

Decrease of White Matter Integrity in Obese Adolescents: Study of Diffusion Tensor Imaging (DTI)

Sunday 11:15-11:25 AM | VSPD11-03 | Room: E451B

PURPOSE

The aim of this study is to investigate the influence of childhood obesity on changes in brain connectivity, comparing to lean adolescents, using DTI by Magnetic Resonance (MRI).

METHOD AND MATERIALS

The images were obtained on 3T MRI scanner. The sample consisted of 120 subjects: 59 obese adolescents and 61 healthy adolescents, aged 12 years to 16 years, and matched regarding gender, age, sexual development and schooling. The images were processed with the FSL-Tbss (Tract Based Spatial Statistics) program and analyzed statistically by the program MATLAB-SPM8 (Statistical Parametric Mapping) with T-test (obese group versus control group). The DTI-measure used was the Fractal Anisotropy (FA). In this study, the significant statistical level considered was 95% or $p < 0.05$. Blood tests were done to evaluate inflammatory markers ratios in order to elucidate the systemic inflammation associated with the obesity. Then, correlation maps with inflammatory markers (TNF- α , TNF- β , IL1- α , IL1- β , IL6). was performed to evaluate the influence of inflammation on cerebral changes.

RESULTS

The statistical and exploratory analysis of 339350 voxels showed a reduction of the FA values in obese patients when compared to the control group in regions located in the body of the corpus callosum (pfwe < 0.001), splenius of the corpus callosum (pfwe < 0.017) and medium orbital gyrus (pfwe < 0.044). There was no region with increased FA in obese patients. Correlation maps revealed a negative association with TNF- β and FA values in splenius of Corpus Callosum (pfwe = 0.028; $z = 3.66$; cluster = 10 voxels). IL6 also presents negative correlation with FA values in medial orbital gyrus (pfwe = 0.028; $z = 3.58$; cluster = 10 voxels) and body of Corpus Callosum (pfwe = 0.05; $z = 3.29$; cluster = 5 voxels). There were no positive correlation results with inflammatory markers and FA values.

CONCLUSION

The data reveal a pattern of damage in important regions responsible for control of appetite, emotions and cognitive functions in obese adolescents, and correlation with some inflammatory markers. Further studies need to be performed to elucidate whether, in fact, obesity inflammation is a consequence of structural changes in the brain.

CLINICAL RELEVANCE/APPLICATION

Childhood obesity is a subject of high clinical importance, and presents data of ascent from 10 to 40% of the last 10 years in most countries.

Resting State Functional MRI Connectivity in Infants with Neonatal Abstinence Syndrome

Sunday 12:30-1:00 PM | PD202-SD-SUA3 | PD Community, Learning Center, Station #3

PURPOSE

Exposure to opioids in utero is believed to have lasting consequences on brain development and behavior, including emotional dysregulation. However, little is known about the impact of in utero opioid exposure on brain function in neonates. We investigated functional connectivity (via resting-state functional MRI; rs-fMRI) of the amygdala (Amg; a limbic region pivotal for emotional function) in infants with neonatal abstinence syndrome (NAS) relative to opioid-naïve (ON) infants.

METHOD AND MATERIALS

We recruited 21 NAS and ON neonates. Subjects underwent rs-fMRI on a Siemens PRISMA 3T scanner at <48 weeks of age. After standard preprocessing, independent component analysis (ICA) was performed. The resulting components corresponded to published infant resting state networks (RSNs; see Figure). Regions of interest (ROIs) were created for the left and right Amg. ROIs were applied to the individual ICA maps, and average network coefficient values were extracted to determine the relative participation of the Amg within each RSN. Group differences in Amg RSN weights were compared with independent t-tests. Five subjects were excluded due to incidental findings and motion; data from 8 NAS and 8 ON were analyzed.

RESULTS

There were no differences between NAS and ON in mean gestational age at birth, age at MRI, and 5 min Apgar score. There were significant differences in mean birth weight and length of hospital stay. There were several significant and trend-level group differences in Amg RSN weights. NAS had higher R and L Amg RSN weights in the frontoparietal RSN ($p=0.04$; $p=0.08$) and higher L Amg RSN weights in the sensorimotor RSN ($p=0.09$). NAS had lower L Amg RSN weights in the executive control RSN ($p=0.07$), and lower R Amg RSN weights in the salience RSN ($p=0.07$).

CONCLUSION

The data suggest that in utero exposure to opioids may result in aberrant functional connectivity of the amygdala, a region involved in emotion regulation. This needs further investigation in larger samples.

CLINICAL RELEVANCE/APPLICATION

Understanding brain functional changes in neonatal abstinence syndrome is important in identifying best methods to manage this condition, and improve outcomes in these infants.

Pivotal Trial of MRI-Guided Transurethral Ultrasound Ablation (TULSA) in Patients with Localized Prostate Cancer

Monday 11:30-11:40 AM | SSC07-07 | Room: E260

PURPOSE

MRI-guided transurethral ultrasound ablation (TULSA) is an incision-free method for customized prostate ablation using directional ultrasound under MRI thermometry feedback control. We report 12-month (12mo) outcomes from the TULSA-PRO Ablation Clinical Trial (TACT) Pivotal study.

METHOD AND MATERIALS

TACT enrolled 115 men with localized prostate cancer at 13 sites. Treatment intent was whole-gland ablation sparing the urethra and urinary sphincter. Primary endpoints were adverse events and proportion of men with PSA reduction $\geq 75\%$. Secondary endpoints included 12mo 10-core biopsy, mpMRI, prostate volume reduction, and quality of life.

RESULTS

Median (IQR) age was 65 (59-69) years and PSA 6.3 (4.6-7.9) ng/ml. Pre-treatment, 72/115 (63%) men had Grade Group 2 (GG2) disease. PI-RADSv2 score ≥ 3 lesions were present in 98/115 (85%) men, ≥ 4 in 77 (67%). Ablation times were 51 (39-66) min for targeted prostate volumes of 40 (32-50) cc. MRI thermometry during treatment indicated 98% (95-99%) thermal coverage with ablation precision of ± 1.4 mm, confirmed qualitatively by post-treatment CE-MRI. Grade 3 adverse events occurred in 8% of men (all resolved), with no rectal injuries or Grade ≥ 4 events. At 12mo, 1% of men were incontinent (>1 pad/day), and 69/92 (75%) maintained erections sufficient for penetration (IIEF Q2 ≥ 2). PSA reduction $\geq 75\%$ was achieved in 110/115 (96%), with median reduction of 95% and nadir of 0.34 ng/ml. Median perfused prostate volume decreased from 41 to 4 cc at 12mo MRI. Of 68 men with baseline GG2 disease, 54 (79%) were free of GG2 on 12mo biopsy. Overall, 72/111 (65%) had no evidence of any cancer. Of 98 men with PI-RADSv2 ≥ 3 at baseline, 26 had MRI lesions at 12mo, 11/26 with biopsy-confirmed GG2 (negative predictive value, NPV 93%). Multivariate predictors of residual GG2 included intraprostatic calcifications at screening, MRI thermal coverage of target volume, and PI-RADSv2 ≥ 3 at 12mo ($p < 0.05$).

CONCLUSION

The TACT Pivotal study of MRI-guided TULSA for whole-gland ablation in men with localized prostate cancer met its primary PSA endpoint in 96% of patients, with low rates of severe toxicity and residual GG2 disease. MRI at 12mo detected residual disease with NPV of 93%.

CLINICAL RELEVANCE/APPLICATION

Whole-gland ablation using MRI-guided TULSA achieves predictable PSA and prostate volume reduction. Multiparametric MRI is promising for post-TULSA follow-up.

Special Interest Session: E-cigarette/Vaping-associated Lung Injury (EVALI)

Monday 4:30-5:30 PM | SPSI27 | Room: N228

MODERATOR

Mark L. Schiebler, MD

Disclosure: Stockholder, Stemina Biomarker Discovery, Inc. Stockholder, HealthMyne, Inc.

MODERATOR

Jeffrey S. Klein, MD

Disclosure: Editor, Wolters Kluwer nv

LEARNING OBJECTIVES

- 1) Define the public health significance of e-cigarette/vaping related associated lung disease injury (EVALI) in the USA.
- 2) Learn the common CT and CXR findings of Vaping Related Lung Disease.
- 3) Learn how the pathology helps to define the possible causes of this disorder.
- 4) Learn how vaping affects the vascular system.

SPSI27A	Introduction Travis S. Henry, MD
SPSI27B	Scope of the Problem Mark L. Schiebler, MD
SPSI27C	CXR and CT Findings of Vaping Lung Disease Seth J. Kligerman, MD
SPSI27D	Histopathology of Vaping Lung Disease Brandon T. Larsen, MD, PhD
SPSI27E	Physiological Changes with Vaping Alessandra Caporale, PhD
SPSI27F	Q&A

Deep-Learning Quantification of Coronary Calcium on CT and Mortality in the National Lung Screening Trial (NLST)

Tuesday 9:00-9:10 AM | RC303-02 | Room: E350

PURPOSE

Coronary artery calcification (CAC) is quantifiable on low-dose chest CT and can guide statin therapy. Quantification is not routinely performed due to time and equipment limitations. We developed a deep-learning algorithm that automatically quantifies coronary calcium on standard lung screening CT and evaluated prognostic value in 14,959 National Lung Screening Trial (NLST) participants.

METHOD AND MATERIALS

The deep learning algorithm was developed in 1,600 cardiac CTs from with manual CAC measurement as the reference. The deep learning calcium score was categorized as: High (CAC>300), Moderate (CAC: 101-300), Low (CAC: 1-100), and Very Low (CAC: 0). The association of the deep learning calcium score with all-cause and cardiovascular mortality was then tested in 14,959 heavy smokers aged 55-74 having lung cancer screening chest CT at 33 US sites in NLST. The intraclass correlation coefficient (ICC) between automated and human manual CAC was assessed in 396 NLST chest CTs.

RESULTS

All-cause (7.3% (1,092/14,959)) and cardiovascular (1.9% (288/14,959)) mortality was assessed over median follow-up of 6.5 years. There was a significant association between deep learning calcium score and all cause mortality: High: HR 2.9 (95%CI: 2.4-3.5), Moderate: 1.9 (1.5-2.3), Low: 1.3 (1.1-1.6), all $p < 0.01$ compared to Very Low; as well as for cardiovascular mortality: High: HR 6.6 (4.3-10.3), Moderate: 3.8 (2.3-6.1), Low: 2.2 (1.4-3.6), all $p < 0.001$ compared to Very Low. The ICC between manual and automatic calcium classes was 0.858 (95%CI: 0.830-0.882).

CONCLUSION

The automated deep learning algorithm quantified CAC on lung screening CT. Automated CAC corresponded closely to human readers and was strongly associated with all-cause and cardiovascular mortality in a large multicenter cohort of NLST participants having lung screening.

CLINICAL RELEVANCE/APPLICATION

Automated quantification of coronary calcium using existing lung screening CTs identifies persons at high and low risk to guide cardiovascular prevention.

Blood-Brain Barrier Opening in the Hippocampus and Entorhinal Cortex Using MR-Guided Focused Ultrasound in Patients with Alzheimer's Disease

Tuesday 11:20-11:30 AM | SSG11-06 | Room: N230B

PURPOSE

Alzheimer's disease (AD) is the most common cause of dementia and has no effective treatment. MR-guided low intensity focused US (LIFU) has been shown to reversibly open the blood-brain barrier (BBB), reduce amyloid- β plaque burden, improve memory and allow for targeted drug and stem-cell delivery in animals. As a proof of concept, a recent phase I clinical trial demonstrated safe and temporary opening of the BBB with LIFU in the dorsolateral prefrontal cortex in 5 patients with AD. We report initial results and MRI findings of a phase II trial, which is currently in progress to assess safety and efficacy of BBB opening within the hippocampus and entorhinal cortex at sites of abnormal amyloid burden in patients with early AD.

METHOD AND MATERIALS

Inclusion criteria of this phase II Insightec-sponsored and FDA/IRB-approved trial includes early stage AD and amyloid-PET positivity. Three successive treatments were administered to two female patients (aged 61 and 73 years) at two week intervals. Treatments consisted of stereotactic headframe placement followed by MR-guided LIFU sonication with 220kHz using the ExAblate Neuro Type 2 system and concomitant IV microbubble (Definity[®]) bolus injection. Three sonication targets in the right (first patient) and left (second patient) hippocampus/entorhinal cortex, were targeted based on anatomy and amyloid burden.

RESULTS

Post-sonication brain MRI revealed immediate IV contrast enhancement within the targeted hippocampus/entorhinal cortex and adjacent subcortical regions (figure), indicating BBB opening focally within treated areas. Resolution of contrast enhancement, indicating BBB closure, was observed at each parenchymal target within 24 hours. There were no clinical or radiologic treatment-related adverse effects. A distinctive perivascular pattern of enhancement and FLAIR hyperintensity was consistently observed.

CONCLUSION

This report of the first two patients to undergo MR-guided LIFU sonication of the hippocampus/entorhinal cortex for AD demonstrates safe, precise, reversible, and reproducible BBB opening in the hippocampus/entorhinal cortex, and a distinctive postsonication MR imaging pattern.

CLINICAL RELEVANCE/APPLICATION

Preliminary results of the first two patients to undergo MR-guided LIFU sonication of the hippocampus/entorhinal cortex for AD demonstrates safe and reversible targeted BBB opening with no adverse effects.

Influence of Callosal Microstructural Compromise on Interhemispheric Speed of Processing in Mild Traumatic Brain Injury

Tuesday 3:10-3:20 PM | SSJ18-02 | Room: S406B

PURPOSE

The corpus callosum (CC) is at specific risk in Mild Traumatic Brain Injury (MTBI) and critical for interhemispheric communication. Here we test the hypothesis that microstructural compromise as measured by diffusion MRI affects performance on a novel interhemispheric speed of processing task (IHSPT).

METHOD AND MATERIALS

The study is approved by the institutional review board. 36 MTBI subjects (11 male, 25 female; mean age 36 years) within 4 weeks of injury and 27 controls were included (12 male, 15 female; mean age 37 years). IHSPT measures latency over 80 trials between visual word stimulus presentation to the right vs left visual hemifield. Patients with positive IHSPT values were included (indicating probable left language dominance, necessitating information crossing the CC). Diffusion MRI was performed on 3T (Skyra, Siemens) with 5 b-values (up to 2.5ms/m² with 60 directions). Diffusion metrics of fractional anisotropy, diffusivity and kurtosis (mean, radial and axial; MD, RD, AD, MK, RK, AK) were calculated as well as compartment-specific white matter microstructure metrics, including axonal water fraction (f), a measure of axon density, intra-axonal diffusion (Daxon), reflective of axonal integrity, and extracellular diffusion along and perpendicular to the axis of the axon (Deperp and Dperp), sensitive to glial and inflammatory changes, and changes in myelination, respectively. Region-of-interest analysis was done using freesurfer segmentation of the CC. Relationship between IHSPT performance and diffusion measures was assessed using Pearson's partial correlation in both MTBI and control groups.

RESULTS

In controls, we found correlations between IHSPT and several diffusion measures all localizing to the splenium (MD, RD, AK, and Deperp; $p < 0.05$), lost in MTBI subjects. MTBI subjects, on the other hand, showed significant correlations between IHSPT and kurtosis diffusion measures in the genu of the CC (MK, AK, and RK) (Table 1).

CONCLUSION

In MTBI subjects, we find a relationship between CC body microstructural complexity and IHSPT not seen in controls. Furthermore, the normal relationships seen in controls between tissue microstructure and interhemispheric processing are lost after MTBI.

CLINICAL RELEVANCE/APPLICATION

Understanding how white matter injury affects cognitive performance is the critical next step for better assessing MTBI patients. Here we show altered relationships between CC microstructure and specific IHSPT between MTBI patients and controls.

Multiscale Modeling of Intra-Regional and Inter-Regional Connectivities and Their Alterations in Major Depressive Disorder

Tuesday 3:30-3:40 PM | SSJ19-04 | Room: S404CD

PURPOSE

Resting-state functional magnetic resonance imaging (rs-fMRI) studies have focused primarily on characterizing the connectivity among discrete brain regions. A major drawback is that it fails to provide a mechanistic understanding of brain cognitive function or dysfunction at cellular and circuit levels. To overcome this limitation, we developed a Multiscale Neural Model Inversion (MNMI) framework that linked microscale circuit interactions with macroscale network dynamics and estimated both local coupling and inter-regional connections based on blood oxygen-level dependent (BOLD) rs-fMRI.

METHOD AND MATERIALS

The fMRI data was obtained from a single-center, large-cohort first-episode, treatment-naïve MDD rs- fMRI database, consisting of 66 MDD adults and 66 matched normal controls (NC). We used biologically plausible Wilson-Cowan oscillators to model the dynamics of local neural circuits consisting of excitatory and inhibitory neural populations (Fig. 1). Different brain regions are connected via long-range fibers with initial strength estimated from their respective structural connectivity. The neural activity of each region was converted to BOLD signals with corresponding functional connectivity (FC) matrix using a hemodynamic model. The local and inter-regional connection parameters were optimized via stochastic optimization procedures to minimize the error between the simulated and the empirical FC matrices.

RESULTS

The recurrent excitation and inhibition within the dorsal lateral prefrontal cortex (dlPFC) were found to be reduced in MDD, consistent with the commonly accepted hypothetical model of MDD. In addition, recurrent excitation in the thalamus was found to be abnormally elevated, which may be responsible to abnormal thalamocortical oscillations often observed in MDD.

CONCLUSION

The MNMI framework was able to characterize potential intra-regional pathophysiological mechanisms of MDD, thus could be better than the conventional inter-regional FC analysis.

CLINICAL RELEVANCE/APPLICATION

Understanding impaired circuit dynamics via multiscale neural modeling helps to identify both biomarkers and pathologies of MDD, which is necessary to develop more effective diagnosis and treatment.

Injury Incidence and Patterns Associated with Electric Scooter Accidents

Tuesday 3:20-3:30 PM | SSJ06-03 | Room: S406A

PURPOSE

Electric motorized rental scooters (e-scooters, such as Bird and Lime), touted as a solution for 'last mile' problem, have the potential for significant utility in urban areas and college campuses. These vehicles can reach speeds up to 15 miles per hour. Since their legalization in our municipality on September 4, 2018, anecdotal observations have included a spike in imaging exams for 'scooter' accidents performed within our hospital system. The purpose of this study was to describe the injury incidence and imaging ordering patterns associated with the use of e-scooters in our municipality.

METHOD AND MATERIALS

Electronic medical records (EMRs) and radiology archives in our institutional database were searched for instances of imaging exams ordered to for injuries related to scooter accidents. Inclusion criteria include age 18 years or higher, seen at the ER of a performance site from 2013 to 2018, and 'scooter' included as a key word in the imaging request. Basic statistical analysis of the number and distribution of injuries diagnosed on imaging were performed.

RESULTS

A total of 69 exams performed on 36 unique emergency department patients with a definitive description of involvement of an e-scooter were identified. Two-thirds of these patients were ages 18-30 years. Of the imaging exams, a total of 44 (63.8%) were radiographs of the extremities, including 15 (34.1% of extremity exams) of the forearm/hand/wrist and 17 (38.6% of extremity exams) of the knee/leg/ankle/foot. A total of 18 CT exams (26.1%) were performed, including 13 (72.2% of CT exams) of the head, face or cervical spine. Of the 36 patients, 52.8% (N=19 patients) had documented injuries on 29 separate imaging exams with an overall exam positivity rate of 42.0%. The most common injuries included distal radial fracture (N=6), followed by soft tissue injury of the head, face, wrist, and ankle (N=5).

CONCLUSION

Over half of individuals who received imaging in the setting of e-scooter accidents were found to have a radiographically apparent injury. The injuries vary but the most common patterns include distal radial fracture and soft tissue injuries involving the head, face, wrist and ankle.

CLINICAL RELEVANCE/APPLICATION

Within our health system, imaging performed in the setting of e-scooter injuries was positive in over one half of instances. Radiographs of the extremities as well as CT of the head, face and cervical spine were the exams most likely to be ordered.

Morbidity of Breast Cancer as a Function of Screening Interval: Annual versus Biennial

Wednesday 12:15-12:45 PM | BR275-SD-WEA6 | BR Community, Learning Center, Station #6

PURPOSE

To compare breast cancer tumor characteristics and treatment regimens among women undergoing annual vs biennial screening mammography.

METHOD AND MATERIALS

This IRB-approved, HIPAA compliant retrospective study was performed at an NCI-Designated Cancer Center. Query of a breast imaging database yielded 490 consecutive patients diagnosed with breast cancer during 2016 and 2017. Of these, 232 were women aged 40-84 years undergoing annual or biennial screening with mammographically or clinically detected cancer. Annual screening was defined as 9-15 months; biennial screening as 21-27 months. Records were reviewed for patient demographics, tumor characteristics, and treatment regimens. Comparison between annual and biennial screening cohorts was conducted using t-tests or Wilcoxon rank-sum test for continuous variables and chi square or Fisher's exact tests for categorical variables.

RESULTS

Mean age at cancer diagnosis among 232 patients was 62 + 10 years. 171/232 (74%) cancers were invasive. Screening frequency was annual in 200/232 (86%) patients and biennial in 32/232 (14%). There were no significant differences in baseline characteristics between annual and biennial groups, including age, menopausal status, hormone replacement use, high risk status, family history, or race. Annual screening resulted in fewer late stage presentations (AJCC Stage 2, 3, or 4) than biennial [annual 48/200 (24%) vs biennial 14/32 (44%); p=0.02] and fewer interval cancers [annual 21/200 (11%) vs biennial 12/32 (38%); p<0.001]. Biennial screening was associated with larger mean tumor size at presentation (annual 1.4 + 1.2 cm vs biennial 1.8 + 1.6 cm; p=0.04). There was a trend towards larger median tumor size in the biennial group (annual 1.1 cm, SD 1.2 cm; biennial 1.2 cm, SD 1.6 cm; p=0.09). Compared with annual screening, biennial screening showed a trend for greater use of ALND [annual 24/200 (12%) vs biennial 6/32 (19%)] and chemotherapy [annual 55/200 (28%) vs biennial 12/32 (38%)].

CONCLUSION

Most women received annual rather than biennial screening. Biennial mammographic screening was associated with greater frequency of advanced stage disease and interval cancer.

CLINICAL RELEVANCE/APPLICATION

Biennial screening was associated with advanced stage breast cancer compared with annual screening. These results may be helpful in decision-making regarding frequency of breast cancer screening.

Efficacy of tc-MRgFUS Thalamotomy in The Treatment of Essential Tremor (ET) and Parkinson Disease (PD) Tremor: Experience From 39 Patients in A Single Centre with Long Term Follow-Up

Wednesday 12:45-1:15 PM | NR438-SD-WEB7 | NR Community, Learning Center, Station #7

PURPOSE

To report the mid and long term follow-up clinical and MR imaging results in the treatment of ET and PD tremor using tcMRgFUS thalamotomy

METHOD AND MATERIALS

In the period February 2018-March 2018, we enrolled 39 patients (22 males, 17 females, mean age 64.6 years) with disabling and refractory tremor (18 ET, 21 PD tremor, mean duration of symptomatology 10.4 years) who were subjected to unilateral Vim ablation using MRgFUS. Clinical evaluation was performed using the Fahn-Tolosa-Marin scale (FTM) for tremor and the QUEST score for quality of life, assessed before treatment, immediately after treatment and with follow-up at 1 month, 6 months and 1 year. Instrumental MRI follow-up was performed immediately after treatment and at 1-month, 3-months and 6-months follow-up. Sonication parameters were recorded in all procedures.

RESULTS

Treatment was effective (substantial and immediate reduction of tremor) in 37 out of 39 patients (94.8%). In ET patients FTM scores decreased significantly from mean values of 36.2 before treatment to 13.8 immediately after treatment. The improvement was stable at the following follow up evaluations (14.6 at 1 month, 14.3 at 6 months, 14.5 in the patients evaluated after 1 year). In PD patients FTM scores decreased from mean values of 27.5 before treatment to 11.6 immediately after treatment. At the 6-months follow up mean FTM score was 15.5, due to mild recurrence of tremor in 4 patients, that remained stable at 1 year. Quality of life evaluation showed substantial improvement in both groups (73.2% reduction of the QUEST scores in ET patients, 68% in PD). Temporary side effects and complications (dysarthria, perioral paresthesias, limb weakness) occurred in 7 patients after treatment, with resolution at the 6-months follow-up in 4 patients. Instrumental imaging follow-up showed a progressive reduction of thalamotomy lesion size and perilesional edema in both groups without significant difference between ET and PD patients

CONCLUSION

MRgFUS thalamotomy is a safe and effective treatment option for tremor in patients with ET and PD

CLINICAL RELEVANCE/APPLICATION

Our long term follow up in a consistent number of PD patients confirmed lesser stability of treatment effects in comparison with ET patients, with however significant improvement in quality of life for both patient groups.

High Dose Rate Brachytherapy in Elderly Patients with Non-Melanoma Skin Cancer - Clinical and Cosmetic Outcome

Wednesday 3:10-3:20 PM | SSM24-02 | Room: S104A

PURPOSE

High dose rate brachytherapy (HDRBT) is a well-recognized, but little used form of therapy for early stage non-melanoma skin cancer of the head and neck region. It offers a shorter course of therapy in the elderly population making it an attractive alternative to conventional electron therapy or surgical resection. We present a large series of patients treated with HDRBT using superficial molds with mature follow-up at a single community institution.

METHOD AND MATERIALS

Seventy patients with 81 lesions of either Basal cell carcinoma (BCC, n=53) or Squamous cell carcinoma (SCC, n=28) were treated between August 2013 and April 2019. The sites included nose (n=37), face (n=11), forehead/scalp (n=9), ear (n=8), neck (n=2), and legs (n=14). The median age of the patients was 85 years (range 70-100). The mean size of the lesion was 10 mm (range 3-26mm). Customized Leipzig applicators were used to treat the lesion with a 4 mm margin. A fractionation regimen of 700 cGy per fraction for 6 sessions over two weeks was used. The dose was prescribed at 3 mm depth. The patients were followed regularly in both radiation oncology and dermatology clinics.

RESULTS

The median follow-up was 24 months (range 1-48). The local control was 98% for BCC and 96% for SCC respectively. Two patients, 1 each with SCC and BCC recurred at 3 and 6 months from the time of therapy respectively. Both the recurrences were >2cm in size and involved lower extremity. The cosmetic outlook was excellent in 90% of all cases. Minor late effects in 6 patients included Hypopigmentation (n=3), Hyperpigmentation (n=2), telangiectasia (n=2) and atrophy of the skin (n=1). Two patients experienced wound breakdown 12 and 14 months after completion of therapy. No cases of cartilage necrosis was seen.

CONCLUSION

HDRBT using customized mold applicators offer an alternative option to Mohs surgery in elderly patients with early stage non-melanoma skin cancers with excellent local control and cosmetic outcome.

CLINICAL RELEVANCE/APPLICATION

High dose rate brachytherapy using customized superficial mold applicators offer an alternative strategy to Mohs surgical resection for elderly patients presenting with early stage basal and squamous cell carcinoma of the skin in the head and neck region.

Oral Contraceptive Use Is Associated with Smaller Hypothalamic Volumes in Healthy Women

Wednesday 3:30-3:40 PM | SSM19-04 | Room: S501ABC

PURPOSE

There is limited evidence on the structural and functional effects of hormonal contraceptives on the brain. In particular, these effects on the hypothalamus are not known. In this study, we aim to identify alteration of hypothalamic volume associated with oral contraceptive pill (OCP) use in healthy women.

METHOD AND MATERIALS

We acquired high-resolution MR images of the brain at 3T for a prospective cohort of 50 healthy women. Psychometric tests (Cogstate and PROMIS) were administered at the time of imaging. 21 participants took OCPs at the time of imaging while 29 did not. After training and validation, 5 raters independently performed manual segmentation of the hypothalamus using ITK-SNAP. Total intracranial volume (tICV) was determined using FreeSurfer. The intraclass correlation was calculated for a subset of 20 randomly selected cases to assess inter-rater reliability. A general linear model was fit to test for the association of OCP use with hypothalamic volume, with tICV and birth control used as covariates. Additional exploratory analyses assessed associations with menstrual cycle phase and with cognitive and health measures.

RESULTS

The inter-rater ICC was 0.86. Total hypothalamic volume in participants taking OCPs was smaller than those not taking OCPs ($b=-63.4 \pm 22.2$, $p=0.006$). There was a significant association of hypothalamic volume with greater anger ($p=0.02$) as well as a strong correlation with depression ($p=0.09$). However, no significant correlation was found between hypothalamic volume and cognitive testing results.

CONCLUSION

Our hypothalamic segmentation method is highly reliable. OCP use is associated with smaller total hypothalamic volume, which may be related to interference with known trophic effects of sex hormones and provide a structural mechanism for OCP-mediated inhibition of folliculogenesis as well as potential functional effects.

CLINICAL RELEVANCE/APPLICATION

Characterizing effects of OCPs on the hypothalamus provides a bridge to understanding functional alterations associated with OCP use that may impact selection of contraceptive method.

Blood-Brain Barrier Water Permeability Disruption in Major Depressive Disorder

Wednesday 3:40-3:50 PM | SSM19-05 | Room: S501ABC

PURPOSE

Major depressive disorder (MDD) is the most prevalent and disabling form of depression. Blood-brain barrier (BBB) disruption has been implicated in the development and progression of MDD. The purpose of this study was to investigate differences in BBB integrity between patients with MDD and healthy subjects using the recently developed Intrinsic Diffusivity Encoding of Arterial Labeled Spins (IDEALS) MRI technique.

METHOD AND MATERIALS

14 healthy subjects and 14 MDD patients were recruited with IRB approval and informed consent. Depression symptom severity was assessed with the Beck's Depression Index (demographics in Table 1). All studies were performed on a Siemens 3T Prisma MRI with 64-channel head/neck coil. IDEALS images were acquired according to (Wengler et al. *NeuroImage*, 2019) for mapping of cerebral blood flow (CBF), water extraction fraction (Ew), and water permeability (PSw). High resolution T1w images were acquired for segmentation and spatial normalization. Four regions of interest (ROIs) implicated in MDD were evaluated: anterior cingulate cortex (ACC), amygdala, dorsolateral prefrontal cortex (DLPFC), and hippocampus. ROIs were selected using WFU Pickatlas. Analysis of covariance (ANCOVA) was used to evaluate group differences between BBB water permeability parameters within the 4 ROIs while controlling for age and gender; $p < 0.05$ was considered significant.

RESULTS

Figure 1 displays the group averaged IDEALS parameter maps. Box plots with individual data points for PSw, Ew, and CBF within ROIs are shown in Figure 2. Figure 3 displays the mean values after adjusting for age and gender. No significant differences in CBF between healthy subjects and MDD patients were. Significantly lower Ew was observed in the amygdala, ACC, DLPFC, and hippocampus of MDD patients compared to healthy subjects. Significantly lower PSw was observed in the amygdala and hippocampus of MDD patients compared to healthy subjects.

CONCLUSION

With active trans-membrane water cycling pathways, such as NaK-ATPase, accounting for a large fraction of water exchange, the lower BBB water permeability observed in MDD patients suggests BBB disruption and cerebral metabolic deficits.

CLINICAL RELEVANCE/APPLICATION

Despite its societal impact, the mechanisms underlying major depressive disorder (MDD) are not well understood. This study uses the IDEALS MRI method to probe BBB water permeability disruption in MDD.

Shot, but Not Forgotten: Predicting Long-Term Consequences of Gun Shot Wound-Related Injuries

Thursday 12:15-12:45 PM | HP226-SD-THA3 | HP Community, Learning Center, Station #3

PURPOSE

There continues to be profound lack of substantial information related to gun violence, particularly in predicting long term outcomes. As sites of initial evaluation and follow up, healthcare centers are in a unique position to study predictors of health in patients with a history of gunshot wound (GSW) who represent to the emergency room (ER). The goal of our study was to identify variables that may help predict readmission or reoperation in patients with a history of GSW.

METHOD AND MATERIALS

A retrospective analysis was performed by searching a database from a single institution for non-acute GSW-related imaging exams from January 2018 to April 2018. Their original GSW-related injury pattern on imaging was recorded (neurologic, vascular, visceral, musculoskeletal, multiple) and clinical information regarding prior hospital course (admitting unit) and subsequent encounters (readmission, surgical history) was collected. Demographics (age and gender) were also collected. Imaging studies were examined for bullet morphology (intact, deformed/shrapnel). A total of 174 imaging studies for 110 patients were queried.

RESULTS

The average patient age for our non-acute GSW patient population is 49.7 (SD 16.3) with men accounting for 91.8% (N=101) of non-acute GSW-related imaging. Partial correlation was used to explore the relationship between injury pattern on prior imaging and readmission whilst controlling for age. There was a moderate positive correlation between injury type, namely neurologic and visceral, and subsequent readmission, which were statistically significant $r(107) = .436$, $N=110$, $P < .001$. However, an inspection of the zero order correlation ($r = .514$) suggested that controlling for age had some effect on the strength of the relationship between the two variables. There was a moderate positive correlation between admitting unit (i.e. ICU) during initial GSW encounter and subsequent reoperation, which was statistically significant $r(107) = .494$, $N=110$, $P < .001$. An inspection of the zero order correlation ($r = .495$) suggested that controlling for age had very little effect on the strength of the relationship between these two variables. Logistic regression was performed to assess the impact of a number of factors on the likelihood that GSW patients would be readmitted. The model contained independent variables (age, injury type, region injured, and bullet morphology). The full model containing all predictors was statistically significant, $X^2(5, N=110) = 56.8$, $P < .001$. The strongest predictor of readmission was prior injury type, namely visceral injury, with an odds ratio of 6.44.

CONCLUSION

This retrospective study suggests an association between GSW injury type and readmission. Furthermore, patients who had a prior visceral GSW-related injury were more likely to be readmitted than other GSW-related injuries.

CLINICAL RELEVANCE/APPLICATION

Morbidity and outcomes from gun violence can only be assessed after a firm understanding of injury patterns on imaging. A location/injury severity scale based on imaging findings could be used to predict long term consequences as well as extrapolate costs, and quality of life years (QALYs).

The Art of Imaging Methods - Using Micro-CT to Uncover the Secrets of Ancient Ivory Manikins

Thursday 12:45-1:15 PM | HP227-SD-THB1 | HP Community, Learning Center, Station #1

PURPOSE

Ivory anatomical manikins, allowing the extraction of individual organs, are thought to have been carved in Germany in the late 16th or 17th century. While these manikins may have been used for the study of medical anatomy, little is known about their origin. Our institution holds the largest collection of these manikins (22 out of 180 known manikins worldwide). This study aims to utilize micro-computer tomography (mCT) scanning to investigate the composition of these anatomical manikins. In particular, we hope to determine the ivory type, appreciate repairs and alterations (like pins and screws) that are not visualized by the naked eye, and allow more precise estimations of their age.

METHOD AND MATERIALS

Complete mCT scans of all 22 manikins were performed on an XT H 225 ST Nikon Micro-CT scanner at 150-200 kV with an average exposure time of 267 msec and a slice thickness of 40-80 micrometers. Comparison mCT images of whale bone, deer antler, mammoth/elephant ivory, and rhinoceros horn were extracted from the existing literature. Axial mCT slices of all 22 manikins were evaluated to determine the ivory/bone composition/source, as well as materials other than ivory/bone, such as repairs and pins used in hinging mechanisms.

RESULTS

Twenty out of 22 manikins were made from ivory alone, one figurine was made of antler material and one figurine contained both ivory and whale bone (Figure 1). Metallic components (pins, linings) were found in four manikins and fibers (e. g. 'umbilical cords', Figure 1) were found in two manikins. Eleven manikins contained hinging mechanisms or internal repairs with ivory pins. Trade routes are being analyzed by archeologists to narrow down the time period in which these manikins may have been produced.

CONCLUSION

mCT can be used to identify the different components of fragile archeological manikins. This may enable archeologists to draw conclusions concerning their origins, and further make 3D-renderings and subsequent 3D-prints possible.

CLINICAL RELEVANCE/APPLICATION

Medical imaging methods can benefit arts and archeology significantly by revealing the composition of fragile historical pieces, allowing better understanding of object age, and making these pieces more readily accessible to 3D-printing.