapy +/- chemo ($n=3$). Three have had no evidence of disease for >1.5 years. Within 6 months of treatment 6 patients (38%) experienced respiratory symptoms (cough, fatigue, shortness of breath) that resolved with antibiotics and/or a short course of steroids. One grade 3 toxicity occurred in a patient who developed a bronchial stenosis (PTV, 211cc) requiring hospitalization and stent. Conclusion: Image-guided hypofractionated PT for centrally located stage I NSCLC provides promising local control and long-term survival with acceptable toxicity. Regional nodes and distant relapses remain a problem.

SSK18-08 The First Report to Evaluate Clinical Outcome of Dynamic Tumor-Tracking Stereotactic Body Radiotherapy for Early Stage Lung Cancer and Oligometastatic Lung Tumors Using a Gimbal-Mounted Linear Accelerator

Wednesday, Nov. 30 11:40AM - 11:50AM Room: S104A

Participants
Takamasa Mitsuyoshi, Kyoto, Japan (Presenter) Nothing to Disclose
Yukinori Matsuo, MD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Mitsuhito Nakamura, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Kenji Takashima, MD, Kobe, Japan (Abstract Co-Author) Nothing to Disclose
Masaki Kokubo, MD, Kobe, Japan (Abstract Co-Author) Research Consultant, Mitsubishi Corporation
Takashi Mizowaki, MD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose
Masahiro Hirooka, MD, PhD, Kyoto, Japan (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Recently, stereotactic body radiotherapy (SBRT) has developed as a new treatment modality for early stage lung cancer or oligometastatic lung tumor. When a lung tumor is treated with SBRT, the whole trajectory of a moving tumor is included in the irradiation field. It means healthy tissues are irradiated and leads to increase risks of toxicities. So, we hypothesized that dynamic tumor-tracking (DTT) SBRT using a gimbal-mounted linear accelerator could reduce irradiated volumes of healthy tissues and risks of toxicities without reducing tumor local control (LC) rate. This is the first reported study to evaluate clinical outcomes of DTT-SBRT using a gimbal-mounted linear accelerator.

Materials/Methods: Eligibility criteria were as follows: (1) a single lung tumor with a diameter of 50 mm or less, (2) no metastasis, (3) respiratory tumor movement of 10 mm or more, (4) age of 20 years or above, (5) performance status (PS) of 0-2. Prior to the treatment, gold markers were placed under bronchoscopic guidance around the tumors as an internal surrogate for the tumor position. The tumors and markers were monitored with the kV imagers during irradiation in real-time. Out of 47 patients whom markers had been injected in, 29 patients (62%) were treated by DTT-SBRT successfully between September 2011 and April 2015 in Kyoto University Hospital or Institute of Biomedical Research and Innovation and had been enrolled in this study. The dose fraction schedule was 48 Gy/4 fr for clinical stage IA lung cancer, and 56Gy GY/4 fr for clinical stage IB lung cancer and oligometastatic lung tumors. The prescribed dose was defined at the isocenter. The median age of the patients was 66 years (range, 52-88); male/female: 22/7; PS 0/1/2: 9/16/4; primary lung cancer/oligometastatic lung tumor: 24/5; clinical stage T1a/T1b/T2a: 12/8/4 (UICC-7). Toxicity grading was scored using the Common Terminology Criteria for Adverse Events v.4.0. The survival rates were calculated using the Kaplan-Meier methods. Results: The median follow-up time was 23.4 months (range, 0.2-49.2). The 2-year overall survival (OS), progression free survival (PFS) and LC rate was 72%, 58% and 87%, respectively. Local recurrence developed in 4 patients and distant metastasis developed in 5 patients. At the time of analysis, 21 patients were alive and 8 patients had died. Out of living patients, 4 patients had recurrence. Out of dead patients, 4 patients died from progressive disease. Univariate analysis (log-rank test) could not help to identify the factor for worse OS or PFS. Grade 2 or worse toxicities were occurred in 2 patients (6.9%). One had Grade 2 radiation pneumonitis and the other had Grade 3 radiation pneumonitis. Conclusion: DTT-SBRT using a gimbal-mounted linear for patients with early stage lung cancer and oligometastatic lung tumors resulted in good LC with acceptable toxicities.

SSK18-09 Stereotactic Ablative Body Radiation (SABR) for Stage I Lung Cancer: A Retrospective Single Institution Report

Wednesday, Nov. 30 11:50AM - 12:00PM Room: S104A

Participants
Sarit Appel, Ramat gan, Israel (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Stereotactic Ablative Radiation Therapy (SABR) is the new standard of care in medically inoperable stage I lung cancer and has been advocated for use as an alternative to surgery in patients with operable stage I lung cancer. Prior to beginning a pilot study for use of SBRT in operable stage I lung cancer, we reviewed and report local control, survival and toxicities of SABR in Stage I lung cancer in tertiary single institution since its introduction in 2009. Materials/Methods: A retrospective database analysis of stage I lung cancer treated with SBRT from 2009-2015. Database included: gender, age, histology, stage, radiation dose and fractionation and treatment dates. Survival status was confirmed from the national registry. Local failure was defined as increased FDG uptake on PET-CT scan within a 2 cm radius of the treated region. Survival and local control were dated from first day of radiation and censored at last visit or at event. Toxicity was graded according to common toxicity criteria adverse events (CTCAE) v. 4.03. Statistical methods used were Kaplan-Meier and Cox regression for survival analysis. Results: A total of 114 patients were treated for 122 stage I lung cancer lesions over the study period. Median follow up time was 27 months (range 8.2-69.5 months), median age was 76 (range 40-96). Stage IA was in 82% of the lesions, adenocarcinoma was in 45%, no biopsy was in 19.7%. The prescribed dose to encompass the PTV was 50 Gy/5fx in 68%, 54 Gy/3fx in 14.5% and 60Gy/8fx in 11.5%. The calculated BED was at least 100 Gy in 94.3% of treated lesions. Median survival was 46 months, estimated 3 years overall survival was 59% (95% CI 47-69%). For stage IA and IB, median survival was 51.3 and 41.4 months respectively (NS). Three years local control was 88% (95% CI 78-94%). On Cox regression, the survival and local control were not significantly affected by histology or fractionation. Toxicity was mild and included chest wall pain in 8.4% patients, rib fracture in 0.9%, grade 1-2 pneumonitis in 12%, grade 3 pneumonitis in 12% and grade 5 in 0.9%. Sixteen central lesions were treated with 8-10 fractions without occurrence of
Conclusion: SABR has been successfully implemented at our institution for the treatment of stage I lung cancer in inoperable patients with excellent local control, low toxicity and acceptable overall survival. A prospective study evaluating SBRT as an alternative to surgery in operable patients with stage I lung cancer will be proposed.
Radiation Oncology Wednesday Poster Discussions

Wednesday, Nov. 30 12:15PM - 12:45PM Room: RO Community, Learning Center

RO

AMA PRA Category 1 Credit ™: .50

FDA

Discussions may include off-label uses.

Participants
Edward Y. Kim, MD, Seattle, WA (Moderator) Research support, Eisai Co, Ltd; Research support, Novartis AG; Research support, Johnson & Johnson; Research support, Bayer AG; Research support, Threshold Pharmaceuticals, Inc; Research support, Eli Lilly and Company; Research support, MabVax Therapeutics Inc;

Andra Krauze, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Aradhana Kaushal, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Joanna Shih, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Peter L. Choyke, MD, Rockville, MD (Abstract Co-Author) 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
Baris Turkbey, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Deborah Citrin, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

Sub-Events

RO234-SD-WEA1 Pre-treatment Multiparametric MRI as a Predictive Marker for Biochemical Recurrence Following External Beam Radiation Therapy for Prostate Cancer

Station #1

Awards
Student Travel Stipend Award

Participants
Luca F. Valle, BA, Spokane, WA (Presenter) Nothing to Disclose
Matthew Greer, BS, Cleveland Heights, OH (Abstract Co-Author) Nothing to Disclose
Andra Krauze, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Aradhana Kaushal, MD, Philadelphia, PA (Abstract Co-Author) Nothing to Disclose
Joanna Shih, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Peter L. Choyke, MD, Rockville, MD (Abstract Co-Author) 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
Baris Turkbey, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose
Deborah Citrin, MD, Bethesda, MD (Abstract Co-Author) Nothing to Disclose

PURPOSE
The capacity of pretreatment multiparametric MRI (mpMRI) to predict biochemical recurrence (BR) after external beam radiation therapy (EBRT) +/- androgen deprivation therapy (ADT) is largely unexplored. We evaluated if pretreatment mpMRI of the prostate with dynamic contrast enhanced (DCE) imaging and diffusion weighted imaging (DWI) with apparent diffusion coefficient (ADC) maps could predict the risk of BR after EBRT +/- ADT.

METHOD AND MATERIALS
All patients from our institution with diagnostic mpMRI prior to EBRT were included in this retrospective analysis. BR was defined by Phoenix criteria. mpMRI consisted of endorectal coil T2W imaging, DCE, and DWI with ADC maps. Prostate lesions were identified in each MRI sequence by a prostate-dedicated radiologist. The hazard ratio (HR) of BR associated with mpMRI features was estimated with Cox proportional cause-specific hazard models. mpMRI features were correlated with known clinical predictors of BR using the Kruskal-Wallis rank test. To account for multiple comparisons, p<0.01 defined significance.

RESULTS
141 patients (11 low, 43 intermediate, and 87 high risk by D'Amico grouping) were included. At a median follow up of 60 months, BR occurred in fourteen (10%) patients. High pre-treatment PSA and detectable post-EBRT PSA nadir were predictors of BR (HR 1.2, p<.0001 and HR 4.92, p=0.003, respectively). T2 imaging characteristics including the number of lesions (mean 1.4, range 0-4, p=0.099), size of the dominant prostate lesion (p=0.436), and location of the tumor (p=0.394-0.694) did not predict for BR. DWI and DCE positivity did not predict BR (p=0.868 and p=0.368, respectively). Tumor size did correlate with known predictors of BR, such as increasing Gleason score (p<0.001), T stage (p=0.009), and D'Amico risk grouping (p<0.001).

CONCLUSION
In this retrospective series, mpMRI findings did not predict for BR after EBRT +/- ADT. Although this is the largest series evaluating these parameters as predictive markers in this setting, it is possible that larger patient numbers or a higher proportion of BR may provide an opportunity to elucidate mpMRI characteristics capable of predicting BR.

CLINICAL RELEVANCE/APPLICATION
While mpMRI is effective in the detection of prostate cancer and in the prediction of BR following radical prostatectomy, it may have shortcomings when predicting the risk of BR after EBRT +/- ADT.

RO235-SD-WEA2 Image-based Response Assessment of HCC Treated by Stereotactic Body Radiotherapy with Respiratory Tracking

Station #2

Participants
Hajer Jarraia, Lille, France (Presenter) Nothing to Disclose
Xavier Pauwels, Lille, France (Abstract Co-Author) Nothing to Disclose
Xavier Mirabel, Lille, France (Abstract Co-Author) Nothing to Disclose
Jerome Durand Labrunie, Lille, France (Abstract Co-Author) Nothing to Disclose
PURPOSE
To describe post therapeutic imaging features of HCC treated by SBRT as an aid in assessing response to treatment. To assess tumor response using RECIST, mRECIST and EASL.

METHOD AND MATERIALS
Imaging Data and medical records of 50 patients with 60 HCC treated with stereotactic body radiotherapy (SBRT) were reviewed. Tumor size and contrast enhancement of lesions were evaluated up to 6 months after radiation. Contrast Enhanced Ultrasound performed in 5 patients were reviewed.

RESULTS
Median age was 70 years (range, 44–86 years). Cirrhosis was mainly due to alcohol consumption and majority of patients had CTP A cirrhosis. Half of the patients had already received treatment for HCC, the majority with chemoembolization (23.7%). Median tumor diameter was 32 mm (11,96). Local control rate according to RECIST, mRECIST and EASL were respectively 98.6%, 98.6%,98% (Kappa : -0.45)
Contrast Enhanced US performed in 5 cases was unclusive. Reasons will be be detailed.At MRI, local control was associated with, disappearance, shrunkage of the target and decrease or disappearance of internal enhancement. Progression was associated with size increase and persistence of internal enhancement. Evaluation with mRECIST and EASL are more adequate than RECIST criteria assessed to Local progression free survival LPFS rates. Histological results were obtained in one case showing a radiohistological correlation between radiological features and liver induced focal inflammatory reaction.

CONCLUSION
SBRT is an emerging technique for treatment of unresectable liver malignancies, especially HCC. The interpretation of post therapeutic imaging features may be challenging for radiologists. Being familiar with these features may improve patient management and avoid additional treatments.

CLINICAL RELEVANCE/APPLICATION
Stereotactic Body Radiotherapy is an emerging technique in the treatment of liver malignancies especially HCC and may be safely used as a bridge treatment before transplantation. Radiologists should be familiar with post therapeutic features the interpretation of which may be challenging, to improve patient management and avoid errors of interpretations that may lead to additional harmful treatments. Response assessment is more adequate with mRECIST or EASL compared to RECIST criteria.

RO237-SD- WEAA4
Prognosis of Patients who Received Palliative Intent Radiotherapy for Bone Metastases in Recent Years

Station #4

Participants
Yasushi Hamamoto, MD, Toon-City, Japan (Presenter) Nothing to Disclose
Noriko Nishijima, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Kei Nagasaki, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Hiromitsu Kanzaki, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Toshiharu Manabe, Imabari-City, Japan (Abstract Co-Author) Nothing to Disclose
Teruhito Mochizuki, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE
With the development of systemic cancer therapy, unignorable proportion of patients who receive palliative intent radiotherapy (PIRT) for bone metastases have become to live longer. To consider individualization of PIRT for recent year patients, reinvestigation of survival time after PIRT is necessary. In this study, we examined prognostic factors after PIRT.

METHOD AND MATERIALS
Between December 2009 and June 2015, 100 patients received the initial PIRT for bone metastases in our institution. Of these, 83 patients (range 50–86 years, median 69 years; male : female = 56:27; performance status (PS) 0-1 : PS 2-4 = 45:38; breast cancer : other cancer = 10:73) were followed up until death (80%) or for more than six months (20%). Clinical records concerning the initial PIRT of these 83 patients were examined. Follow-up time was 0.4 - 36.6 months (median 4.7 months).

RESULTS
The overall survival rates at 2-years from the initial PIRT were 19% for all 83 patients, 17% for lung cancer, 28% for breast cancer, 18% for digestive tract cancer, 0% for liver/biliary tract/pancreas cancer. On univariate analysis, statistically significant factors for survival were gender (p=0.0491) and PS (PS0-1 vs. PS2-4) (p=0.0007). Age (<75 vs. 75<) and primary sites (breast vs. other cancer) were not statistically significant factors (p=0.8032 and p=0.0544, respectively). On multivariate analysis, both gender and PS were statistically significant favorable factors for survival. The overall survival rates at 2-years from the Initial PIRT were 33% for female (12% for male) and 26% for PS0-1 patients (11% for PS2-4 patients).

CONCLUSION
Recently, individualized PIRT seemed to be necessary for bone metastases. Based on our series, female and good PS patients seemed to need PIRT with comparatively high total doses and small fraction size.

CLINICAL RELEVANCE/APPLICATION
Female and good performance status seemed to be favorable prognostic factors for patients who received radiotherapy to bone metastases in recent years.

RO238-SD- A Phase I Trial of Ketogenic Diet with Concurrent Chemoradiation (ChemoRT) in Head and Neck
Stereotactic Ablative Radiotherapy (SABR) for Stages I-II Non-Small Cell Lung Cancer (NSCLC): Setting up with Multi-Dampening, First Analysis Has Shown Promising Results

Purpose/Objective(s): Our hypothesis is that multidampening SABR, developed in our hospital, is an efficient method for these patients, well-tolerated and have high rates of local tumor control. Materials/Methods: Between April 2014 and January 2016, a total of 11 patients with 11 primary lung tumors with stage I and II NSCLC (T1, n=3; T2, n=8) were enrolled on prospective study of SABR for lung cancer. All patients had histological confirmation by biopsy or cytological evaluation, the histologies were: 7 adenocarcinoma, 2 squamous cell carcinoma and 1 NSCLC. All patients had ECOG 0-1. The median age was 74 years (67-86). The implementation of SARB in routine requires a careful considering of organ motion, we used stringent customized breathing control that was obtained with our multidampening system. In all cases the technique was guided by CBCT image after CT simulation and calculation. The SABR dose requirements a careful considering of organ motion, we used stringent customized breathing control that was obtained with our multidampening system. In all cases the technique was guided by CBCT image after CT simulation and calculation. The SABR dose requires a careful considering of organ motion, we used stringent customized breathing control that was obtained with our multidampening system. In all cases the technique was guided by CBCT image after CT simulation and calculation.

Results: The median follow-up was 11 months (range, 3-22). The results in terms of local control after treatment were: 5 patients in partial radiographically response, 2 patients with stable disease and 2 in complete response. 8 patients had a pre- and post-treatment PET/CT imaging. All patients had a decrease in post-treatment SUV (decrease percentage, 31-90%). 2 exitus at the time of the study, one from secondary head and neck cancer and one from comorbidities. Median disease-free survival was 11 months. The toxicity reported in all patients was less than G2 in CTCAE.4 scale by site.

Conclusion: While challenging despite PEG availability, KD compliance is possible when combined with concurrent chemoradiotherapy for HNSCC. Enrollment continues.

Ketogenic diet (KD) combined with chemoRT reduced tumor growth and improved survival in pre-clinical models. We hypothesized stage III-IVb HNSCC patients would be able to remain compliant with KD because of PEG tube requirement during chemoRT. Research supported by NIH U54TR001356 and KetoCal® 4:1 provided by Nutricia Pharmaceuticals. Materials/Methods: This phase I clinical trial enrolled stage III-IVb definitive and post-op HNSCC patients receiving concurrent platinum-based chemoradiotherapy (chemoRT). PET-guided ketones (FK) were checked Mon-Fri, and serum beta-hydroxybutyrate (BHB), glucose, and uric acid were checked weekly. Lipid panel was checked at week 3. Serum oxidative stress parameters were assessed prior to, during, and after completing KD. Adverse events were graded utilizing CTCAE version 4.0. Results: Median follow-up for all enrolled subjects (n=12) from completion of RT was 4.9 mo (range: 0-16.6). 4/12 subjects successfully completed 5 weeks of KD as prescribed. Successful subjects used scheduled anti-emetics, consumed shakes via PEG tube as opposed to orally and had strong social support. Median days on KD for those who discontinued was 5.5 (range: 2-8). Of the first 4 subjects treated, 2 completed, 1 withdrew due to fatigue (grade 3), and 1 had a dose-limiting toxicity (DILT) (hyperuricemia, grade 4; 12.7 ng/dL; n ref 2.4-7.0). The protocol was amended to address diet-related hyperuricemia and allow for increased protein intake. Subsequently, 8 eligible subjects enrolled with 2 completing therapy and 2 experiencing DLTs (acute pancreatitis grade 3; hyperuricemia with complicating nausea and vomiting, grade 3). The remaining 4 subjects withdrew due to diet intolerance prior to beginning chemoradiotherapy (n=1), and nausea with vomiting (nausea grade 2, vomiting grade 1, n=3). Serious adverse events included hospitalizations for parotiditis (n=1), acute pancreatitis (n=1), neutropenic fever (n=1), and nausea with vomiting (n=1). Both the acute pancreatitis and nausea with vomiting SAFEs were considered related to study diet and were deemed DLTs. In those who completed KD, the median days FK were elevated and weeks the BHB levels were above baseline were 24.5 days (range: 19-25) and 5 weeks (range: 4-6), respectively. Median uric acid levels were 4.9 ng/dL (range: 3.4-5.4). Lipids remained normal. Serum oxidative stress markers, as assessed by protein carbonyls, increased linearly with above baseline were 24.5 days (range: 19-25) and 5 weeks (range: 4-6), respectively. Median uric acid levels were 4.9 ng/dL (range: 3.4-5.4). Lipids remained normal. Serum oxidative stress markers, as assessed by protein carbonyls, increased linearly with increasing days on KD. Conclusion: While challenging despite PEG availability, KD compliance is possible when combined with concurrent chemoradiotherapy for HNSCC. Enrollment continues.

Purpose/Objective(s): The standard of care for treatment of early-stage non-small cell lung cancer patients is definitive surgery. However, there are patients who refuse surgery or are not surgical candidates. In these patients SABR is an alternative to surgery. Our hypothesis is that multidampening SABR, developed in our hospital, is an efficient method for these patients, well-tolerated and have high rates of local tumor control. Materials/Methods: This phase I clinical trial enrolled stage III-IVb definitive and post-op HNSCC patients receiving concurrent platinum-based chemoradiotherapy (chemoRT). PET-guided ketones (FK) were checked Mon-Fri, and serum beta-hydroxybutyrate (BHB), glucose, and uric acid were checked weekly. Lipid panel was checked at week 3. Serum oxidative stress parameters were assessed prior to, during, and after completing KD. Adverse events were graded utilizing CTCAE version 4.0. Results: Median follow-up for all enrolled subjects (n=12) from completion of RT was 4.9 mo (range: 0-16.6). 4/12 subjects successfully completed 5 weeks of KD as prescribed. Successful subjects used scheduled anti-emetics, consumed shakes via PEG tube as opposed to orally and had strong social support. Median days on KD for those who discontinued was 5.5 (range: 2-8). Of the first 4 subjects treated, 2 completed, 1 withdrew due to fatigue (grade 3), and 1 had a dose-limiting toxicity (DILT) (hyperuricemia, grade 4; 12.7 ng/dL; n ref 2.4-7.0). The protocol was amended to address diet-related hyperuricemia and allow for increased protein intake. Subsequently, 8 eligible subjects enrolled with 2 completing therapy and 2 experiencing DLTs (acute pancreatitis grade 3; hyperuricemia with complicating nausea and vomiting, grade 3). The remaining 4 subjects withdrew due to diet intolerance prior to beginning chemoradiotherapy (n=1), and nausea with vomiting (nausea grade 2, vomiting grade 1, n=3). Serious adverse events included hospitalizations for parotiditis (n=1), acute pancreatitis (n=1), neutropenic fever (n=1), and nausea with vomiting (n=1). Both the acute pancreatitis and nausea with vomiting SAFEs were considered related to study diet and were deemed DLTs. In those who completed KD, the median days FK were elevated and weeks the BHB levels were above baseline were 24.5 days (range: 19-25) and 5 weeks (range: 4-6), respectively. Median uric acid levels were 4.9 ng/dL (range: 3.4-5.4). Lipids remained normal. Serum oxidative stress markers, as assessed by protein carbonyls, increased linearly with increasing days on KD. Conclusion: While challenging despite PEG availability, KD compliance is possible when combined with concurrent chemoradiotherapy for HNSCC. Enrollment continues.

SABR dosing was either 54 Gy in 3 fractions or 50 Gy in 5 fractions, according to the risk adapted fractionation scheme of biologically effective dose (BED) > 100 Gy, and treatment lasted between one-and-a-half to two weeks. Failure was defined radiographically, chest radiography the first month after treatment, thereafter every 3 months for 2 years and then annually; CT of chest and upper abdomen every 3 months the first year and then every 6 months. PET/CT is obtained at the 6 month in all cases. Results: The median follow-up period was 11 months (range, 3-22). The results in terms of local control after treatment were: 5 patients in partial radiographically response, 2 patients with stable disease and 2 in complete response. 8 patients had a pre- and post-treatment PET/CT imaging. All patients had a decrease in post-treatment SUV (decrease percentage, 31-90%). 2 exitus at the time of the study, one from secondary head and neck cancer and one from comorbidities. Median disease-free survival was 11 months. The toxicity reported in all patients was less than G2 in CTCAE.4 scale by site. Conclusion: SABR used as a radical treatment for non-operable patients is safe and promising. The SABR with multidampening method is well-tolerated, seems to be an efficient alternative and to have a low risk of complications. Although recommendations exist for CT- and PET/CT-based follow-up after SABR, better metrics are required for early detections of recurrence and distinguishing recurrence from fibrosis.
Participants
Edward Y. Kim, MD, Seattle, WA (Moderator) Research support, Eisai Co, Ltd; Research support, Novartis AG; Research support, Johnson & Johnson; Research support, Bayer AG; Research support, Threshold Pharmaceuticals, Inc; Research support, Eli Lilly and Company; Research support, MabVax Therapeutics Inc;

Sub-Events
RO240-SD-WEB1 Trends in the Utilization of Adjuvant Vaginal Brachytherapy in the Treatment of Women with Stage I and II Endometrial Cancer: Results of an Updated Period Analysis of SEER Data

Station #1

Awards
Student Travel Stipend Award

Participants
Ankit Modh, MD, Detroit, MI (Presenter) Nothing to Disclose

ABSTRACT
Purpose/Objective(s): Adjuvant vaginal brachytherapy (VB) is a well-established and effective radiation treatment (RT) modality in women with early stage endometrial carcinoma (EC). We sought to evaluate and update the trends in utilization of VB versus other RT modalities (pelvic external beam RT (EBRT) or the combination of VB and pelvic EBRT using the National Cancer Institute’s Surveillance, Epidemiology, and End Results (SEER) database.Materials/Methods: The SEER database was queried for adult females with histologically confirmed FIGO (1988) stage I-II endometrial cancer diagnosed from 1995-2012 who underwent hysterectomy and adjuvant radiation therapy. Patients with multiple primary malignancies, those who received radiation treatment prior to surgery or those who did not have any adjuvant RT were excluded. Chi-squared tests were used to assess differences by radiation modality (VB, EBRT, and VB+EBRT) and various demographic and clinical variables.Results: We identified 15,201 patients who met our inclusion criteria. There was an overall increase in the use of VB observed from 17.1% in 1995-2000 compared to 57.1% in 2007-2012 (p < 0.001). Conclusion: There continues to be a trend for the increased use of VB in the adjuvant setting for patients with FIGO stage I-II EC. This trend was observed across patient or treatment factors analyzed.

RO241-SD-WEB2 Acute Toxicities using Intensity Modulates Radiation Therapy for Adjuvant and Definitive Salvage Treatment of Endometrial Cancer: A Single Institution

Station #2

Participants
Phoebe Chidley, MBBS, Heidelberg, Australia (Presenter) Nothing to Disclose
Carmina Lapuz, MBBS,FRANZCR, Melbourne, Australia (Abstract Co-Author) Nothing to Disclose
Adeline Lim, FRANZCR, Heidelberg, Australia (Abstract Co-Author) Speaker, Teva Pharmaceutical Industries Ltd

ABSTRACT
Purpose/Objective(s): Intensity modulated radiation therapy (IMRT) can be used to reduce dose to organs at risk (OARs) whilst maintaining target coverage, theoretically reducing treatment-related morbidity and allowing dose escalation. IMRT is dosimetrically advantageous compared with conventional external beam radiotherapy (EBRT) in the treatment of endometrial cancers as there can be large volumes of OARs within conventional pelvic fields, increasing potential toxicities and limiting dose escalation in recurrent disease. The aim of this study is to evaluate the acute toxicities of adjuvant and definitive salvage EBRT for primary or recurrent endometrial cancer confined to the pelvis using IMRT. Materials/Methods: Patients treated with pelvic EBRT for adjuvant or definitive salvage therapy of endometrial cancer between April 2013 to January 2016 were identified from our center's database. All patients were treated using 7 to 9 field IMRT to a dose of 45 - 50.4 Gy to the pelvis in the adjuvant setting and 54 - 59.4 Gy using a simultaneous integrated boost to recurrent disease, with or without chemotherapy. Target and OARs contouring was based on published guidelines. Daily cone beam imaging was used for image guidance. Acute toxicity data was collected according to Common Terminology Criteria for Adverse Events v4.0 weekly. Descriptive statistics was used for analysis. Results: 20 patients were included in this study. Median age was 66.5 years (range: 51-90 years). Stage 1, 2, 3 and recurrent disease was seen in 4, 4, 6 and 6 patients respectively. Concurrent chemotherapy with cisplatin was given in 5 patients. Grade 1 acute genitourinary toxicities were seen in 65% and grade 2 in 15% of patients, predominantly reported as urinary frequency. Grade 1 acute bowel toxicities were seen in 65% of patients and grade 2 in 20%, mainly in the form of diarrhea and bowel frequency. 14 patients experienced grade 1-2 nausea. Grade 1-2 fatigue was seen in 11 patients. There were no cases of acute toxicities greater than grade 2. Conclusion: Pelvic EBRT with doses up to 59.4 Gy for endometrial cancers using IMRT is well tolerated and is associated with low grade acute genitourinary and gastrointestinal toxicities only. This is consistent with published studies, however, longer follow-up is required to assess late toxicities and tumor control. The results of larger prospective studies are awaited to assess whether IMRT results in reduction in acute and long term toxicities and better tumor outcomes compared with conventional EBRT.

RO242-SD-WEB3 PET Response Assessment in Patients with Hodgkin Lymphoma Receiving Brentuximab: A Single Institution Experience

Station #3

Participants
Genevieve Maquilan, MD, Dallas, TX (Presenter) Nothing to Disclose
Purpose/Objective(s): Brentuximab is increasingly being used for treating CD30-positive Hodgkin lymphoma (HL). Anecdotal reports of high false-positive rates on post-brentuximab imaging with positron emission tomography (PET), including a 75% rate in a phase II study of early stage non-bulky HL (NCT01534078), have caused concern about interpretation of results and guidance of further therapy, including consolidative radiotherapy. This study was conducted in order to determine the prognostic potential of CBCT for evaluating treatment outcome in terms of GTV reduction and to determine the difference of tumor reduction based on different histology. Materials/Methods: Forty-one NSCLC patients treated with definitive radiotherapy at one institution who received daily CBCT were randomly selected. Patients received mean EBRT of 60.7 Gy (range: 50-71.4 Gy) at 1.8 or 2 Gy per fraction. Initial mean gross tumor volume (GTV) was 197.3 cc (range: 3.4-1815.0 cc). Six sets of CBCT at an interval of one week were chosen, starting from the first fraction of treatment. The CBCTs were transferred to MIM Software (v.6.0) and single physician manually contoured the GTV on each slice. The change in GTV was recorded. Patient’s clinical information was obtained from the institution electronic medical record. All statistical analysis was conducted on MedCalc (v.16.2). Univariate survival analysis was done using the Kaplan-Meier method with log-rank test. Median overall GTV reduction was used as a cutoff value (DGTVDGTV=45%). A univariate regression analysis was done to explore the correlation between histology and GTV reduction. A p

Results: A consistent regression analysis was done to explore the correlation between histology and GTV reduction. A p

Conclusion: Positive PET findings after the completion of treatment with brentuximab were biopsied in the absence of clear clinical progression, with demonstration of one apparent false positive case that changed therapy. Our single institution findings raise caution in regards to presuming a high false-positive rate on post-treatment PET, and, if feasible, biopsy should be considered.
Announcement of Education Exhibit Awards

Announcement of Quality Storyboard Awards

Annual Oration in Radiation Oncology: Prostate Cancer: Improving the Flow of Research

Participants
Richard L. Baron, MD, Chicago, IL (Presenter) Nothing to Disclose

Sub-Events
PS40A Announcement of Education Exhibit Awards

Participants
PS40B Announcement of Quality Storyboard Awards

Participants
PS40C Annual Oration in Radiation Oncology: Prostate Cancer: Improving the Flow of Research

Participants
Colleen A. Lawton, MD, Milwaukee, WI (Presenter) Nothing to Disclose
Edward Y. Kim, MD, Seattle, WA (Presenter) Research support, Eisai Co, Ltd; Research support, Novartis AG; Research support, Johnson & Johnson; Research support, Bayer AG; Research support, Threshold Pharmaceuticals, Inc; Research support, Eli Lilly and Company; Research support, MabVax Therapeutics Inc;

Abstract
Prostate cancer for men like breast cancer for women is the second leading cause of cancer death in the United States. This fact alone should cause nation-wide concern and result in a push for improved screening and treatment for men plagued with this disease. Yet over the past three decades we have seen screening with PSA come and go and treatment for localized disease improve, but at a relative snail’s pace. Treatment for locally advanced disease has seen progress, but hereto the tempo is sluggish and adoption of the advances not universal. Recently there has been a large influx of treatment options for metastatic patients which of course is progress, but in the end these patients will likely die of their disease. The goal of this presentation will be to review what we have learned from prostate cancer research over the past three decades. This will include a review of the research on imaging for accurate staging in addition to research on screening and treatment options. We will look at where we have succeeded and where much work still needs to be done. Finally we will explore opportunities to identify what needs to be done to help increase the flow of research so as to brighten the future for prostate cancer patients.
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): There is a paucity of information exploring obesity’s influence on radiotherapy-related toxicity for localized prostate cancer. The purpose of this study is to evaluate whether obese patients undergoing external beam radiation therapy (EBRT) for treatment of prostate cancer will have an increase in treatment-related toxicity.

Materials/Methods: Between 1995 and 2009, 3,713 patients were treated with EBRT for prostate cancer using our institution’s proprietary treatment planning system. With 3,178 files archived, only 535 electronic files were readily accessible for analysis. Due to concomitant use of brachytherapy, 285 patients were excluded, while the remaining 250 patients met inclusion criteria for analysis. Of the cohort, neoadjuvant hormonal therapy was prescribed in 143 patients. Abdominal adiposity was measured by contouring the waist circumference between the 4th and 5th level of the lumbar spine, which is an established surrogate measure for obesity. For Cox regression analysis, bladder neck and multivariate analysis (MVA) using Cox regression analysis was used to identify factors associated with G-tube placement during radiation therapy as well as dysphagia chronically. Predictors of overall survival (OS) and progression free survival (PFS) were also identified. Results: Eighty two patients with a median age at diagnosis of 58.1 (range, 41–87) were treated. Seventy four (90%) of the patients were male, and 71 (87%) were Caucasian, with an ECOG PS = 1 in 94% and a Charlson Comorbidity Index (CCI) of 1 in 79% of patients. Ultimately, 19% of patients underwent G-tube placement during treatment. The only patient related factor associated with G-tube placement was lower baseline PS (p = 0.043). Chronic dysphagia correlated with prior G-tube placement, but did not achieve significance (p = 0.058). However, higher pre-treatment CCI (p = 0.002) and non-cisplatin based chemotherapy (p = 0.002) were both associated with patient reported chronic dysphagia. With a median follow up of 36 months, the overall survival and progression free survival were 74.6 ± 3 % and 73.9 ± 3 %, respectively. On univariate analysis, G-tube placement was associated with a worse mean OS of 58 months versus 79 months (p = 0.004). G-tube placement was not significant on MVA for OS, but was significant for reduced PFS.Conclusion: While G-tube placement was not significantly correlated with chronic dysphagia, it was associated with a reduction in progression free survival, and this may be attributable to toxicity-related treatment interruptions. While the majority of patients can avoid G-tubes, early G-tube placement in patients with poor performance statuses should be considered for this patient population.
In addition, diabetes was associated with a significant increase in urinary toxicity (HR 2.21, P = 0.02), while bladder neck dosimetry analysis did not yield a significant correlation. Analysis of late GI toxicity events did not show a significant association between obesity and GI toxicity, or between obesity and other relevant comorbidity variables. Further, biochemical recurrence and distant metastasis were not associated with abdominal obesity. Conclusion: Obese patients with prostate cancer have an increased risk of long-term genitourinary toxicity following curative radiation therapy to the prostate. Further evaluation of the relationship between obesity and genitourinary toxicity should be conducted.

SSM21-03 Outcomes and Complications of Radiation Therapy in Patients with Familial Adenomatous Polyposis

Wednesday, Nov. 30 3:20PM - 3:30PM Room: S105AB

Awards
Student Travel Stipend Award

Participants
Meng Gan, Salt Lake Cty, UT (Presenter) Nothing to Disclose
Shane Lloyd, MD, Salt Lake City, UT (Abstract Co-Author) Consultant, Sirtex Medical Ltd
Dustin Boothe, MD, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose
Jonathan Frandsen, Salt Lake City, UT (Abstract Co-Author) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): Familial adenomatous polyposis (FAP) is an autosomal dominant condition due to mutations in the APC gene highly associated with colorectal and other cancers. There are no large published series on the effectiveness and complications of radiation therapy (RT) in patients with FAP. Materials/Methods: We queried the Hereditary Gastrointestinal Cancer Registry which tracks patients with familial cancer syndromes enrolled on trials at a referral center for genetics and cancer research. Fourteen patients were identified with FAP who received radiation therapy. Outcomes assessed included treatment toxicity, local recurrence, and secondary malignancies. Common Terminology Criteria for Adverse Events (CTCAE) version 4 was used to grade adverse events. Results: Median age at treatment was 44. Mean length of follow up was 8.4 years after RT. Treated sites included rectal cancer (n=3, median RT dose 45 Gy), intra-abdominal desmoid (n=3, median RT dose 49 Gy), prostate cancer (n=2), breast cancer (n=1), melanoma (n=1), medulloblastoma (n=1), gastric cancer (n=1), and glioma (n=1). Eight patients received concurrent systemic therapy. 2 of 4 patients with desmoid tumors and 1 of 3 patients with rectal cancer recurred locally within 5 years. Overall 35.7% of patients experienced recurrence after RT. Secondary infiel tumors occurred in 2 patients: a medulloblastoma was diagnosed in a patient treated for glioma, and a desmoid tumor was diagnosed in a patient treated for rectal cancer. While all 9 patients treated with abdominal or pelvic RT had previously undergone prophylactic colectomies, rates of GI toxicity were acceptable with one patient experiencing grade 2 diarrhea. Overall, 21% experienced CTCAE grade 1, 29% grade 2, and 7% grade 3 toxicity. The most common toxicity was dermatitis, seen in 50% of patients. Conclusion: In this cohort, RT was well tolerated with adverse effects consistent with non-FAP patients. Rates of secondary in-field tumors were increased likely due to prior predilection from FAP itself, although an increased role of radiation cannot be ruled out.

SSM21-05 Prognosis of Patients Who Received Palliative Intent Radiotherapy for Bone Metastases in Recent Years

Wednesday, Nov. 30 3:40PM - 3:50PM Room: S105AB

Participants
Yasushi Hamamoto, MD, Toon-City, Japan (Presenter) Nothing to Disclose
Noriko Nishijima, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Kei Nagasaki, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Hiromitsu Kanzaki, Toon-City, Japan (Abstract Co-Author) Nothing to Disclose
Toshiharu Manabe, Imabari-City, Japan (Abstract Co-Author) Nothing to Disclose
Teruhito Machizuki, MD, Toon, Japan (Abstract Co-Author) Nothing to Disclose

PURPOSE

With the development of systemic cancer therapy, unignorable proportion of patients who receive palliative intent radiotherapy (PIRT) for bone metastases have become to live longer. To consider individualization of PIRT for recent year patients, reinvestigation of survival time after PIRT is necessary. In this study, we examined prognostic factors after PIRT.

METHOD AND MATERIALS

Between December 2009 and June 2015, 100 patients received the initial PIRT for bone metastases in our institution. Of these, 83 patients (range 50-86 years, median 69 years; male : female = 56:27; performance status (PS) 0-1 : PS 2-4 = 45:38; breast cancer : other cancer = 10:73) were followed up until death (80%) or for more than six months (20%). Clinical records concerning the initial PIRT of these 83 patients were examined. Follow-up time was 0.4 - 36.6 months (median 4.7 months).

RESULTS

The overall survival rates at 2-years from the initial PIRT were 19% for all 83 patients, 17% for lung cancer, 28% for breast cancer, 18% for digestive tract cancer, 0% for liver/biliary tract/pancreas cancer. On univariate analysis, statistically significant factors for survival were gender (p=0.0491) and PS (PS0-1 vs. PS2-4) (p=0.0007). Age (<75 vs. 75+) and primary sites (breast vs. other cancer) were not statistically significant factors (p=0.8032 and p=0.0544, respectively). On multivariate analysis, both gender and PS were statistically significant favorable factors for survival. The overall survival rates at 2-years from the Initial PIRT were 33% for female (12% for male) and 26% for PS0-1 patients (11% for PS2-4 patients).

CONCLUSION

Recently, individualized PIRT seemed to be necessary for bone metastases. Based on our series, female and good PS patients seemed to need PIRT with comparatively high total doses and small fraction size.

CLINICAL RELEVANCE/APPLICATION

Female and good performance status seemed to be favorable prognostic factors for patients who received radiotherapy to bone metastases in recent years.
SSM21-06  Improved Pain Control Following Conformal Palliative Radiotherapy for Painful Bone Metastases

Wednesday, Nov. 30 3:50PM - 4:00PM Room: S105AB

Participants
Kara Romano, MD, Charlottesville, VA (Presenter) Nothing to Disclose

ABSTRACT

Purpose/Objective(s): High quality care for patients with advanced cancer and bone metastases requires treatment that is effective while avoiding excess health care costs. Palliative radiotherapy (RT) for bone metastases has traditionally been delivered with conventional, non-conformal radiation therapy (NCRT), such as with AP:PA portals. NCRT is simpler and potentially less expensive than the more complex delivery of conformal radiation therapy (CRT), but may lead to more normal tissue irradiated and more acute toxicity. We evaluated short-term outcomes of patients treated with CRT versus NCRT. We hypothesize that CRT decreases acute toxicity compared to NCRT. Materials/Methods: We retrospectively evaluated a cohort of patients who received palliative RT (CRT on a TomoTherapy unit or NCRT on a TrueBeam/Trilogy unit) at our institution for axial skeletal bone metastases from 2012 to 2014. Patient and treatment characteristics were obtained including: technical details, concurrent chemotherapy, acute toxicity and subjective pain during treatment and in the acute post-treatment period (defined as ≤ 60 days after completion). Acute toxicity was scored according to CTCAE v4.0 criteria. Statistical analyses were conducted using t-tests, Chi-square tests, and multivariate logistic regression (MVA). Results: A total of 179 patients and 267 treatment plans were identified (145 CRT, 122 NCRT). No significant differences were observed between CRT and NCRT groups for: total dose, number of fractions, number of vertebral bodies treated, treatment site, and concurrent chemotherapy. In MVA models, technique (CRT vs NCRT) was not associated with toxicity rates (any, = Grade 2, or = Grade 3 events). Only a higher number of vertebral bodies in the treatment field was significantly associated with a higher rate of acute toxicity post-treatment (p = 0.015), and only a higher total dose was significantly associated with a higher rate of acute toxicity during treatment (p = 0.0141). CRT was associated with higher rates of improvement of pain during treatment (31% vs. 14%; p) and a non-significant trend toward fewer patients reporting significant worsening of pain after treatment (2.7% vs. 7.4%; p = 0.08). Conclusion: Our results suggest that CRT is associated with improved pain control, with no difference in acute toxicity, when compared to NCRT for painful bone metastases. These findings suggest a potential role for CRT in bone metastasis management, which must be balanced against cost considerations. Conclusions are limited by retrospective, nonrandomized study design, with multiple potential confounders including differences in concurrent therapy, patient selection for RT technique, and subjective reporting of pain. Larger studies are needed to further evaluate the role of CRT for bone metastases and to explore differences in patient reported outcomes between RT techniques.
Participants
Jessy Abed, Toronto, ON, (jessy.abed@hotmail.com) (Presenter) Nothing to Disclose

LEARNING OBJECTIVES
1) Explain the importance and relevance of an MRI-guided approach to prostate cancer treatment (EBRT, HDR brachytherapy). 2) Explain the rationale for GTV-tumour targeted approach versus whole gland prostate treatment. 3) Discuss the interventional program at Princess Margaret Cancer Centre, including demonstration of the innovative MRI-guided HDR brachytherapy suite.

ABSTRACT
With the evolution of advancements in image-guided technologies, radiation therapy treatment accuracies and efficiencies in delivery continue to improve as well as a reduction in associated toxicities. But despite these improvements, local recurrence of prostate cancer remains prevalent. Localized prostate cancer is not limited to the prostate gland. As such, regions of tumor-density within the prostate can serve as the gross tumour volume (GTV). Adopting a tumour-targeted radiation therapy (RT) approach to treat prostate cancer is one that may improve the therapeutic ratio by decreasing normal tissue toxicities while improving local control. This can be accomplished by adopting magnetic resonance imaging (MRI) as the image-guided modality for external beam radiation therapy (EBRT) and high dose rate (HDR) brachytherapy for prostate cancer. MRI provides excellent soft tissue contrast without exposing the patient to ionizing radiation. It also allows for more specialized delineation of anatomic structures and disease, thereby allowing more accurate visualization of the target volume. Interventional radiotherapy using MRI-guidance can increase target precision while allowing for dose escalation and normal tissue avoidance. Our institution employs MRI for interventional prostate HDR and EBRT treatment. Adopting a tumor-targeted method for prostate cancer is an innovative approach to prostate cancer RT treatment.
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 tumors and illustrate the importance of multimodality imaging for tumor contouring.
Controversy Session: Is It Time to Put Whole Brain Radiotherapy to Pasture? What’s New in the Treatment of Limited Brain Metastases

Thursday, Dec. 1 7:15AM - 8:15AM Room: E450B

NR RO

AMA PRA Category 1 Credit ™: 1.00
ARRT Category A+ Credit: 1.00

Participants
Simon S. Lo, MD, Seattle, WA, (simonslo@uw.edu) (Moderator) Research support, Elekta AB; Travel support, Accuray Incorporated; Speaker, Accuray Incorporated
Arjun Sahgal, Toronto, ON (Presenter) Speaker, Medtronic, Inc; Speaker, Elekta AB; Medical Advisory Board, Varian Medical Systems, Inc; Speaker, Accuray Incorporated; Research Grant, Elekta AB
Andrew B. Lassman, MD, New York, NY (Presenter) Consultant, AstraZeneca PLC; Consultant, BioClinica, Inc; Consulente, F. Hoffmann-La Roche Ltd; Consultant, Mateon Therapeutics, Inc; Consultant, VBI Vaccines Inc; Consultant, Sapience Therapeutics, Inc; Consultant, Cortice Biosciences, Inc; Consultant, AbbVie Inc; Speaker, prIME Oncology
Simon S. Lo, MD, Seattle, WA, (simonslo@uw.edu) (Presenter) Research support, Elekta AB; Travel support, Accuray Incorporated; Speaker, Accuray Incorporated;

LEARNING OBJECTIVES
1) Review the role of stereotactic radiosurgery in the treatment of limited brain metastases. 2) Describe the benefits and risks of whole brain radiotherapy to treatment of patients with CNS metastatic disease. 3) Determine the optimal multidisciplinary approach for treatment of patients with single and multiple brain metastases.

ABSTRACT
The aim of this session is to review the evidence for radiosurgery for brain metastases and why whole brain radiation is less and less a treatment of choice. There are serious harms associated with whole brain radiation which will be discussed. Novel strategies with targeted therapy and SRS are also the future in particular with melanoma. Ultimately whole brain radiation will be phased out as a therapy of last resort.
**Participants**
Rojano Kashani, Saint Louis, MO (Moderator) 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.

**ABSTRACT**

**Sub-Events**

**RC622A  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.

**RC622B  Integrating MRI, The Clinician Perspective**

Participants
Mary U. Feng, MD, San Francisco, 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 Impact of Volume of Bone Marrow Irradiated in Head and Neck Cancer on Hematologic Toxicity

Participants
Edward Y. Kim, MD, Seattle, WA (Moderator) Research support, Eisai Co, Ltd; Research support, Novartis AG; Research support, Johnson & Johnson; Research support, Bayer AG; Research support, Threshold Pharmaceuticals, Inc; Research support, Eli Lilly and Company; Research support, MabVax Therapeutics Inc;

Method and Materials
Head and neck cancer patients receiving definitive IMRT alone in one institution was reviewed from 2000 to 2012. Serial hematocrit (Hct), hemoglobin (Hgb), total lymphocyte count (TLC), total neutrophil count (TNC), total monocyte count (TMC), platelets (Plt), and total white blood cell (WBC) were recorded for pre (latest CBC w/ DIFF before treatment), during (4-6 weeks after start of treatment), and after treatment (0-2, 2-6, 6-12, >12 month after IMRT). CTCAEv.4 criteria was used to determine Hct, Hgb, TLC, TNC, TMC toxicity endpoints. Grade 2-3 toxicity was considered moderate and Grade 4 was considered severe. Radiation treatment plans were restored and isodose lines were regenerated followed by the segmentation of bony structures receiving 1 Gy, 2 Gy, 6 Gy, 10 Gy dose thresholds. Recursive partitioning analysis (RPA) was used to identify bony dose-volume thresholds associated with moderate and severe hematologic toxicity during and after IMRT.

Results
Of the 430 patients reviewed, 63 patients head and neck cancer patients were evaluated during and after IMRT; median age was 58 years old (14 – 78), 47 (74.6%) were male, 52 (82.5%) were Caucasian, 39 (61%) were treated for oropharyngeal cancer. Median radiation dose was 66 Gy (14.4-72) in 30 fractions (4-40). 48 patients (76.2%) had stage III-IV cancer. 48 (76.2%) patients suffered moderate to severe lymphopenia. 3 (4.8%) suffered moderate anemia and 3 (4.8%) suffered leukopenia. No patients suffered a decrease in TNC nor Plt. RPA identified whole bone V6 (volume receiving 6 Gy) ≥ 541.5 cc to be significantly associated with moderate to severe lymphopenia during IMRT (RPA logworth p<0.002; cumulative ROC AUC 0.7379; chi-square p<0.01). Baseline TLC was normal, dropped 67.5% during treatment, and did not return to baseline after 12 months.

Conclusion
Our findings strongly suggest that treatment related lymphopenia is a common enduring side effect of radiation treatment in head and neck cancer patients. Higher bony V6 was associated with the development of moderate and severe lymphopenia during the course of treatment.

Clinical Relevance/Application
Dose-volume association of irradiated bone marrow and moderate to severe lymphopenia suggest immune preservation is important in IMRT to the head and neck.

The Sydney Swallow Questionnaire (SSQ) as a Predictor of Clinical Outcomes in Patients Undergoing Radiation Therapy for Head and Neck Cancer

Participants
Jay C. Shiao, BS, Houston, TX (Abstract Co-Author) Nothing to Disclose
Abdallah S. Mohamed, MD, MSc, Houston, TX (Abstract Co-Author) Nothing to Disclose
Aasheesh Kanwar, Houston, TX (Abstract Co-Author) Nothing to Disclose
Andrew Wong, BS, Houston, TX (Abstract Co-Author) Nothing to Disclose
David I. Rosenthal, Houston, TX (Abstract Co-Author) Advisory Board, Bristol-Myers Squibb Company Advisory Board, Merck KGaA Research support, Merck KGaA
Brandon Gunn, MD, Galveston, TX (Abstract Co-Author) Nothing to Disclose
Adam S. Garden, MD, Houston, TX (Abstract Co-Author) Nothing to Disclose
Merrill Kies, Houston, TX (Abstract Co-Author) Nothing to Disclose
Clifton D. Fuller, MD, PhD, Houston, TX (Presenter) Nothing to Disclose

Method and Materials
Head and neck cancer patients receiving definitive IMRT alone in one institution was reviewed from 2000 to 2012. Serial hemoglobin (Hgb), total lymphocyte count (TLC), total neutrophil count (TNC), total monocyte count (TMC), platelets (Plt), and total white blood cell (WBC) were recorded for pre (latest CBC w/ DIFF before treatment), during (4-6 weeks after start of treatment), and after treatment (0-2, 2-6, 6-12, >12 month after IMRT). CTCAEv.4 criteria was used to determine Hct, Hgb, TLC, TNC, TMC toxicity endpoints. Grade 2-3 toxicity was considered moderate and Grade 4 was considered severe. Radiation treatment plans were restored and isodose lines were regenerated followed by the segmentation of bony structures receiving 1 Gy, 2 Gy, 6 Gy, 10 Gy dose thresholds. Recursive partitioning analysis (RPA) was used to identify bony dose-volume thresholds associated with moderate and severe hematologic toxicity during and after IMRT.

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Conclusion
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Clinical Relevance/Application
Dose-volume association of irradiated bone marrow and moderate to severe lymphopenia suggest immune preservation is important in IMRT to the head and neck.

Awards
Student Travel Stipend Award
ABSTRACT

Purpose/Objective(s): The Sydney Swallow Questionnaire (SSQ) is a validated quantitative tool for the evaluation of swallowing function in the head and neck cancer (HNC) patient. We hypothesized that the SSQ may predict for clinical outcomes such as weight loss and changes in Functional Oral Intake Scale (FOIS) during a course of radiotherapy to guide management decisions.

Materials/Methods: Measures of patient clinical status including SSQ score, weight, feeding tube status, and FOIS were captured at all clinical visits from February 2015 to December 2015 for patients who underwent radiotherapy for head and neck cancer at our institution. Statistical correlations between the SSQ score, its change, and weight loss or FOIS level were evaluated by the Pearson product-moment correlation coefficient. Results: Ninety-three patients who underwent treatment had SSQ scores captured throughout radiation treatment. Median weight change rate during radiation treatment was -0.44 kg per week [interquartile range (IQR), -0.85 to -0.03] and median absolute weight change over treatment course was -2.87 kg [IQR, -6.29 to -0.55]. A negative correlation was found between magnitude of SSQ score increase for each patient and average FOIS \((r = -0.479; p)\). There was also a weak but statistically significant correlation between SSQ score change and max percentage weight loss \((r = 0.208; p = 0.0496)\). For 10 patients who eventually used a PEG tube for nutrition, a strong correlation was found between maximum percentage weight loss and magnitude of SSQ score increase \((r = 0.796; p = 0.006)\). Conclusion: Magnitude of increase in SSQ score was negatively correlated with FOIS confirming that a worsening swallow function leads to compensatory change in functional intake such as switching to softer diet or using a feeding tube. Such adaptations seem to be a partial but incomplete compensation for swallow dysfunction given the weak but significant correlation between SSQ score change and percentage weight loss. SSQ score may be one important predictive factor for identifying patients at increased risk for substantial weight loss, but it likely lacks sufficient explanatory power to predict for such patients independently.
Clinical Characteristics, Prognosis and Outcome of Elderly Nasopharyngeal Carcinoma Patients in the United States: A Population-Based Study

Purpose/Objective(s): Because of age and co-morbid conditions, most elderly nasopharyngeal carcinoma (NPC) patients were excluded from randomized clinical trials. Survival of elderly NPC patients in the United States was not explored before. This study was to evaluate clinical characteristics, prognosis and outcome of elderly (=65 years old) NPC patients in the United States.

Materials/Methods: We searched the Surveillance, Epidemiology, and End results (SEER) database for patients with NPC who were diagnosed from 2004 to 2012. We analyzed the clinical characteristics, prognosis and outcomes of elderly (=65 years old) patients. The overall survival (OS) and cancer-specific survival (CSS) rates were calculated by Kaplan-Meier method, and compared by log-rank test. Prognostic factors were analyzed by Cox regression model.

Results: Our search criteria retrieved 3911 NPC patients. Among them, 904 (23.1%) patients were elderly patients (=65 years old). The 1-, 3-, and 5-year CSS rates were 80%, 67.7%, and 60.1% respectively. The 1-, 3-, and 5-year OS rates were 65%, 45.2% and 34.1% respectively. Their clinical characteristics and outcomes were compared with those of younger patients (P=0.459, P=0.462). Conclusion: Elderly NPC patients (=65 years old) have worse survival than younger patients. Important prognostic factors include clinical stage and receiving radiotherapy. Radiotherapy is an effective curative treatment for elderly NPC patients. Radiotherapy needs to be considered in the treatment of elderly patients (=65 year old) with nasopharyngeal carcinoma.
Hot Topic Session: Radiation and Immune Therapies: Challenges in Evaluation of Treatment Response

Thursday, Dec. 1 3:00PM - 4:00PM Room: E353B

LEARNING OBJECTIVES
1) Describe the mechanisms of synergy between radiation and the immune system. 2) Develop an understanding of how to combine radiation and immune therapy to enhance both local and systemic responses.

ABSTRACT
That radiation therapy has the capacity to prime immune responses has gained traction in recent years. Various mechanisms of synergy between radiation and adaptive immune responses have been identified in preclinical studies. There are now multiple clinical studies attempting to integrate immunotherapy with RT to extend the effects beyond the primary tumor. However, in addition to these positive stimuli on immunity, RT also initiates suppressive mechanisms in the tumor, which relate to intrinsic processes associated with repair of damaged tissues. A greater understanding of the positive role which radiation plays on adaptive immunity and the negative feedback on inflammation that shuts down these immune responses is needed by radiation oncologists. This input from preclinical models is particularly relevant as we begin to integrate immunologic agents into clinical practice. This educational session will provide an introduction to radiation and immunotherapy broken down into radiation’s impact on adaptive immunity and the negative feedback that radiation can cause in the tumor environment and on innate immune cells that may limit the efficacy of radiation combined with immunotherapy. In the process we will identify promising targets for clinical translation and extend the audiences understanding through checkpoint inhibitors and beyond.

Participants
Marka R. Crittenden, MD, PhD, Portland, OR (marka.crittenden@providence.org) (Presenter) Advisory Board, Regeneron Pharmaceuticals, Inc; Advisory Board, AstraZeneca PLC; Advisory Board, Pfizer Inc; Researcher, Jounce Therapeutics, Inc; Researcher, Rigel Pharmaceuticals, Inc; Researcher, Bristol-Myers Squibb Company

SPSH53B Radiation and Immune Therapy in CNS Tumors

LEARNING OBJECTIVES
1) Review the existing data on immunotherapy for treatment of primary and secondary brain tumors. 2) Learn about new areas of study and clinical trials. 3) Recognize challenges for response evaluation.

ABSTRACT
Response of primary and secondary brain tumors to immunotherapy has brought into question the dogma of the central nervous system as an immuno-privileged site. In this educational session, we will review the clinical data for immunotherapy in the treatment of primary and secondary brain tumors, as well as existing clinical trials. We will also discuss the challenges in determining response and possible toxicities from combined immunotherapy and brain irradiation.

Participants
Lia M. Halasz, MD, Seattle, WA (lhalasz@uw.edu) (Presenter) Nothing to Disclose

SPSH53C Radiographic Imaging and Cancer Immune Therapy

LEARNING OBJECTIVES

ABSTRACT

URL
MRI: Imaging for Radiation Treatment Planning

Thursday, Dec. 1 4:30PM - 6:00PM Room: E351

ACCRA Category 1 Credits: 1.50
ARRT Category A+ Credits: 1.50

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

**ABSTRACT**

MRI for Anatomical Definition

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

**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.

Active Handout: Eric Paulson

MRI for Functional Definition

Participants
Uulke A. van der Heide, PhD, Amsterdam, Netherlands (*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.