PHS-TUA

Physics Tuesday Poster Discussions

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

PH

AMA PRA Category 1 Credit ™: .50

FDA Discussions may include off-label uses.

Participants
Zheng Feng Lu, PhD, Chicago, IL (*Moderator*) Nothing to Disclose
Xiaohong J. Zhou, PhD, Chicago, IL (*Moderator*) Nothing to Disclose

Sub-Events

PH240-SD-TUA1 Evaluation of Simulated Radiation Dose in Chest Examinations Performed Using Super-High-Resolution CT with 0.25-mm Slice Thickness×128 Detector Rows

Station #1

Participants
Keiichi Nomura, MS, Kashiwa, Japan (*Presenter*) Nothing to Disclose
Keisuke Fujii, Nagoya, Japan (*Abstract Co-Author*) Nothing to Disclose
Yoshihisa Muramatsu, PhD, Kashiwa, Japan (*Abstract Co-Author*) Nothing to Disclose
Hirobumi Nagasawa, RT, Tokyo, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinsuke Tsukagoshi, MS, Otawara, Japan (*Abstract Co-Author*) Employee, Toshiba Corporation
Ryutaro Kakinuma, MD, PhD, Chuo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose
Noriyuki Moriyama, MD, PhD, Chuo-Ku, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

We have reported in previous studies that super-high-resolution CT images are useful for diagnosis in chest examinations (Ultra-High-Resolution CT Images of Adenocarcinomas Obtained Using a Prototype Scanner; RSNA 2013 etc.). The purpose of the present study was to evaluate radiation doses in chest examinations performed using Quarter-pixel Detector CT (QDCT) in which the channel pitch and row pitch of the detector is both one-half that of conventional MDCT.

METHOD AND MATERIALS

The simulated CTDIvol, organ doses and effective doses from QDCT were compared with the doses from conventional Multi-Detector row CT (MDCT).Method 1 CTDIvolThe chest scanning conditions for a scan range of 32 cm were 120 kV, 0.25 mm × 128 rows, 40 mA, 0.5 s/rot., and PF 0.80 for QDCT and 120 kV, 0.5 mm × 64 rows, 30 mA, 0.5 s/rot., and PF 0.83 for MDCT. We compared CTDIvol displayed on QDCT and MDCT.Method 2 Organ and effective dosesOrgan and effective doses in chest scanning conditions were evaluated with Monte Carlo simulation software (ImactMC; CT Imaging, Erlangen, Germany). For the dose simulation, the X-ray characteristics such as X-ray spectrum and bow tie filter shape for QDCT and MDCT were estimated and 3D voxelized data of an adult anthropomorphic phantom (THRA-1; Kyoto Kagaku, Japan) was derived.

RESULTS

Results 1 CTDIvolThe displayed CTDIvol (mGy) values for QDCT and MDCT were 1.9 and 2.2, respectively.Results 2 Organ and effective dosesThe organ dose values for QDCT and MDCT were 4.1 mGy and 4.7 mGy, respectively, for the thyroid, 3.1 mGy and 3.3 mGy for the lung, 2.0 mGy and 2.1 mGy for the breast, 2.8 mGy and 2.9 mGy for the liver, and 2.9 mGy and 3.1 mGy for the stomach. The effective doses defined in ICRP 103 were 1.8 mSv in QDCT and 1.9 mSv in MDCT.

CONCLUSION

QDCT provides super-high-resolution images that are useful for diagnosis in the chest with the almost same radiation doses as MDCT.

CLINICAL RELEVANCE/APPLICATION

QDCT provides super-high-resolution images for visualizing small structures with radiation exposure comparable to conventional CT, which should lead to new imaging techniques for improved diagnosis.

PH241-SD-TUA2 Microbubble Cavitation for Disruption and Antibacterial Sensitization of Staphylococcus Aureus Biofilms in Synovial Fluid

Station #2

Participants
Sana Dastgheyb, PhD, Philadelphia, PA (*Abstract Co-Author*) Nothing to Disclose
John R. Eisenbrey, PhD, Philadelphia, PA (*Presenter*) Research support, Lantheus Medical Imaging, Inc; Research funded, General Electric Company; Equipment support, General Electric Company
Maria Stanczak, MS, Philadelphia, PA (*Abstract Co-Author*) Research Grant, General Electric Company; Research Grant, Siemens AG; Research Grant, Toshiba Corporation
Flemming Forsberg, PhD, Philadelphia, PA (*Abstract Co-Author*) Equipment support, Toshiba Corporation; Research Grant, General Electric Company; Research Grant, Toshiba Corporation; Equipment support, Siemens AG; In-kind support, General Electric Company; In-kind support, Lantheus Medical Imaging, Inc
Ji-Bin Liu, MD, Philadelphia, PA (*Abstract Co-Author*) Research Grant, GluMetrics, Inc
Shunxin Zhang, MD, Beijing, China (*Abstract Co-Author*) Nothing to Disclose
Chunli Zhang, MD, Wuhan, China (*Abstract Co-Author*) Nothing to Disclose
Noreen J. Hickok, PhD, Philadelphia, PA (*Abstract Co-Author*) Researcher, Zimmer Holdings, Inc; Researcher, Synergy Technologies,

Inc; Research collaboration, Acuitive Technologies, Inc; ;

PURPOSE

Bacteria often form large biofilm-like aggregates in synovial fluid (SF) making them recalcitrant to antimicrobial therapy and difficult to eradicate. This study explored the use of microbubble cavitation to disrupt these aggregates in synovial fluid, thereby sensitizing the bacteria to antibiotic treatment.

METHOD AND MATERIALS

Staphylococcus aureus strain ATCC 25923 (n = 3 for 6 groups) were incubated overnight in either Trypticase Soy Broth (TSB) or SF with or without antibiotic (100 µg/mL cefazolin) at 37ºC. Bacterial aggregates formed overnight in 1 mL of SF were transferred to Seal-a-Meal bags. Prior to vacuum sealing, 100 µl of activated Definity microbubbles (Lantheus Medical Imaging, N. Billerica, MA) were added. Microbubble cavitation was then generated using a high mechanical index (> 0.6) flash replenishment sequence for 6 minutes on a S9Pro ultrasound scanner with a curvilinear probe (SonoScape, Shenzhen, China). Post-treatment, samples were permitted to continue incubation for an additional 12 hours. Survival of bacteria was quantified by manual colony counts after plating the sample onto TSB agar and incubating overnight at 37ºC.

RESULTS

In all groups treated with microbubble caviation, dispersion of the bacterial clumps was visually observed post treatment. Bacteria combined with ultrasound and microbubbles (without antibiotic) resulted in 7.3 E8 ± 4.6 E8 colony-forming units (CFU)/ml in SF. Bacteria and antibiotic (cefazolin, without microbubbles) resulted in 1.2 E7 ± 1.1 E6 CFU/ml in SF and 0 ± 0 CFU/ml in TSB, demonstrating the antibiotic resistance of Staphylococcus aureus aggregates in SF. However, the combination of microbubbles, ultrasound, cefazolin, and bacteria resulted in 0 ± 0 CFU/ml in SF, establishing the ability of microbubble caviation to sensitize bacterial aggregates in SF to antimicrobial therapy.

CONCLUSION

The addition of ultrasound contrast agent cavitation appears to disrupt bacterial aggregates in SF. While not lethal to the bacteria, this disruption then returns antibiotic susceptibility to bacterial aggregates.

CLINICAL RELEVANCE/APPLICATION

Ultrasound triggered microbubble cavitation may sensitize bacterial aggregates within synovial fluid to antimicrobial therapy, thereby improving clinician's ability to treat joint infection.

PH242-SD-TUA3 Verification of Dynamic ADC Change Due to Blood Flow using Cranial MRI-Phantom

Station #3

Participants
Shota Ishida, BS, Kanazawa, Japan (*Presenter*) Nothing to Disclose
Tosiaki Miyati, PhD, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Naoki Ohno, PhD, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Shinnosuke Hiratsuka, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Yuki Hiramatsu, RT, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshitaka Aoki, BS, RT, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Takaaki Ono, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose
Toshifumi Gabata, MD, Kanazawa, Japan (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

Arterial blood flow into the cranium induces fluctuation of water molecules, ie., indirect effect of blood flow, resulting in apparent diffusion coefficient (ADC)-change of the brain during the cardiac cycle (delta-ADC). However, delta-ADC includes the effect of intravoxel incoherent motion which is mainly caused by perfusion, ie., direct effect of blood flow. Therefore, we assessed the effect of blood flow on delta-ADC using an original cranial MRI-phantom to clarify this mechanism.

METHOD AND MATERIALS

On a 3.0-T MRI, we obtained sagittal diffusion weighted images of the cranial phantom using electrocardiographically (ECG)-triggered single-shot diffusion echo-planar imaging (EPI) with multiple b-values (b=0, 50, 200, 500, and 1000 s/mm2), as simulated total cerebral blood flow (500, 758, 1000, 1250, 1500 mL/s) was pumped into the phantom using a programmable pump. EPI was performed with sensitivity encoding and half-scan techniques to minimize the effect of bulk motion. Then, ADC images of 29 phases during the pulsation period were calculated in combination with b-values. Moreover, we determined delta-ADC in the high-density filter (brain tissue) of the cranial phantom. Finally, these values were compared with the regional simulated cerebral blood flow (rSCBF) obtained by pseudo-continuous arterial spin labeling technique.

RESULTS

Delta-ADCs in combination with very low b-values (eg., delta-ADC0-1000, delta-ADC50-1000) were significantly correlated with rSCBF, indicating the direct effect of blood flow on the delta-ADC. As the higher combination of b-values (eg., delta-ADC200-1000, delta-ADC500-1000), the correlation between delta-ADC and rSCBF became weaker, reducing the direct effect of the blood flow. However, the indirect effect still remained because ADC values change significantly in the pulsation period under these conditions.

CONCLUSION

Our original phantom enabled us to clarify the influence of blood flow on dynamic ADC change, and delta-ADC with higher b-value combination makes it possible to eliminate the direct effect of blood flow.

CLINICAL RELEVANCE/APPLICATION

Delta-ADC with optimized b-value combination makes it possible to obtain accurate functional information on the water-molecule fluctuation of the brain.

PH243-SD-TUA4 An Experimental Study of Pulmonary Embolism Diagnosis in Rabbits: Compare of Q-SPECT, CTPA, Q-SPECT/CT, and Q-SPECT/CTPA

Station #4

Participants
Q K. Liu, MMed, Gaungzhou, China (*Abstract Co-Author*) Nothing to Disclose
Ping Chen, MD, Guangzhou, China (*Presenter*) Nothing to Disclose
Haiping Liu, BSD, MS, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose
Peng Hou, Guangzhou, China (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Q-SPECT/CT has a higher sensitivity, accuracy than Q-SPECT and can provide diagnostic accuracy similar to both CTPA and Q-SPECT/CTPA for PE diagnosis in rabbits. Using Q-SPECT/CT imaging, the diagnosis of two readers has the best consistency.

Background

To evaluate the diagnostic ability of Q-SPECT, CTPA, Q-SPECT/CT, and Q-SPECT/CTPA through establishing PE rabbit models whose final diagnosis was confirmed by pathology.

Evaluation

(1) The PE models were made by injecting Gelfoam into the femoral veins of rabbits. Q-SPECT, CTPA, Q-SPECT/CT and Q-SPECT/CTPA fusion images were obtained by integrated SPECT/CT. (2) All images were evaluated by consensus of two experienced nuclear medicine physicians who were blinded to pathologic findings. The locations and numbers of lung lobes with PE were recorded respectively. (3) Serial sectioning of the lungs was performed and pathologic determination of locations and numbers of lung lobes with PE were recorded. (4) Sensitivity, specificity, and accuracy were compared with the McNemar test; positive predictive value (PPV) and negative predictive value (NPV) were compared with the Pearson $\chi 2$ test. Kappa analysis was used to determine the agreement between two nuclear medicine physicians. P values < 0.05 regarded as statistically significant.

Discussion

(1) Pathologic analysis revealed PE in 26 of 105 pulmonary lobes. (2) The sensitivity, specificity, accuracy, PPV, and NPV of four imaging methods: Q-SPECT was 53.9%,93.7%,83.8%,73.7%,86.1%; CTPA was 73.1%,96.2%,90.5%,86.4%,91.6%; Q-SPECT/CT was 76.9%,93.7%),89.5%,80.0%,92.5%; Q-SPECT/CTPA was 88.5%,91.1%,90.5%,76.7%,96.0%. (3) Q-SPECT/CT and Q-SPECT/CTPA had higher sensitivity for the detection of pulmonary embolism than Q-SPECT (P=0.031,0.004),Q-SPECT/CT had higher accuracy than Q-SPECT (P=0.031). (4) Kappa values of four imaging methods for readers 1 and 2 were 0.902,0.915,0.973,0.884, respectively.

PH244-SD-TUA5 Computerized Detection of Maxillary Sinusitis Using Contralateral Subtraction Technique

Station #5

Participants
Yuma Miki, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Takeshi Hara, PhD, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Chisako Muramatsu, PhD, Gifu, Japan (*Abstract Co-Author*) Nothing to Disclose
Tatsuro Hayashi, PhD, Tokyo, Japan (*Presenter*) Nothing to Disclose
Akitoshi Katsumata, DDS, PhD, Mizuho, Japan (*Abstract Co-Author*) Nothing to Disclose
Hiroshi Fujita, PhD, Gifu City, Japan (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

The proposed method could successfully locate maxillary sinus regions in images with variable positioning. The results indicate that it may be useful for drawing the attention of dentists to extraoral regions.

Background

Dental panoramic radiographs are routinely used in dental clinics for dental checkups, diagnosis and treatment. It not only visualizes the oral regions, but also pictures other sites such as mandibular joint and paranasal regions. Although radiologic information in perioral regions is beneficial, it is often ignored by dentists whose interests lie in oral regions. One such information possibly observed is radiopacity in paranasal sinus caused by maxillary sinusitis. Early detection and treatment of sinusitis are desirable for preventing its becoming chronic. Automated detection of the radiopacity regions can be useful in alerting dentists who are not focused on the perioral regions. Maxillary sinusitis due to dental caries and inappropriate treatment of dental root canal generally appears as unilateral abnormality. In this study, we developed a computerized scheme to detect it using the contralateral subtraction technique.

Evaluation

Our proposed method detects a small difference in radiopacity by subtraction of the original image from its flipped image and comparison of pixel values in regions of interest (ROIs) placed on the right and left maxillary sinuses. The ROIs are set based on the automated search of a hard palate and the average widths of tooth crowns. Preferably, dental panoramic radiographs are obtained with the Frankfort plane aligned horizontally. In order to manage the ROI setting in images with inappropriate positioning, the ROI locations are individually adjusted on the basis of the relationship between the reference line and the alveolar line. The proposed method was evaluated with two databases of 59 and 39 images including 19 cases each of maxillary sinusitis.

Discussion

Based on the visual assessment, the ROI localization was successful in more than 90% of the cases in both databases. By the receiver operating characteristic (ROC) analysis, the areas under the ROC curves for the sinusitis detection were 0.86 and 0.82 for the two databases.

PH245-SD-TUA6 Is CT Attenuation Correction Needed, How It Should be Performed, and Does it Affect Localization of Epileptic Focus in [99mTc]HM-PAO Brain SPECT?

Station #6

Participants
Miia Pitkonen I, MSc, Helsinki, Finland (*Presenter*) Nothing to Disclose
Toni Ihalainen, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose
Antti Loimaala, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose
Outi Sipila, DSc, Helsinki, Finland (*Abstract Co-Author*) Nothing to Disclose

CONCLUSION

Differences were observed between different attenuation correction methods. Their clinical significance should be further evaluated.

Background

Epilepsy patients with unknown ictal-onset zone are continuously monitored in a video-EEG suite. 64 electrodes register brain's electrical activity. [99mTc]HM-PAO injection is delivered when EEG reveals an epileptic seizure, followed by ictal SPECT-CT. Interictal SPECT-CT is executed when there are no seizures. Due to practical issues, SPECT-CT is done with or without the electrodes. A subtraction image of these two SPECT data may reveal the area of abnormal perfusion (epileptic focus).Brain tissues and metallic electrodes cause attenuation of gamma photons. Attenuation can be corrected with CT or Chang method, which assumes homogenous material inside manually defined elliptic volume. Both methods are in clinical use.We evaluated whether the different attenuation correction methods resulted in equivalent epileptic foci and how the presence of electrodes affected both methods.

Evaluation

9 epilepsy patients were included into the study; 3 patients had electrodes in ictal and interictal SPECT, 3 only in ictal SPECT and 3 in neither acquisition. SPECT data were reconstructed using CT and Chang attenuation correction methods. Interictal and ictal SPECT were normalized. Subtraction images were calculated from the coregistered interictal and ictal SPECT, and compared. In the preliminary evaluation, these two methods gave different results.To evaluate the effect of the combination of electrodes and CT automatic tube current modulation (TCM) on doses, we measured them in various locations in the brain with MOSFET dosimeters. Brain scans of a pediatric anthropomorphic phantom were performed with TCM on and off, with and without the electrodes. Use of TCM increased the dose by 9% when the electrodes were attached, and decreased it by 8% when they were not attached.

Discussion

Even though subtraction images showed different foci, the areas of greatest perfusion differences were equal. Using TCM did not substantially affect the patient dose. As the electrodes occasionally disturbed this function, we de-activated it in the protocol.

PH246-SD-TUA7 Redefining the Lower Statistical Limit in X-ray Phase-contrast Imaging

Station #7

Participants
Mathias Marschner, Garching, Germany (*Presenter*) Nothing to Disclose
Lorenz Birnbacher, DIPLPHYS, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose
Marian Willner, Munchen, Germany (*Abstract Co-Author*) Nothing to Disclose
Andreas Fehringer, DIPLPHYS, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose
Julia Herzen, Garching, Germany (*Abstract Co-Author*) Nothing to Disclose
Peter B. Noel, PhD, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose
Franz Pfeiffer, Munich, Germany (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

X-ray grating-based phase-contrast computed tomography (gbPC-CT) is currently investigated and developed as a potentially very interesting extension of conventional CT, because it provides high soft-tissue contrast for weakly absorbing samples. A major obstacle towards mainstream application of this technique is that phase retrieval fails for scans with very low dose when using the traditional phase stepping approach. We show that this lower statistical limit can be redefined by using a novel measurement procedure, which allows phase retrieval even in cases with low dose levels. This procedure relies on a linear approximation of the sinusoidal phase stepping curve around the zero crossings instead of sampling the stepping curve completely.

METHOD AND MATERIALS

A Talbot-Lau interferometer consisting of a laboratory X-ray source, three X-ray gratings and a photon counting detector is used to carry out several tomographic scans of biological soft-tissue with varying exposure times. We use this experimental data as well as simulations to compare the results of the linear approximation with the prevalent phase-stepping technique. We also examine the statistical properties of this novel method with regard to the ability to retrieve the phase information at very low photon counts.

RESULTS

We find that the linear approximation gives comparable results to the prevalent phase stepping method for scans of biological soft tissue with high statistics. For low statistics, the linear approximation is superior in the sense that the differential phase signal can be retrieved even with very low photon counts and statistical phase wrapping can be avoided. We demonstrate that this results in an improved image quality in the tomographic reconstructions, which is visible through better feature recognition and a significantly reduced noise level.

CONCLUSION

Our results show that it is possible to obtain good image quality in gbPC-CT using the linear approximation method even with very low photon counts, where the normal phase retrieval breaks down completely. Consequently, this method makes low dose gbPC-CT scans feasible, which was previously deemed impossible.

CLINICAL RELEVANCE/APPLICATION

Being able to perform low dose scans enables the development of a clinical phase-contrast CT scanner, which will feature high contrast 3D imaging of soft tissue.

PH247-SD-TUA8 Interventional Fluoroscopy: KAP and Scatter Reduction Using Eye Controlled Regional Attenuation

Station #8

Participants
Stephen Balter, PhD, New York, NY (*Presenter*) Research Consultant, ControlRad Systems, Inc
Dan Simon, MD, West Orange, NJ (*Abstract Co-Author*) control rad
Maxim Itkin, MD, Bla Cynwyd, PA (*Abstract Co-Author*) Stockholder, ControlRad Systems, Inc; Consultant, ControlRad Systems, Inc
George Dangas, MD, PhD, New York, NY (*Abstract Co-Author*) control rad
Haim Melman, Kfar Saba, Israel (*Abstract Co-Author*) Officer, ControlRad Systems, Inc

CONCLUSION

ECR measurably reduced both KAP and operator exposure by approximately 75% relative to control levels in an interventional radiology animal model without substantially increasing either fluoroscopic or procedure times. Less scatter, produced when ECR is engaged, improved subjective image quality in the ROI.

Background

This paper reports the first dose reduction results obtained using a novel technology (ControlRad Systems) called Eye Controlled Region of Interest (ECR). Its collimator includes a partially X-ray attenuating plate with a non-attenuating aperture. An eye tracker automatically positions the aperture anywhere in the active FOV of the image receptor in real time. Image processing software adjusts brightness and contrast in the aperture and peripheral region.

Evaluation

We measured the effect of applying ECR on 'patient' and operator irradiation while performing fluoroscopically guided stent placements in a 50 kg animal model. Experiments were performed using a mobile fluoroscope with a 30 cm image intensifier and fixed X-ray techniques. The factory collimator, operator's monitor, and image processing software were replaced for this study. Subject irradiation was determined by physical KAP measurements. Operator irradiation was characterized by dose and dose-rate measurements near the operator. Data were collected from three pairs of interventions in each of five subjects. The full 30 cm FOV of the image intensifier was irradiated when ECR was disengaged. When ECR was engaged: Overall fluoroscopy time was increased by 4% (sd 20%), and procedure time by 14% (sd 35%), KAP was reduced by 78% (sd 5%) and operator irradiation by 70% (sd 8%).

Discussion

Measured KAP reduction corresponds to calculations based on 100% irradiation in the aperture and 10-20 % irradiation in the remainder of the 30 cm FOV. The small difference between KAP and operator reduction can be modeled by differences in self-absorption by the subject as the aperture is moved around the FOV. Reducing beam intensity outside of the region of interest reduces the total amount of scatter inside the ROI and thus increases subject contrast within the ROI.

PH248-SD-TUA9 Functional Network Identification in Resting-State Functional MRI Data Using Reduced Dimension Granger Causality

Station #9

Participants
Adora M. D' Souza, BEng, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose
Anas Z. Abidin, MS, Rochester, NY (*Presenter*) Nothing to Disclose
Mahesh B. Nagarajan, PhD, Los Angeles, CA (*Abstract Co-Author*) Nothing to Disclose
Axel Wismueller, MD, PhD, Rochester, NY (*Abstract Co-Author*) Nothing to Disclose

PURPOSE

To explore the effect of dimension reduction on functional network identification in resting-state functional MRI (rsfMRI) using a reduced dimension Granger Causality (rdGC) analysis approach, and to compare it with conventional multivariate Granger Causality (cmGC) analysis.

METHOD AND MATERIALS

Resting-state fMRI scans through the motor cortex in 4 healthy subjects were acquired (1.5T, EPI-BOLD sequence, TR=0.5s, TE=40ms, 512 acquisitions). A finger tapping motor stimulation task sequence was used to localize the motor cortex (localization aid). Data was motion corrected and detrended. Both rdGC and cmGC were used for functional network identification in rsfMRI. Both approaches do not group voxels in similar anatomical regions; hence the influence of individual voxel time series on every other voxel can be obtained in a multivariate sense. However, they differ in how the influence is obtained. Influence scores in rdGC are obtained using the first N principal components of the time series ensemble, while the cmGC coefficients are obtained from the full time series ensemble without prior dimension reduction. These coefficients form a network whose underlying structure was recovered using spectral clustering. The recovered motor cortex network was quantitatively compared with the localization aid using both Dice Coefficient (DC) and Area under Receiver Operator Characteristic Curve (AUC).

RESULTS

The motor cortex network recovered using rdGC for N=5 (DC=0.50±0.03, AUC=0.79±0.06) and for N=10 (DC=0.53±0.03, AUC=0.80±0.04) components was in close agreement with the localization aid. In contrast, cmGC (DC=0.26±0.029, AUC=0.61±0.034) fails to recover the network, because the fMRI time series are not long enough to provide reliable estimation of network parameters, as prior dimension reduction is not applied to reduce system complexity.

CONCLUSION

The rdGC approach can identify the motor cortex network structure from rsfMRI time series, while cmGC fails to do so. Our findings suggest that rdGC is a powerful method for enabling multivariate Granger causality analysis, where cmGC would require much longer time-series to achieve a comparable performance on functional connectivity analysis in brain networks.

CLINICAL RELEVANCE/APPLICATION

Our rdGC approach can reliably infer network structure from short rsfMRI time-series which can be helpful in decreasing scan duration when imaging patients in reduced general condition and children.

PH249-SD-TUA10 Methods for Minimization of Dose to Clinical Personnel

Station #10

Participants
Lennart Karstensen, MSc, Mannheim, Germany (*Abstract Co-Author*) Nothing to Disclose
Auguste van Poelgeest, PhD, Mannheim, Germany (*Presenter*) Nothing to Disclose

CONCLUSION

A validated empirical model can be established to inform clinical personnel on the distribution of scattered radiation prior to an X-Ray scan. By giving feedback to clinical personnel on the distribution of scattered radiation for an intraoperative X-Ray scan, the position in the intervention room can be chosen accordingly. Hence the dose from scattered radiation to clinical personnel can be reduced significantly.

Background

Clinical personnel working in an intervention room using an intraoperative X-Ray scanners are repeatedly subject to scattered radiation. The accumulated dose can be reduced if, during the scan, a position is chosen in the intervention room where the dose rate is low.

Evaluation

The scattered radiation is measured for typical X-Ray screenings in an intervention room, and a model is created to estimate dose distribution for a range of screening types. The measurements are performed in an experimental intervention room where an "Artis Zeego" scans the Human Whole Body Phantom Type "SET UPh-02T". The scattered radiation is measured at various radii and angles from the X-Ray focal point using 24 digital RaySafe i2 Dosimeter. As coordinate system, polar coordinates are used with the longitudinal axis passing vertically through the X-Ray focal point, and the origin on the floor is used. The standard resolution is 5° x 0,05m x 0,2m (circular x horizontal distance x vertical distance) and the range is 360° x 2m x 2m. For regions of interest the resolution is increased to 1° x 0,01m x 0,05m.

Discussion

The scattered radiation is dependent on the focus of the X-Ray on the patient and the type of screening. Especially dose distribution in the angular dimension has a high variability: A variation of up to 36% of the exposed dose has been measured. The measurement also showed an increase in dose dependent on the height. For a given height, the dose increased, the further away the dosimeter was positioned. Thus, to protect the eyes, it may be better to stand closer to the table, assuming a full lead apron is worn.

PH012-EB-TUA Thermometry Methods for Therapy Monitoring for MRgFUS Applications

Hardcopy Backboard

Participants
Senay Mihcin, Dundee, United Kingdom (*Presenter*) Nothing to Disclose
Ioannis Karakitsios, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andrew Dennison, Dundee, United Kingdom (*Abstract Co-Author*) Nothing to Disclose
Andreas Melzer, MD, DDS, Dundee, United Kingdom (*Abstract Co-Author*) Research Consultant, IBSmm Engineering, spol sro Shareholder, VueKlar Cardiovascular Ltd Research Grant, VueKlar Cardiovascular Ltd

CONCLUSION

Baseline thermometry and reference-less thermometry produced similar results in this stationary phantom experiment. The measurements with thermocouples prove these two methods as reliable. As a next step, a moving phantom needs to be used to compare the results . Maximum temperature versus time graphs needs to be provided in the GUI for the surgeon to apply the sonication up to a certain threshold level and sonication should be stopped automatically when this temperature is achieved.

FIGURE (OPTIONAL)

http://abstract.rsna.org/uploads/2015/15008421/15008421_kk6u.jpg

Background

Thermometry methods are utilized to monitor the temperature within the patient during MRgFUS treatment. MR imaging allows thermal mapping. Temperature mapping using the Proton Resonance Frequency (PRF) shift is based on the measurement of the phase differences due to the temperature changes in the resonance frequency. Baseline and referenceless thermometry are common methods to measure temperature.For effective tumour ablation, it is crucial to monitor temperature in real time and to achieve a level of 57-60C.

Evaluation

In house code written in C++ with reference-less temperature mapping and RTHawk Software (HeartVista Inc., CA, USA) using baseline imaging methodology were used to monitor the temperature.MR imaging was performed on a tissue-mimicking phantom gel using a 1.5T scanner (Signa, HDx, GE Medical Systems, WI, USA). A cardiac coil was used for image acquisition. Axial scans of the phantom and coronal scans of the transducer were loaded on MevisLab software (MevisLab, Germany) to define the co-ordinates of the sonication area. The sonications were performed through the control PC (CPC), with power of 600 J and 1000 J for 20 s. Colour overlapping was used to show the heated area. Fibre optical thermocouples (FOTEMP-4, OPTOCON,Germany) were used as a validation tool to measure the increase in the sonicated region

Discussion

Temperature measurement with MRI is within the temperature range by the thermocouples. The difference between the measured temperature by using the baseline and by using reference-les thermometry was less than 1C°. Temperature difference by thermocouples and the MR was less than 2 C°. This was due to difficulties in sonicating near to the thermocouples due to practical limitations.