

Role of Cerebrospinal Fluid in Spaceflight-Induced Visual Impairment and Ocular Changes

Monday 11:00-11:10 AM | SSC11-04 | Room: N226

PURPOSE

Ocular and vision changes known as visual impairment intracranial pressure (VIIP) syndrome have been reported in nearly two thirds of long-duration mission International Space Station (ISS) astronauts. These changes are currently attributed to cephalad vascular fluid shift induced by exposure to microgravity. This study assesses ocular shape and CSF volume changes related to spaceflight to determine the underlying cause for these changes.

METHOD AND MATERIALS

High resolution orbit and brain MRI scans before and shortly after spaceflights for 7 long-duration mission ISS astronauts and 9 short-duration mission Space Shuttle astronauts were analytically measured and compared. Post flight increases in globe flattening and nerve protrusion were tested for association with increases in intra-orbital CSF volume, ventricular CSF volume, and brain tissue interstitial fluid volume.

RESULTS

Compared to short-duration astronauts, long-duration astronauts had significantly greater post-flight increases in globe flattening indices ($p < 0.00001$) and optic nerve protrusion indices ($p < 0.00001$). Long-duration astronauts also had significantly greater post flight increases in orbital CSF volume ($p = 0.005$) and ventricular CSF volume ($p = 0.048$). There were no significant post flight changes of grey matter volume or white matter volume in either group. The large post spaceflight ocular changes observed in ISS crewmembers were associated with greater increases in intra-orbital and intracranial CSF volume but not with interstitial brain tissue fluid volume.

CONCLUSION

The strong positive relationships between globe deformations and CSF volumes increases without changes to brain volumes indicate CSF has a direct role in spaceflight induced ocular changes. Vascular fluid shift has a lesser role than CSF in microgravity duced visual impairments and ocular changes syndrome.

CLINICAL RELEVANCE/APPLICATION

This study elucidate the previously unexplored role of the CSF in the formation of space-induced visual impairments. Identifying the origin for the space-induced ocular changes is necessary for the development of countermeasure to protect the crew from the ill effects of long-duration exposure to microgravity.

Body Composition Predictors of Trabecular and Cortical Microarchitecture in Adolescents with Morbid Obesity

Monday 12:45-1:15 PM | PD219-SD-MOB5 | PD Community, Learning Center Station #5

PURPOSE

Obesity was believed to be protective for bone health; however, recent studies have shown that childhood obesity is associated with higher incidence of forearm fractures. The purpose of our study was to determine predictors of trabecular and cortical microarchitecture of the distal radius in adolescents with morbid obesity. We hypothesized that lean mass would be positively, and visceral adiposity negatively, associated with bone microarchitecture in this population.

METHOD AND MATERIALS

Our study was IRB approved and HIPAA compliant. Written informed consent was obtained. We recruited 11 adolescents (mean age: 16 ± 2 years, 9 f, 2 m – recruitment is ongoing) with morbid obesity (mean BMI: 42 ± 6 kg/m²). 3D HR-pQCT of the distal radius was performed with an isotropic voxel size of 82 μ m (Xtreme CT, Scanco Medical, Basserdorf, Switzerland) to assess cortical and trabecular microarchitecture, including individual trabecular segmentation (ITS), which models the trabecular region as a lattice of individual plates and rods. Body composition, including estimated visceral adipose tissue (VAT) mass was determined by DXA (Discovery A; Hologic, Bedford, MA, USA). Non-parametric linear regression analysis was performed to determine body composition predictors of bone microarchitecture.

RESULTS

Two subjects were unable to undergo HR-pQCT due to body size. BMI was positively associated with cortical thickness ($r=0.82$, $p=0.007$) and cortical area ($r=0.68$, $p=0.04$). Lean mass was positively associated with trabecular density and volume ($r=0.77$, $p=0.02$ for both correlations), and measures of trabecular integrity by ITS ($r=0.72$ to 0.83 , $p=0.04$ to 0.003). VAT mass was positively associated with cortical porosity ($r=0.73$, $p=0.02$).

CONCLUSION

Lean mass is a positive predictor of measures of trabecular integrity, whereas VAT is a negative predictor of cortical integrity in adolescents with morbid obesity.

CLINICAL RELEVANCE/APPLICATION

High VAT mass and low lean mass are risk factors for skeletal dysregulation in adolescents with morbid obesity.

Neuroradiological Findings Related to Zika Epidemic: Experience from a Brazilian University Hospital

Wednesday 12:45-1:15 PM | NR394-SD-WEB2 | NR Community, Learning Center Station #2

PURPOSE

Present the imaging aspects in the three target groups affected by Zika virus infection, as follows: adults who developed acute neurological syndrome, newborns with vertical infection with neurological disorders and pregnant woman who presented suggestive exanthematic fever syndrome by Zika.

METHOD AND MATERIALS

Since January 2016 we received patients with exanthematic fever suggesting Zika to perform imaging exams, and we divided these patients, as described. Neural axis MRI were performed in adult patients with acute neurological syndrome after exanthematic fever suggestive of Zika infection. Newborns with microcephaly whose mothers had exanthematic fever underwent brain MRI, some also with US and CT, and histopathological study of the placenta. Fetal MRI was performed in pregnant women who have had exanthematic fever. There is a limited ability for laboratory confirmation of Zika in the locations affected by the epidemic, so that exanthematic fever was considered as a marker for infection. Patients were scanned with a 1,5T MRI, and in adults using a protocol with pre and post contrast acquisitions.

RESULTS

Most adult patients presented with symptoms of Guillain-Barré syndrome and variants, a few patients presented with encephalomyelitis. The most common finding was lumbar root enhancement followed by lumbar dorsal ganglia enhancement and facial nerve enhancement. Other findings included brain stem lesions with high T2/FLAIR signal, spinal cord lesions with high T2/FLAIR signal, and trigeminal nerve enhancement. We found good correlation of symptoms and imaging findings. In newborns MRI and fetal MRI showed anatomical changes in the brain parenchyma and orbital injuries.

CONCLUSION

MRI was used in clinical investigation of adult patients, excluding other common diseases in this age group, helping in the different diagnosis, given the limited availability of specific serologic test for Zika in Brazil. We observed acute neurological syndromes related to Zika, such as Guillain-Barré syndrome and Miller Fisher variant, Bickerstaff syndrome, and encephalomyelitis. In newborns and fetuses anatomical changes can be related to gestational age which pregnant had the exanthematic fever.

CLINICAL RELEVANCE/APPLICATION

MRI is a sensitive tool for demonstrating signs of Guillain-Barré syndrome and encephalomyelitis associated with Zika virus. In newborns and fetuses, MRI helped us understand the injuries that occur in the developing brain, as other TORCH.

Relationship Between MEG and Diffusion Imaging Measured Changes Over a Season of High School Football

Monday 3:10-3:20 PM | SSE20-02 | Room: S102AB

PURPOSE

The purpose of this study is to characterize associations between Diffusion Tensor Imaging (DTI), Diffusion Kurtosis Imaging (DKI), and magnetoencephalographic (MEG) measure delta waves over a season of high school football in the absence of clinical concussion.

METHOD AND MATERIALS

Twenty-four players from a high school football team (mean age=16.9; no history of concussion) were instrumented with the Head Impact Telemetry System (HITS) during all practices and games. The biomechanical metric Risk Weighted cumulative Exposure (RWE) was computed. All players received pre- and post-season MRI. Whole-brain DTI images were acquired using a 2D single-shot EPI sequence. DTI-derived metrics were calculated using DTI-TK. DKI-derived metrics were computed using the Diffusional Kurtosis Estimator. Eight minutes of eyes-open, resting-state MEG data were acquired pre- and post-season for each subject and brain space delta wave power was computed. Changes (post-minus pre-season) of each metric were computed for each subject and then used to determine the total number of abnormal voxels (2 standard deviations above or below the group mean). We have previously shown changes in select DTI, DKI, and MEG metrics to correlate with RWE. Spearman's rank correlation analyses were performed to examine the relationships between MEG, DTI, and DKI data.

RESULTS

Spearman's rank correlation analyses revealed a statistically significant association between the number of abnormal SKI Tortuosity voxels and abnormally increased MEG delta power voxels. There was also a strong correlation between DTI axonal water fraction (AWF) and MEG delta power.

CONCLUSION

We demonstrate a significant correlation between the changes in tortuosity and MEG delta power over a season of high school football in the absence of clinical concussion. Fractional anisotropy (FA) was not significant, possibly because it is a less specific measurement. Tortuosity is expected to be sensitive to the myelinated axonal fraction where FA is a measure of general anisotropy. The relationship of Tortuosity with delta waves may indicate a correlation between the number of myelinated axons and delta waves.

CLINICAL RELEVANCE/APPLICATION

Both DKI and MEG may be more sensitive than current conventional imaging and they may provide information regarding physiological changes mediating sub concussive and concussive injuries.

DTI in Healthy Children Pre/Post Musical Training

Wednesday 12:15-12:45 PM | PD235-SD-WEA1 | PD Community, Learning Center Station #1

PURPOSE

Music modulates structural and functional changes in the brain, which promotes cognitive, motor, sensory, emotional and even social processes. The maturation of tracts and connections between motor, auditory and other modalities areas, allow the development of cognitive functions during the course of life, including musical skills.

METHOD AND MATERIALS

15 pediatric healthy subjects between 5 and 6 years old were recruited for this study. All subjects were: right handed, and had no antecedents of sensory, perception or neurological disorders. All volunteers had not been trained in the past with any kind of artistic discipline. Volunteers were healthy during the study protocol. Scanning was performed in a 1.5 T Philips-InteraAchieva scanner (Philips). Children received musical training for 9 months. Diffusion tensor imaging (DTI) data were acquired using a SE-EPI sequence. Diffusion weighted gradients were applied along 15 non-collinear directions with a b-value=800 s/mm². High-resolution images were acquired using 3DT1. The diffusion tensor was fitted with linear least-square after a preprocessing step correcting for head movements and eddy currents was applied by registering all volumes. Finally, using MEDINRI, diffusion tensors were calculated to obtain Fractional Anisotropy (FA) with FA threshold of 0.2 and Mean Diffusivity values. Segmentation of the cerebellum CB was manually drawn on midline sagittal 3D-T1 images.

RESULTS

It shows that there was an increase in fiber length of minor forceps, which involves fibers interconnecting the front regions and some axons of the cingulate cortex rostral anterior and medial and ventral prefrontal cortex via the knee and face of the corpus callosum, which could be cause by music instruction and demand required to perform certain activities that are within the training, such as imitate coordinated movements.

CONCLUSION

We show the plastic effects that can provide music instruction to extend axons of the fibers, especially in the minor forceps are evident. This may have occurred because of the need to create more connection between the two hemispheres to run more efficiently the tasks required for musical training.

CLINICAL RELEVANCE/APPLICATION

Musical training might be an option for intervention to treat the disorders mentioned above, because although it is known that music can help patients with autism and ADHD, with the results shown in this paper, could create targeted strategies especially these pathologies.

Diabetes and Mortality in the National Lung Screening Trial

Sunday 1:00-1:30 PM | CH241-SD-SUB1 | CH Community, Learning Center Station #1

PURPOSE

Presence of diabetes increases mortality, but extent to which diabetes increases lung and other cancer mortality among heavy smokers is unclear. We examined the risk for all-cause, lung cancer and non-lung cancer mortality among people with vs without diabetes followed in the National Lung Screening Trial (NLST) cohort.

METHOD AND MATERIALS

There were 53,212 participants enrolled in the NLST trial, and 5,174 reported having diabetes at screening. Over the course of the study, there were 3,936 total deaths, 1,021 from lung cancer and 826 non-lung cancer. Cox proportional hazards regression models were used to examine the relative risk for overall, lung cancer and non-lung cancer mortality associated with diabetes, adjusted for age, gender, randomization group and covariates of interest (body mass index [BMI] and pack-years of smoking).

RESULTS

Subjects with diabetes were older (62 ± 5 vs. 61 ± 5 years, $p < 0.0001$), reported more pack-years of smoking (62 ± 29 vs. 55 ± 23 , $p < 0.001$), and had higher BMI (31.1 ± 5.8 vs 27.6 ± 4.9 , $p < 0.0001$) than people without diabetes at screening. There were 650 deaths (12.6%) among participants with diabetes, vs 3,286 deaths (6.8%) among non-diabetic subjects ($p < 0.0001$). In cox proportional hazards models, diabetes was associated with an increased risk for all-cause mortality (RR=2.2, 95% CI 1.8-2.6, $p < 0.0001$), lung cancer mortality (RR=1.8, 95% CI 1.3-2.5, $p = 0.0008$) and non-lung cancer mortality (RR 1.6, 95% CI 1.04- 2.3, $p = 0.03$) in women. Among men, diabetes increased the risk only for all-cause (RR=1.7, 95% CI 1.5- 1.9, $p < 0.0001$) and non-lung cancer mortality (RR=1.68 (95% CI 1.3-2.0, $p < 0.0001$), but not lung cancer (RR=1.1, 95% CI 0.8-1.4, $p = 0.63$).

CONCLUSION

Diabetes increases the risk of death from all causes and non-lung cancer deaths among heavy smokers, and increases the risk for lung cancer mortality in women.

CLINICAL RELEVANCE/APPLICATION

Heavy smokers with diabetes are at increased risk for mortality from cancer at sites other than the lung in men and both lung and non-lung cancers in women compared to non-diabetic subjects.

Characterization of All-terrain Vehicle-related Chest Injury Patterns in Children

Tuesday 9:30-9:40 AM | RC313-06 | Room: N228

PURPOSE

To evaluate chest injury patterns in pediatric patients involved in all-terrain vehicle (ATV) accidents.

METHOD AND MATERIALS

A retrospective review of the trauma registry at a level I trauma institution from 1992-2013 was performed for patients between 0-18 years admitted after ATV-related incidents. Only patients with chest imaging were included. Type of chest injuries, mechanism of injury, driver/passenger status and demographic data were recorded. Clinical data such as length of hospital stay and intensive care unit (ICU) admission were documented. Comparison of demographic data and clinical data between patients with and without chest injury was conducted using the Chi-square test for categorical variables and two-sample t test for continuous variables.

RESULTS

A total of 455 pediatric patients were admitted after an ATV injury during the study period. Of these, 102 patients (22%) had a chest injury. Most injuries occurred due to a rollover (44/102, 43%), collision with landscape (20/102, 20%) or falls (16/102, 16%). The patient was the driver in 41 (40%) and passenger in 33 (32%) cases (others unknown). Patients with chest injury were older (13 vs 11 years, P 0.0027), taller (157 cm vs 148 cm, P 0.0012), and heavier (57 kg vs 48 kg, P 0.0006) than those without chest injury. The most common injury was pulmonary contusion (62/102, 61%), followed by pneumothorax (46/102, 45%) and non-flail rib fracture(s) (35/102, 34%). There were no cardiac, esophageal, or airway injuries, and no vascular injury other than a case of subclavian artery transection. Patients with chest injury more often required ICU care (41/102, 40% compared to 77/353, 22%, P 0.0002) and had longer median hospital stay (3 days vs 2 days, P 0.0054) compared to patients without chest injury. Eight patients with chest injury died (8%).

CONCLUSION

Chest injuries are a relatively common occurrence in children following ATV accidents, which remain a significant public health issue in terms of morbidity and mortality. Patients with chest injuries were more likely to require ICU care and to have a longer hospital stay.

CLINICAL RELEVANCE/APPLICATION

Chest injuries following ATV accidents in the pediatric population are common and increased public awareness of these potentially devastating injuries is needed.

Association between Alcohol Consumption and Presence of Coronary Artery Disease

Tuesday 11:20-11:30 AM | SSG02-06 | Room: S502AB

PURPOSE

It has been suggested that light alcohol consumption is associated with reduced risk for coronary artery disease (CAD). However, data regarding regular alcohol consumption and its association with the presence of CAD still remain controversial. The aim of this study was to assess the association between alcohol consumption and the presence of CAD as detected by coronary CT angiography (CTA).

METHOD AND MATERIALS

Consecutive patients referred for coronary CTA were enrolled in our study. We excluded patients with history of stroke, acute myocardial infarction or coronary revascularization. The weekly alcohol consumption was registered using a questionnaire. Alcohol units were calculated as follows: 1 unit equals 2 dl beer or 1 dl wine or 4 cl spirit. Based on the presence of any plaque on coronary CTA we classified the patients in CAD and no CAD groups.

RESULTS

In total, 1,925 patients were enrolled (mean age 57.3 ± 16.1 years, females 43.1%). Atherosclerotic plaque was present in at least one coronary segment in 74.3% of the patients. Alcohol consumption was reported by 37.3% of the patients with a median of 6.7 (IQR:3.3;10.8, range:0.2-66.7) units weekly. Using univariate analysis to compare CAD and no CAD patients we found significant difference regarding cardiovascular risk factors ($p < 0.001$) but no difference in alcohol consumption ($p = 0.35$). After adjusting for cardiovascular risk factors with logistic regression we found no association between alcohol intake and the presence of CAD (OR:1.00;CI:0.98-1.02; $p = 0.76$). We performed a secondary analysis to assess the relationship between alcohol consumption and CAD among no drinkers and light drinkers (maximum 14 units per week; 82.7% of alcohol drinkers) and found no association (OR: 1.02;CI:0.98-1.06; $p = 0.33$). Furthermore, we analyzed the effect of different alcohol types (wine, beer, spirit) on the presence of CAD, but no relationship was found.

CONCLUSION

Our study suggests that the amount of weekly alcohol consumption does not show association with the presence of CAD. We did not detect any association between alcohol intake and CAD among light drinkers either. In addition, we did not find any association between the different alcohol types and the presence of coronary atherosclerosis.

CLINICAL RELEVANCE/APPLICATION

It seems that there is no association between light to moderate alcohol consumption and coronary artery disease.

Longitudinal Analysis of Brain Degeneration in MCI using a Biomechanical Framework

Wednesday 11:20-11:30 AM | SSK14-06 | Room: N226

PURPOSE

The purpose of this study was to characterize the brain degeneration profiles for subjects with mild cognitive impairment (MCI) under different intensities of exercise intervention. Finite strain theory was applied to analyze not only brain volume changes, but also directional/shear deformations. We hypothesize that there will be directionally different brain degeneration patterns in MCI adults according to the exercise intervention.

METHOD AND MATERIALS

Longitudinal MR images for 35 adults with MCI were acquired as part of a randomized controlled trial investigating an exercise intervention (n=16 aerobic exercise, n=19 stretching control). Brain MRI was acquired at baseline and 6-months later after the exercise intervention on 3T-Siemens Skyra using a high-resolution 20 channel head/neck coil (Siemens Healthcare, Erlangen, Germany). High-resolution structural anatomic T1-weighted images of each subject were collected from which the deformation field during the 6 months period was estimated. Volumetric and directional/shear deformation parameters were derived from the image registration and all parameter maps were warped to standard MNI152_T1 space. Voxel wise statistical analysis was applied to see the effects of the type of exercise intervention.

RESULTS

For both aerobic and stretching exercise groups, volumetric increases were observed in most regions of the gray matter ($p < 0.05$ with FDR correction). However, right posterior corona radiata showed volumetric contraction in stretching control. Different volumetric increases were observed between groups around the genu of corpus callosum, right middle temporal gyrus and bilateral superior frontal gyri, showing higher volumetric expansions ($p < 0.005$, cluster size threshold=608 voxels). Directional/shear deformation patterns also showed similar patterns with volume changes in most statistically significant brain regions.

CONCLUSION

Aerobic exercise intervention could preserve or possibly even improve brain volumes in MCI subjects compared to stretching control.

CLINICAL RELEVANCE/APPLICATION

The proposed biomechanical metrics appear to be sensitive biomarkers for evaluating interventions in subjects with MCI. These structural biomarkers could be used for classification of MCI and Alzheimer's disease via machine learning algorithms, which could improve the sensitivity and specificity of neurodegenerative disease prognosis and diagnosis.

Effects of 24-hour-shift Related Short Term Sleep Deprivation on Cardiac Function: a CMR Based Study

Friday 10:50-11:00 AM | SST02-03 | Room: E450A

PURPOSE

Sleep deprivation is known to increase blood pressure, inflammatory processes, and stress hormone secretion. This study sought to investigate the immediate effects of 24 hour shift associated sleep deprivation on radiologists.

METHOD AND MATERIALS

15 subjects (1, female, mean age 31.6 ± 2.1 years; mean EF 60.5%) were scanned on a clinical 1.5 T CMR scanner (Philips Ingenia) before and following a 24 hour shift with an average of 3 hours of sleep. In addition venous blood and urine samples were collected from all subjects and blood pressure (BP) as well as heart rate (HR) were measured. Short axis slices as well as horizontal long axis views were acquired using standard SSFP-sequences. Standard CMR parameters for left ventricular volumes, ejection fraction and wall thickness as well as Feature Tracking derived circumferential and longitudinal strain parameters were measured.

RESULTS

Following short term sleep deprivation (average sleep duration: 182 min) significant increases in systolic (pre: 112.6 ± 12.9 mm Hg; post: 118.5 ± 14.3 mm Hg; $p=0.017$) and diastolic BP (pre: 63.9 ± 12.3 mm Hg; post 71.5 ± 7.7 mm Hg, $p=0.021$), HR (pre: 66 ± 9.8 min⁻¹; post: 71.4 ± 11.6 min⁻¹; $p=0.002$) as well as peak systolic circumferential strain (PSCS; pre: $-22.3 \pm 2.4\%$; post: $-23.9 \pm 2.4\%$, $p=0.011$) and peak systolic longitudinal strain (PSLS; pre: $-21.4 \pm 1.9\% \cdot s^{-1}$, post: $-23.1 \pm 1.9\% \cdot s^{-1}$, $p=0.005$) were revealed. Additionally significant increases in cortisol (pre: 10.0 ± 4.4 µg/dl; post: 14.7 ± 5.7 µg/dl; $p=0.023$), TSH (pre: 1.6 ± 0.5 µU/ml, post: 2.7 ± 1.0 µU/ml; $p=0.002$) FT3 (pre: 3.1 ± 0.98 pg/ml, post: 3.4 ± 0.5 pg/ml; $p=0.039$) and FT4 (pre: 0.9 ± 0.1 ng/dl, post: 1.0 ± 0.1 ng/dl; $p=0.039$) levels were found. In contrast, left ventricular ejection fraction, noradrenalin, glucose and insulin levels were unchanged ($p = ns$).

CONCLUSION

For the first time it could be shown that 24 hour shift related short term sleep deprivation leads to a significant increase in cardiac contractility, blood pressure, heart rate and stress hormone secretion.

CLINICAL RELEVANCE/APPLICATION

The clinical relevance is not yet well understood, since these effects may only be short lived and should be further studied in a larger cohort.

Current Era Screening Mammography Outcomes from the National Mammography Database, Involving Nearly 7 Million Examinations

Monday 11:30-11:40 AM | RC215-15 | Room: Arie Crown Theater

PURPOSE

Mammography is the standard imaging examination for breast cancer screening and has substantially reduced mortality from breast cancer. In the last decade, different interpretations of the evidence on outcomes have resulted in various screening guidelines and debate regarding the balance of benefits and risks of mammography screening. There is uncertainty about when to stop screening, as women ≥ 75 years were not included in randomized trials, limiting available data to mostly small observational studies. This knowledge gap may be informed by new large-scale evidence from the National Mammography Database (NMD), an up-to-date mammography outcomes database with data representing a large proportion of US states. The purpose of our study is to evaluate the relationship between patient age and screening mammography performance metrics in women age ≥ 40 years.

METHOD AND MATERIALS

Our HIPAA Compliant and IRB approved project analyzed data from 218 mammography facilities in 39 states in the NMD registry. The NMD receives clinical practice data including self-reported demographics, clinical findings, screening mammography interpretation, and biopsy results (the reference standard). Performance metrics calculated were cancer detection rate, recall rate, and positive predictive values for biopsy recommended (PPV2) and biopsy performed (PPV3).

RESULTS

We analyzed data for 6,980,054 screening mammograms performed between January 2008 and December 2014 in 3,416,075 women. Overall, we found a mean cancer detection rate of 3.65 per 1000 (95% CI: 3.60-3.69), recall rate of 10% (95% CI: 10-10%), PPV2 of 20% (95% CI: 19-20%), and PPV3 of 28% (95% CI: 28-29%). Based on increasing age, performance metrics demonstrate a gradual upward trend for cancer detection rate, PPV2 and PPV3, and downward trend in recall rate, until age 90 years.

CONCLUSION

The NMD provides up-to-date nationwide benchmarks for screening performance metrics. According to these metrics demonstrating preserved cancer detection, recall rate, and PPV, our study suggests that there is no clear age cut-point to inform the decision when to stop screening.

CLINICAL RELEVANCE/APPLICATION

The stability of screening mammography performance metrics in women aged 75-90 years, does not provide evidence for age-based mammography cessation but rather adds support for guidelines that encourage screening decisions based on individual patient values, co-morbidities, and health status.

Common Findings on Head Computed Tomography in Neonates with Confirmed Congenital Zika Syndrome

Sunday 12:30-1:00 PM | PD200-SD-SUA1 | PD Community, Learning Center Station #1

PURPOSE

Describe central nervous system (CNS) computed tomography (CT) findings in neonates with congenital microcephaly associated with the presence of Zika virus in cerebral spinal fluid.

METHOD AND MATERIALS

A series of 14 newborns with congenital microcephaly who exhibited abnormality findings on brain CT without contrast as part of the protocol established by the health ministry during outbreak of Zika, from October to December 2015. These infants had negative IgM serology for toxoplasmosis, rubella, cytomegalovirus and syphilis, and IgM negative for dengue virus and positive for ZIKA virus by ELISA in the CSF. All CT scans were performed in multislice CT scanner and analyzed by the same radiologist.

RESULTS

We reported findings of cranial CT of 14 newborns, 9 male and 5 female. Gestational age ranged from 31 to 40, weight at birth from 810 to 3.840 grams and head circumference from 23 to 33 centimeters. Calcification in the central nervous system (CNS) were seen in all patients, being punctiform in 8 (57.1%) and coarsely in 6 (42.8%). 13 neonates (92.8%) showed calcification in the cortico-medullary junction, 3 (21.4%) in thalamus and 1 (7.1%) in midbrain. The cortico-medullary junction calcifications were located mainly at frontal (92.8%) and parietal lobes (78.5%) and less often at occipital (35.7%) and temporal lobes (28.5%). Global hypogyration of the cerebral cortex was seen in 11 (78.5%) infants. In 13 (92.8%) neonates ventriculomegaly was present. Cerebellar hypoplasia was seen in 4 patients (28.5%). Prominent occipital bone was identified in 9 patients (64.2%), which can be associated with fetal brain disruption sequence, characterized by severe microcephaly, overlapping sutures, scalp rugae and marked neurological impairment, reflecting important intrauterine brain damage.

CONCLUSION

There is a pattern of tomographic findings in central nervous system of neonates with microcephaly and Zika virus infection. Although the etiopathogenesis and associated risk factors have not yet been well established these data strongly suggest that Zika virus can cause microcephaly.

CLINICAL RELEVANCE/APPLICATION

There is a pattern of tomographic findings in central nervous system associated with the microcephaly outbreak that suggest a new etiology. In face of the increase of microcephaly cases, and the possibility of global dissemination of Zika virus, it's necessary to recognize these radiologic findings.

Combination of Magnetic Resonance Imaging and Virtual Reality Systems to Generate Immersive Fetal 3D Visualizations

Wednesday 12:45-1:15 PM | PD230-SD-WEB1 | PD Community, Learning Center Station #1

PURPOSE

Advances in image-scanning technology have led to vast improvements in medicine, especially in the diagnosis of fetal anomalies. In general, three main technologies are used to obtain images within the uterus during pregnancy i.e. Ultrasound (US), Magnetic Resonance Imaging (MRI) and Computed Tomography (CT). MRI offers high-resolution fetal images with excellent contrast that allow visualization of internal tissues. When US yields unexpected results, MRI is generally used, because it provides additional information about fetal abnormalities and conditions for which US cannot provide high-quality images.

METHOD AND MATERIALS

The construction process of the 3D accurate virtual model starts with the 3D modeling volume built through the MRI slices sequentially mounted, followed by the segmentation process where the Physician selects the important body parts to be analyzed that will then be reconstructed in 3D. Having the accurate 3D model (womb, umbilical, cord, placenta and fetus) the final stage is the programming of the virtual device (Oculus Rift 2), including the heartbeat sounds of the fetus to improve the immersive sensation. The navigation through internal paths can be pre-defined by the physician responsible for the patient in order to highlight the main subjects to be studied by the fetal medicine team as well for parents understanding.

RESULTS

Virtual reality fetal 3D models based on MRI were successfully generated. They were remarkably similar to the postnatal appearances of the newborn baby, especially in cases with pathology, increasing the possibilities of digital tools to help fetal medicine researches.

CONCLUSION

The use of MRI may improve our understanding of fetal anatomical characteristics, and can be used for educational purposes and as a method for parents to visualize their unborn baby. The images can be segmented and applied on virtual reality immersive technologies.

CLINICAL RELEVANCE/APPLICATION

We have demonstrated that MRI data can be used to create a 3D model, including of the respiratory tract in a normal fetus. We believe that this technique could become a useful tool for the assessment of fetal airway patency and for other possible applications.

Essentials of Intrauterine Zika Virus Infection: Pre and Postnatal CNS Findings

Wednesday 12:15-12:45 PM | PD232-SD-WEA3 | PD Community, Learning Center Station #3

PURPOSE

Zika virus (ZIKV) belongs to the family of flavivirus and as for dengue and chikungunya infections may be recognized *Ae. Aegypti* and *Ae. Albopictus* mosquitoes as transmission agents. This virus has tropism for the central nervous system (CNS) and has been strongly associated with common findings to congenital infections, with some features which are described in this presentation.

METHOD AND MATERIALS

We performed a prospective study with seven pregnant patients with ZIKV infection at different gestational ages. They were subjected to ultrasound and fetal MRI. After birth, the newborns performed transfontanelar US, CT and MRI of the head, with posterior 3D reconstructions of the skull. We compared the cases with and without CNS involvement in the patients with intrauterine ZIKV infection. We quantified and illustrated the most frequent findings in the patients who had changes in their CNS. The main findings of CNS abnormalities were reported and several specific findings were displayed on a chart, including microcephaly, and submitted to statistical analysis.

RESULTS

From the 7 cases of ZIKV infection, 4 showed brain abnormalities with microcephaly. Multiple calcifications with cortical and mainly subcortical distribution were seen in all of these 4 cases. Significant thinning of the brain parenchyma, which have extensive periventricular areas of hyperintensity on T2 MR-WI were reported in all of the 4 cases. Neuronal migration anomalies were reported in 3 cases. Dysgenesis of the corpus callosum and ventricular enlargement secondary to cortical/subcortical atrophy were also detected in all of these 4 cases. The cerebellum was affected only in 1 case. Brain stem was not affected on these 7 cases.

CONCLUSION

Microcephaly with almost complete agyria, hydrocephalus, and multifocal dystrophic calcifications in the cortex and subcortical white matter, with associated cortical displacement were the main findings on intrauterine ZIKV infection with CNS involvement.

CLINICAL RELEVANCE/APPLICATION

Brain calcifications detected prenatally was a finding suspicious with a intrauterine infection. Moreover, perinatal imaging by MRI and CT scan enabled diagnosis of pachygyria, corpus callosum dysgenesis, small anterior fontanel with premature closure of cranial sutures. All of these aspects are seen in the majority of the intrauterine ZIKV infection with CNS involvement and it can be considered on diagnosis criteria.

Aberrant Brain Networks Efficiency in Mild Traumatic Brain Injury Patients with Depression Symptom – A Multimodal Study

Tuesday 3:20-3:30 PM | SSJ19-03 | Room: N228

PURPOSE

Comorbid psychiatric disorders, such as anxiety disorders and major depressive disorders (MDD), are very common among military personnel with traumatic brain injury (TBI). The goal of this study is to identify relationships between brain microstructural changes and network connectivity in military mild TBI (mTBI) patients.

METHOD AND MATERIALS

Participants included 130 male active service members diagnosed with mTBI (age 34.7 ± 7.8 years old) and 53 non-TBI male controls (age 31.9 ± 8.3 years old) who underwent structural MRI, diffusion weighted imaging (DWI) and resting state fMRI (rsfMRI) exams on a 3T MRI scanner. Depression symptoms were rated based on the Beck Depression Inventory (BDI). Subjects with a BDI score greater than 20 are considered to have moderate to severe depression symptoms, and less than 19 is considered mild or minimal. Global probabilistic tractography was performed to reconstruct major white matter tracts followed by extraction of diffusion tensor imaging metrics (Fig A). Normalized Z-score of correlation coefficients of rsfMRI temporal dynamics were reconstructed for statistical analyses. Probabilistic ICA (FSL MELODIC) was applied to identify the functional networks.

RESULTS

Among 130 mTBI participants, 75 of them were classified as having moderate to severe depression symptoms. The moderate to severe MDD TBI group had lower FA than mild depressed mTBI group over the hippocampal branch of the right cingulum bundle, and both of the temporal and parietal branches of the right superior longitudinal fasciculus. For functional connectivity, the moderate to severe MDD mTBI had decreased connectivity within the anterior default mode network (Fig. B) and executive control network, but increased thalamo-striatal connectivity than the non-TBI and/or mild depressed mTBI, suggesting reduced DMN suppression and increased rumination in symptomatic depressed mTBI (Fig. C).

CONCLUSION

Our results suggest that disrupted neurocircuitry, particularly the cognitive-emotional pathways, e.g. cingulum bundle interconnecting frontal cortex, parietal cortex and limbic system, play an important role in the comorbidity of MDD-TBI spectrum disorders.

CLINICAL RELEVANCE/APPLICATION

Aberrant WM tracts and changed functional connectivity interconnecting the fronto-cingulate-temporal regions and the limbic system suggest poor top-down emotional processing and greater maladaptive rumination in symptomatic depressed mTBI patients.