

## SS2. Radiology session

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Eszterhazy hall / Eszterházy terem

Track Radiology

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László Galuska, Zsolt Garami, Kinga Karlinger, Dávid László Tárnoki

SS2. Radiology session

Moderátor: Prof. Dr. Kinga Karlinger, Zsolt Garami, MD

Zsűritag: Prof. Dr. Kinga Karlinger, Prof. Dr. Galuska László, Zsolt Garami, MD, David L. Tarnoki, MD, PhD, med. habil.

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11:15 - 11:25

### 31 A Twin Study Analysing The Heritability of Limbic system's grey matter structures

Amirreza Alijanpourotagsara MD<sup>1</sup>, David Strelnikov MD<sup>2</sup>, Bianka Forgo MD, PhD<sup>3</sup>, Csaba Oláh MD, PhD<sup>4</sup>, Marton Piroska MD<sup>2</sup>, László Kostyál MD, PhD<sup>4</sup>, Ildiko Kalina MD<sup>2</sup>, Pal Maurovich-Horvat M.D., Ph.D., M.P.H.<sup>2</sup>, David Laszlo Tarnoki MD, PhD, med.habil<sup>2</sup>, Adam Domonkos Tarnoki MD, PhD, med.habil<sup>2</sup>

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#### Abstract

**Aim:** To evaluate the heritability of the volume of limbic system grey matter structures in a healthy twin population.

**Methods:** 120 adult healthy twins (86 monozygotic and 34 dizygotic, mean age  $50 \pm 26.5$  years) from the Hungarian Twin Registry underwent brain MRI. Volumetric measurements of the limbic cortex structures, hippocampus, subiculum, amygdala, and nucleus accumbens were performed using an automated quantitative analysis tool (volBrain) on 3D T1W. Age and sex-adjusted MZ and DZ correlations were calculated, and the univariate ACE model was applied.

**Results:** Strong genetic influence was detected in most of the limbic grey matter compartments. The age and sex-adjusted heritability was 77.5% (95% CI, 0.62-0.87) for total limbic cortex volume, 85.4% (95% CI, 0.76-0.91) for total hippocampus volume, 84.5% (95% CI, 0.73-0.91) for total nucleus accumbens volume and 73.8% (95% CI 0.58-0.84) for total subiculum volume. Unique environmental effects were responsible for the remaining variance (between 14.6% and 26.2%, respectively). Shared environmental factors explained a large proportion of phenotypic variance of the total amygdala volume 59.1% (95% CI 0-0.85), while additive genetic and unique environmental factors accounted for 26.8% (95% CI 0-0.86) and 14.1% (0.08-0.24), respectively.

**Conclusion:** Genetic effects strongly influence the grey matter compartments of the limbic system. Common environmental factors play a substantial role in the volume of the amygdala, which points toward environmental factors on disorders such as post-traumatic stress, anxiety, and depression. Our results should stimulate further studies to identify genes affecting the volume of limbic structures.

**Keywords:** Brain, Limbic system, volumetry, MRI

#### Categories

Radiology

**Language of your presentation:**

English

### **34 Heritability of Subcortical Grey Matter Structures in Twins using Magnetic Resonance Imaging**

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#### **Abstract**

##### **Aim:**

To examine the heritability of six subcortical brain volumes; the amygdala, caudate nucleus, pallidum, putamen, thalamus, and nucleus accumbens, and four general brain volumes; total intracranial volume, grey matter, white matter, and cerebrospinal fluid volume in twins.

##### **Methods:**

120 healthy adult twins from the Hungarian Twin Registry (86 monozygotic and 34 dizygotic; median age 50±26.5years) underwent brain MRI. Two automated pipelines (CAT12 and volBrain) were used to calculate subcortical and general brain volumes from three-dimensional T1-weighted images. Age- and sex-adjusted monozygotic and dizygotic intra-pair correlations were calculated and the univariate ACE model was applied. Pearson's correlation test was used to compare the results obtained by the two pipelines.

##### **Results:**

Age- and sex-adjusted heritability estimates for the four general brain volumes were 0.78-0.93 and 0.89-0.94 using CAT12 and volBrain, respectively. Heritability estimates, using CAT12 for the amygdala, caudate nucleus, pallidum, putamen, and nucleus accumbens were between 0.76-0.95. The thalamus was more strongly influenced by common environmental factors ( $C=0.49-0.74$ ). Heritability estimates, using volBrain were between 0.73-0.92 for the nucleus accumbens, pallidum, putamen, right amygdala and right caudate. The left caudate, left amygdala and thalamus were more strongly influenced by common environmental factors ( $C=0.49-0.86$ ). A strong correlation between CAT12 and volBrain ( $r=74-94$ ) was obtained for all volumes.

##### **Conclusion:**

The majority of examined subcortical volumes appeared strongly heritable. The thalamus was more strongly influenced by common environmental factors. Our results underline the importance of identifying relevant genes responsible for the variation in subcortical structure volume and associated diseases.

**Keywords:** Brain, Volumetry, Heritability

#### **Categories**

Radiology

#### **Language of your presentation:**

English

## **59 Differentiation of traumatic and non-traumatic white matter microbleeds: A susceptibility weighted versus diffusion tensor imaging MRI study on perilesional white matter microstructural integrity.**

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### **Abstract**

#### **Aims:**

Detection and individual diagnosis of traumatic axonal injury (TAI) is not yet resolved, white matter (WM) microbleeds -considered as markers of TAI- can be detected by susceptibility-weighted (SWI) MRI. WM microbleed development however, can be observed in numerous conditions. Detection of perilesional diffusion alterations by diffusion tensor imaging (DTI) may imply a tool of TAI related (TMB) and not-TAI-related microbleed (nTMB) differentiation.

#### **Methods:**

63 moderate-severe acute traumatic brain injured (TBI) patients, five, age- (+-3 years) and sex-matched non-TBI and five paired controls underwent our imaging protocol. For precise microbleed detection, coregistration of SWI images to MPRAGE was performed (FSL-FLIRT). Perilesional white matter analysis was performed by an FSL-based, home-developed semi-automatic algorithm. Diffusion scalar (FA, MD, AD, RD) values were calculated in spherical WM “shells” contentrically, up to 20 millimeters, increasing by 2 millimeters from the microbleeds’ center; in identical contralateral location and in identical ipsi- and contralateral locations in controls. For group analysis maximum 3 per patient microbleeds were randomly selected.

#### **Results:**

184 nTMBs in non-TBI and 192 TMBs in TBI patients could be detected; 15 TMBs and 12 nTMBs were selected for analysis. Significant ( $p < 0.05$ ) perilesional MD and RD alterations could be revealed in both TMBs and nTMBs compared to controls; a tendency of AD increase in peri-nTMB WM while AD decrease in peri-TMB WM compared to the identical, contralateral locus could be observed in every shell.

#### **Conclusion:**

DTI reveals local white matter DTI scalar abnormalities that may distinguish TMBs from microbleeds of different aetiology.

### **Categories**

Radiology

### **Language of your presentation:**

Hungarian

## 63 Investigation of normal-appearing white matter (NAWM) with intravoxel incoherent motion (IVIM) technique in glioma patients

Dorottya Kata Szabó Steigerwald Dr.<sup>1,2</sup>, Bálint Soma Környei Dr.<sup>1,2</sup>, Zsolt Horváth Dr.<sup>3</sup>, Béla Kajtár Dr.<sup>4</sup>, Szilvia Nagy Dr.<sup>3,5,6,7</sup>, Péter Bogner Prof. Dr.<sup>1,2</sup>, Arnold Tóth Dr.<sup>2</sup>, Andrea Horváth Dr.<sup>2</sup>

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### Abstract

Keywords: IVIM, glioma, normal-appearing white matter, diffusion, perfusion

Introduction: The poor outcome of glioma is related to its infiltrative spread. Perfusion and diffusion MRI provide functional information of tissue microstructure. Noninvasive intravoxel incoherent motion (IVIM) MRI is capable of quantitative measurement of diffusion and perfusion, simultaneously without contrast agent administration. Using lower b values in IVIM provide information about tissue perfusion by measuring pseudodiffusion coefficient ( $D^*$ ) and volume fraction (f).

Our study aimed to reveal glioma specific diffusion and perfusion alterations in glioma patients' contralateral normal-appearing white matter (NAWM) with IVIM in order to detect possible tumor infiltration.

Methods: 18 (avg. age: 46,72 years) newly-diagnosed pre-treatment diffuse glioma patients (>18 years) and 18 sex and age matched ( $\pm 4$  years) healthy subjects were included in our prospective study. IVIM scans ( $b=0,50,100,150,200,250,500,800,1000$  s/mm<sup>2</sup>) were acquired on a 3T MRI magnet. The entire contralateral white matter (WM) was segmented on MPRAGE images, then WM masks were registered to IVIM images. Mean apparent diffusion coefficient (mADC), tissue diffusion coefficient (D),  $D^*$  and f in the NAWM contralateral to the tumor were compared between patients and controls.

Results: NAWM in glioma patients showed significantly higher mADC ( $p < 0.05$ ) than in controls. D,  $D^*$  and f values showed no significant ( $p > 0.05$ ) difference between control subjects and glioma patients.

Conclusions: Perfusion parameters were not different between patients and controls, however more facilitated diffusion was revealed in the contralateral NAWM of glioma patients, which implies the presence of tumor-related vasogenic oedema rather than tumor infiltration.

### Categories

Radiology

### Language of your presentation:

English

## **64 Do traumatic or non-traumatic microbleeds affect white matter integrity? Preliminary results of a tract level diffusion tensor imaging study.**

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### **Abstract**

Brain microbleeds are increasingly detected in various neurological disorders since the widespread use of susceptibility weighted imaging (SWI). However, their exact association with white matter (WM) integrity is debated. This study aims to observe tract level correlations between traumatic- (TMB) and non-traumatic (nTMB) microbleeds and WM alterations revealed by diffusion tensor imaging (DTI).

63 acute TBI patients with negative neurological, psychiatric, and neurotraumatological history; 7 patients with chronic small vessel disease (CSVD); and 61 healthy control patients were enrolled. For precise microbleed detection, the coregistration of SWI and MPRAGE images was performed, and tract-level localisations were registered (TMB: 156; nTMB: 148). Automatic reconstruction of 42 WM tracts and calculation of average DTI scalars were performed by an FSL-FMRIB based home-developed algorithm. Statistical analysis included a comparison of TMB positive, nTMB positive, and healthy control tracts; and also the comparison of microbleed positive tracts with their contralateral microbleed negative counterparts both in the TBI and nTBI groups (SPSS v28).

TMBs were present in 35 TBI patients, a total of 117 TMB- and 67 nTMB-tracts were detected. Compared to control subjects, significant MD ( $p < 0.001$ ), AD ( $p = 0.025$ ) and RD ( $p = 0.001$ ) increase in TMB-tracts while compared to contralateral tracts, significant RD and MD increase in nTMB but no significant alterations in TMB tracts could be revealed.

While WM integrity is abnormal in both TBI and CSVD compared to healthy controls, microbleed presence appears to be a marker of WM alteration at tract level in CSVD but not in TBI

### **Categories**

Radiology

### **Language of your presentation:**

English

12:05 - 12:15

### **83 CT texture analysis can differentiate between kidney tumors robustly against imaging protocols**

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#### **Abstract**

Keywords: radiomics analysis; machine learning; kidney cancer; renal cell carcinoma

**Aims:** We aimed to construct a radiomics-based machine learning (ML) model that can differentiate non-clear cell from clear cell renal cell carcinomas (CCRCC).

**Methods:** We retrospectively collected preoperative CT scans from 209 patients diagnosed with RCCs. 107 radiomics parameters (RP) were extracted from the tumors. The most predictive RPs were selected by the least absolute shrinkage and selection operator (LASSO) algorithm. A support vector classifier (SVC) was constructed to predict tumor types and its performance was evaluated on the KiTS19 public dataset using receiver operating characteristic curve (ROC) analysis. The performance of the SVC was also compared with an expert radiologist's.

**Results:** The LASSO algorithm identified 10 corticomedullary phase predictors that were then used for training an SVC. The SVC achieved an area under the ROC curve (AUC) value, accuracy, sensitivity, and specificity of 0.83, 0.78, 0.80, and 0.74 on the external test set, respectively. Adding unenhanced and excretory phase RPs did not further increase the performance. Meanwhile, the expert radiologist achieved similar performance with an AUC, accuracy, sensitivity, and specificity of 0.77, 0.79, 0.84, and 0.69 in the same comparison.

**Conclusions:** Radiomics-based ML can help the diagnostics of RCCs. The performance of our SVC is comparable with the expert radiologist's, and it proved to be reproducible during external validation.

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#### **Categories**

Radiology

#### **Language of your presentation:**

English