Basic Science / Engineering

Abstract #1

Closed-loop Control of Attention in Children

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Rationale

Children with epilepsy commonly suffer from debilitating attention deficits that contribute to academic difficulties, promote psychosocial isolation, and erode future potential. No effective treatments for these children exist. Here we developed a first-in-human approach to rescue these deficits and control attention through real-time modulation of a core attentional control network.

Methods

Stereoelectroencephalography (sEEG) data were recorded during performance of an attentional task in children with epilepsy. We engineered personalized machine learning classifiers to predict lapses of attention during the task based on pre-stimulus spectral signatures derived from sEEG. The classifiers were subsequently deployed to inform real-time closed-loop neuromodulation in response to predicted attentional lapses.

Results

Across participants (N=30), the machine learning classifiers revealed that neural activity originating from a consistent and reproducible brain network predicted lapses of attention in real-time and over multiple sessions (AUC=0.63, 95%CI: 0.60-0.66). Moreover, connectivity within this network predicted symptom severity in an independent sample of children with attention deficit/hyperactivity disorder (N=226, $p<0.05$ cluster-corrected). In children with epilepsy, closed-loop stimulation of the control network in response to predicted lapses restored large-scale network function and rescued attention indexed by eye-tracking measures and task performance ($p<0.05$ linear mixed effects modelling). Scalp electroencephalography revealed concordant network signatures that enabled non-invasive control of attention through precisely timed transcranial magnetic stimulation.

Conclusion

We identified a human attentional control network to decode and control attentive behaviour in real-time. Our findings provide novel insight into the neural basis of attention and stand to redefine treatment of attention deficits in children with epilepsy

Clinical Epilepsy / EEG / Antiepileptics

Abstract #2

Detection of Focal to Bilateral Tonic-clonic Seizures With a Smart Shirt

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Rationale

Epilepsy affects over 50 million people worldwide. Thirty percent of patients suffer from recurrent seizures despite anti-seizure medications. Particularly, focal to bilateral tonic-clonic seizures (FBTCS) are associated with abnormal cardiac activity, labored breathing, and impaired awareness. The unpredictable nature of seizures increases the risk of injury and mortality, raising the need for automated seizure detection. New connected objects can monitor vital signals using non-invasive sensors. In this work, we developed a seizure detection algorithm based on electrocardiogram and acceleration signals recorded with the Hexoskin smart shirt (Carré Technologies Inc., Montreal, Canada).

Methods

We recruited patients with epilepsy admitted to the University of Montreal Hospital Centre epilepsy monitory unit. We filtered the electrocardiogram and acceleration signals, then extracted linear and nonlinear features. Then, we trained machine learning algorithms to detect epileptic seizures. We compared the performances of four classifiers, namely support vector machine, decision tree, logistic regression and XGBoost, using nested cross-validation.

Results

We recorded 26 FBTCS from 18 patients with epilepsy who wore the Hexoskin shirt. Tested on one preictal hour per seizure, XGBoost reached a sensitivity of 92%, with a false alarm rate of 0.52/hour. Mean time in warning was 30 seconds. The support vector machine, logistic regression, and decision tree, performed with a sensitivity (false alarm rate) of 88% (1.28/hour), 100% (1.72/hour), and 80% (1.8/hour), respectively.

Conclusion

Our study shows promise for the detection of FBTCS using a smart shirt. Future work should aim at reducing false alarms and validating the results in a residential setting on a larger patient cohort.

Neuroimaging

Abstract #3

Polygenic Risk Effects of Temporal Lobe Epilepsy on Brain Structure in Typical Development

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Rationale

Temporal lobe epilepsy (TLE) is commonly associated with widespread structural alterations and a complex genetic architecture. With the seizure onset often in youth, genetic effects and atypical brain development may contribute to epilepsy risk in many patients and relate to alterations in brain structure. Here, we mapped associations between polygenic risk scores (PRS) related to TLE and brain morphology in childhood and assessed its concordance with case-control atrophy.

Methods

We aggregated structural T1w magnetic resonance imaging (MRI) and whole-genome sequencing data of 4,139 neurotypical children and adolescents from the Pediatric Imaging, Neurocognition and Genetics2 and Adolescent Brain Cognition Development datasets.3 Individualized PRS were computed based on the weighted sum of common genetic risk variants for hippocampal sclerosis (HS). Surface-based linear models related PRS-HS and cortical thickness maps in pediatric participants. We evaluated the correspondence between imaging-genetic and TLE-specific atrophy maps using spatial correlations with autocorrelation preserving null models.

Results

Widespread thickness decreases were observed in children with high PRS-HS that mainly targeted temporo-limbic cortices ($pFWE < 0.05$). Peak effects were observed in paralimbic regions, according to the Mesulam atlas. However, no significant correlation between PRS-HS mediated shifts and atrophy in left and right TLE were found (all $p > 0.15$).

Conclusion

Our findings revealed widespread thinning associated with increased PRS-HS, localizing to temporo-limbic regions—pathophysiological epicentres of the condition. As PRS-HS effects did not strongly resemble adult case-control patterns of atrophy, our findings suggest that adult TLE atrophy likely reflects additional factors related to disease progression and ageing.

Epilepsy Surgery

Abstract #4

Anatomical Features Predicting Outcome From Stereotactic Laser Amygdalohippocampotomy

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Rationale
Optimal operative ablation location and extent of Stereotactic laser amygdalohippocampotomy (SLAH) is uncertain, as are the neuroanatomical features guiding successful ablations.

Methods
Patients treated with SLAH for MTS at Emory University between 2011 and 2019(n=65) were considered in this retrospective study. Post-procedure T1 MRI scans of patients were used to create manual segmentations of the ablation region of each patient. Ablations were assessed in relation to whether they crossed the coronal plane of the lateral mesencephalic sulcus (LMS), the extent to which the ablation extended posterior to the LMS, and the extent of ablation of the uncus. Wilcoxon ranked-sign test was performed for each variable of interest between groups of patients with Engel score 1 versus Engel score 2-4.

Results
Distance of ablation past the LMS was not different between Engel class 1 (mean 6.32±4.16mm), and Engel class 2-4 (7.93±3.75mm)(p=0.099). Ratio of ablations extending posterior to the LMS was 0.82(SD=0.39) in Engel 1, and 0.90(SD=0.30) in Engel 2-4 (p=0.370). Volume of ablation showed little correlation with 12-month seizure freedom average ablation of Engel 1 =6064±2128mm3, Engel 2-4 = 5828±3031mm3, and no significant difference with Wilcoxon ranked-sign test (p=0.239). Ablation of the uncus showed a strong association with better surgical outcome, with ratio of uncus ablation for Engel 1 at 0.71(SD=0.31), and Engel 2-4 at 0.37(SD=0.36);p<0.001).

Conclusion
Further investigation of the anatomic features predicting successful SLAH is warranted. Contrary to current practice, extension of SLAH ablation posterior to the lateral mesencephalic sulcus did not demonstrate improved post-operative outcomes.

Neuroimaging

Abstract #5

Assessment of Excitation/Inhibition (E/I) From Resting State Magnetoencephalography (MEG) and its Relationship With Cortical Thickness in Temporal Lobe Epilepsy (TLE) Patients

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Rationale

Temporal lobe epilepsy (TLE) is characterized by an unbalance of excitation/inhibition (E/I) and progressive cortical thinning. Measuring E/I in vivo, especially at non-primary cortical regions, remains challenging. New E/I indexes from resting state magnetoencephalography (MEG) are emerging, but their potential applications in epilepsy remain unknown. We applied new measures of E/I balance to address their relationship with cortical thickness in TLE patients

Methods

Thirty-two TLE patients (17L) underwent MEG for E/I estimation and high-resolution 3T MRI for head modeling and cortical thickness assessment. Six-minute wakefulness resting state activity was reconstructed at cortical level. The exponent and offset of the aperiodic component of the power-spectrum, as well as cortical thickness, were modeled vertex-wise. A sample of 127 MEG recordings from healthy subjects was used as reference.

Results

Compared to healthy subjects, TLE patients showed higher exponent and offset in the anterior temporal regions. The exponent increase was lateralized and concordant with the focus side (82% for left and 73% for right). There was a significant positive correlation between cortical thickness and exponent in the precentral regions.

Conclusion

New measures from resting state MEG appear to demonstrate sensitivity to E/I unbalance in TLE and are linked to well-known structural changes occurring in in these patients. The increase of both offset and exponent suggests that E/I change are most likely driven by increased neuronal population spiking. The topographical specificity of the exponent may be considered as complementary measure to assess focus laterality in TLE.

Abstract #6

Clinical Utility of Advanced Neuroimaging Techniques in Preoperative Workup of Epilepsy

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Rationale

Around 30% of people with focal epilepsy are medically refractory; for these patients, neurosurgery may be a viable treatment option. However, identifying suitable candidates and localizing the epileptogenic zone remain significant challenges. We introduce and evaluate the clinical utility of three advanced neuroimaging techniques developed at established epilepsy surgery centers in the pre-surgical assessment at the recently designated District Epilepsy Center, Kingston Health Sciences Center (KHSC).

Methods

Patients in the pre-surgical pathway were discussed in multidisciplinary team (MDT) meetings (n=11). Patients who had already undergone resections(n=3) and those deemed unsuitable for surgery(n=4) were excluded. Patients meeting the criteria for surgical candidacy with inconclusive clinical data, such as a negative MRI or discordant data (n=4), were recruited for a comprehensive MRI evaluation. This evaluation included high-resolution 3D T1-weighted scans for hippocampal/amygdala (HA) quantitative volumetry, high-resolution 3D FLAIR to facilitate lesion detection, and functional magnetic resonance imaging (fMRI) for language lateralization. The benefits of this additional data were documented in a follow-up questionnaire during the reevaluation of the patients.

Results

Following our multimodal assessment, previously discussed surgery candidates were now deemed suitable or could proceed to next assessment steps. The protocol has improved localization of epileptic tissue, identified imaging abnormalities, and lateralized language, as acknowledged by MDT clinicians.

Conclusion

Our findings demonstrate that these advanced neuroimaging modalities can be introduced into clinical practice at a newly established epilepsy surgery center and provide valuable information to benefit patient care.

Abstract #7

Association Between Capillary Blood Glucose Levels and FDG-PET Grey Matter Signal Variation in Patients With Refractory Epilepsy

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Rationale

18-fluorodeoxyglucose positron emission tomography (FDG-PET) is essential for evaluation of patients with non-lesional drug resistant epilepsy (DRE). Identification of focal hypometabolism increases a patient's odds of further surgical evaluation or resection, providing the best opportunity of attaining seizure freedom. This study aims to elucidate factors independent of a patient's epilepsy that may impact diagnostic yield of FDG-PET.

Methods

We analyzed a collection of FDG-PET images obtained in routine presurgical evaluation of patients with DRE. After spatially normalizing attenuation-corrected images, we extracted mean and standard deviation (SD) of grey matter signal intensity. For each acquisition we extracted patient age, body mass index, sex, radiopharmaceutical dose, uptake time, capillary blood glucose, and reported results. Linear regression was performed using the above variables.

Results

Forty-two people with DRE were included with a median (IQR) glucose at scan acquisition of 5.2 mmol/L (4.8-5.7). Mean and SD of grey matter intensity were both predicted by the regression models. Variables that significantly influenced grey matter SD included age (β=-0.31, p=0.04), sex (β=0.84, p=0.002), and blood glucose (β=-0.36, p=0.009). High grey matter SD predicted a greater likelihood of a diagnostic scan (OR 2.17, 95% CI 0.63-7.44) although this result did not reach statistical significance.

Conclusion

In this cohort, SD of FDG-PET grey matter signal intensity increased with lower capillary glucose, even across a normal range. Greater signal variation may augment visual identification of focal hypometabolism, which could improve diagnostic yield. These data support fasting prior to FDG-PET and possible re-evaluation of non-diagnostic scans in the setting of high-normal glucose.

Abstract #8

Combined Resting-State Functional MRI and Functional Near-Infrared Spectroscopy in Preoperative Language Mapping in Children with Drug-resistant Epilepsy

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Rationale

Functional MRI (fMRI) is the only clinically available tool for non-invasive preoperative language mapping in children with drug-resistant epilepsy (DRE). Cooperation during the study is low; motion and network immaturity reduce reliability. A combined method with fNIRS, a lower-complexity technique, may cope with some limitations. We developed a combined approach utilizing fNIRS and resting-state fMRI to preoperatively map children with DRE.

Methods

We are conducting a pilot feasibility study including 39 patients. Two language tasks and resting-state fMRI were performed. In a subgroup of 12 patients, a T1w wearing the fNIRS cap and vitamin E markers and an fNIRS study with the same protocol was performed. A 3D-morphometric model was used to co-register fNIRS to fMRI. An fNIRS-guided seed-based analysis was carried out and compared to both, task fMRI and resting-state fMRI. All outputs were compared with Dice coefficient.

Results

A higher incidence of atypical language lateralization was observed in fMRI methods. Preliminary results (N=7) in the pilot group suggest lateralization with fNIRS is concordant and well tolerated by children. Discrepancies in task-specific lateralization were observed in some participants. We expect that the fNIRS-guided SEED-based analysis results will be comparable to those of other fMRI techniques.

Conclusion

Atypical language in children with DRE remains a challenge for non-invasive mapping. The fNIRS/fMRI combined approach is a novel technique to localize language networks in this population that may increase accessibility and reliability of children to non-invasive techniques. Larger cohorts and invasive confirmation is needed to further validate these method.

Abstract #9

Evaluation of Abnormalities of Neural Synchronization in Epilepsy Using Movie-Driven fMRI

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Rationale

Evaluations of cognition during clinical assessment of candidates for epilepsy surgery tend to rely on simple stimuli that are unimodal and abstract. Paradigms incorporating dynamic naturalistic stimuli, like movies, may complement standard cognitive assessment tools by probing “real world” cognition, The focus of this work was the novel use of a short movie (an 8-minute Alfred Hitchcock TV episode) to explore abnormalities of neural synchronization (quantified via inter-subject correlation; ISC).

Methods

Individuals with temporal lobe epilepsy being evaluated for surgical treatment (n = 16) and a group of neurotypical controls (n = 21) watched the same engaging film clip during functional magnetic resonance imaging. To reduce the dimensionality of the neural data recorded over the course of the film, a well-known 360-region cortical surface parcellation scheme (Glasser et al., 2016) was applied.

Results

Movie viewing elicited expected neural response patterns (high ISC in early auditory and auditory association cortices) in both epileptic and neurotypical individuals. Taking ISC in controls as normative, ISC profiles were abnormal in five of 16 people with epilepsy. We also identified regions that were particularly sensitive to abnormalities in patients (sensory, sensory association, and higher-order areas), based on their reliable activation in controls during movie viewing, and found that people with epilepsy exhibited a greater number of abnormalities in these regions than might be expected due to chance.

Conclusion

Movie driven fMRI shows potential as a sensitive, non-invasive, and cost-effective tool to reveal focal and network functional abnormalities during the presurgical assessment of epilepsy.

Abstract #10

Investigation of Cortical Thickness Changes in in First Time Unprovoked Seizure Subjects

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Rationale

An epilepsy diagnosis after a First-time Unprovoked Seizure (FUS) could help to alleviate epilepsy uncertainty anxiety and allow for quicker medical intervention, reducing subsequent seizure occurrence. This research aims to determine if cortical thickness changes can be an epilepsy biomarker in FUS patients.

Methods

This study compared the 7T MRI scans of 16 FUS subjects, including six subjects diagnosed with epilepsy post-scan, and 16 age- and sex-matched healthy controls. Adult patients were recruited after a FUS and undergoing a clinical 1.5T or 3T MRI scan; subjects were excluded if they received an epilepsy diagnosis before the 7T scan or had scan abnormalities.

Results

The subject groups' cortical thicknesses were compared using a two-tailed t-test. No statistically significant differences were found between the groups once false discovery rate corrections were applied. However, sex-dependent trends of cortical thinning and thickening were observed in multiple brain regions, including the striate, motor, retrosplenial, auditory, cingulate, insula, intraparietal, and prefrontal cortices, with a preference for cortical thickening on the right hemisphere and cortical thinning on the left hemisphere. The diagnosed epilepsy FUS subjects had sex- and hemisphere-dependent patterns of cortical thickening and thinning were evident in the motor, secondary somatosensory, temporal, parietal, extrastriate, prefrontal, and cingulate cortices. Cortical thickening occurred more prominently regardless of sex or hemisphere.

Conclusion

After applying FDR correction, the trend of cortical thickness differences between the groups were not significant. This lack of significance, potentially due to the small sample size, disallows any conclusion that cortical thickness changes are a reliable bioindicator of epilepsy.

Abstract #11

Magnetoencephalography Source Connectivity Analysis in Patients With Temporal Plus Epilepsy

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Rationale

Temporal plus epilepsy (TL+) is defined as the extension of the temporal epileptogenic focus to neighboring regions in temporal lobe epilepsy (TLE) cases and is associated with a post-surgical failure rate of 75-85%. Alteration of functional connectivity of interictal epileptiform discharges (IEDs) within the epileptogenic network may provide an added value in predicting surgical outcomes. We hypothesize that magnetoencephalography (MEG) source connectivity analysis of IEDs may help disentangle TL+ from TLE.

Methods

Retrospectively, we selected 4 patients with TL+ (average age: 41, 2 females) and 2 patients with TLE (average age: 45, 1 female) from the CHUM MEG database. Patient had Engel I or II surgery outcome (follow-up ≥ 2 years). Following IEDs' annotation, independent component analysis (ICA) was performed. Temporal and extratemporal components were selected based on a minimum of 75% goodness-of-fit of equivalent current dipole (ECD) source localizations. Nonlinear distance correlations (NDC) were extracted between selected sources, and one-way ANOVA was performed to evaluate mean differences in connectivity between source activities at the rising phase of IEDs.

Results

On average, 30 IEDs were analyzed for each patient. Findings revealed that in TL+, NDC between temporal and at least two extratemporal regions was significantly increased ($p < 0.05$), compared to the other connections. In contrast, in TLE, NDC were not significantly different from baseline or from other connections of the network ($p > 0.05$).

Conclusion

Preliminary results show that ICA-ECD source estimation together with dynamic connectivity analysis may provide an added value to disentangle the group of patients with TL+ from TLE.

Abstract #12

Normative Modelling of Hippocampal Morphology in Epilepsy

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Rationale

New neuroimaging methods are required to improve outcomes for drug-resistant epilepsy (DRE) patients. We are evaluating the efficacy of normative modelling (NM) at varying sample sizes applied to the epilepsy population, using hippocampal segmentation and reconstruction.

Methods

Hippocampal thickness was extracted from T1w Magnetic Resonance Imaging with Hippunfold which segments and reconstructs hippocampal surfaces. Linear models were trained on controls to predict normal hippocampal thickness based on age, sex, and acquisition site inputs. Z-scores were computed to compare ground truth and predicted hippocampal thickness. To study sample size, a holdout set of 251 subjects was taken for testing and sampling between 25-1000 subjects for training. To evaluate NMs in epilepsy, our model trained on 1000 subjects was applied to the 33 subjects with DRE.

Results

With greater numbers of subjects in our training set, we observed a decrease in bias as evidenced by decreasing error and the apparent convergence of Z-scores and residuals for models trained on more than 100 subjects. We used our 1000-subject model to predict thickness and to compute Z-scores on several known subjects with DRE. Currently, we have epilepsy localization information for 8 subjects. Most Z-score values range between 0 and 2 regardless of epilepsy type.

Conclusion

This analysis shows differences between smaller and larger training set size models, and possibly relevant differences between epilepsy and control subjects for thickness z-scores. Further research requires larger datasets of epilepsy subjects with more detailed clinical information to enable an understanding of the possible clinical utility of NM in diseases like epilepsy.

Abstract #13

The Effect of Previous Surgery on Magnetic Source Reconstruction in Pediatric Drug-Resistant Epilepsy

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Rationale

Focal epilepsy surgery requires accurate localization of the epileptogenic zone. This remains extremely challenging in poorly-defined cases (i.e., lesion-negative imaging), with ~50% of patients suffering from recurring seizures, and sometimes requiring a repeat presurgical evaluation, for which magnetoencephalography (MEG) is a well-accepted component. A previous study raised concerns that cerebrospinal fluid-filled cavities (i.e., resections) could alter magnetic source localization, calling into question the utility of MEG for such cases. We hypothesize that such effects would be observed in pediatric epilepsy patients who have undergone a previously failed surgery, but that adequate biophysical modeling of head tissues would overcome these challenges.

Methods

We obtained n=6 MEG rest recordings of pediatric drug-resistant epilepsy patients undergoing presurgical evaluation following a previously failed epilepsy surgery. Magnetic source imaging of epileptiform activity was performed for different types of head models (overlapping spheres, OS, finite element model, FEM) and anatomies with and without cavities (i.e., individual and generic).

Results

When comparing across anatomies and head models, early results show shifts in source maps between individual and generic anatomies, with greater differences found when using OS head models. Quantification of such differences (e.g., translations, source strengths, Dice coefficients) will be presented.

Conclusion

Thus far, our observations indicate surgical cavities affect the mapping of epileptiform activity captured with MEG. We foresee that they should be factored into the biophysical models used for brain source imaging to optimize the presurgical planning of such cases.

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CLINICAL EPILEPSY / EEG / ANTIEPILEPTICS

Abstract #14

Withdrawn

Abstract #15

CORE-VNS 12-Month Safety and Efficacy in Generalized Tonic-Clonic Seizures

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Rationale

Generalized tonic-clonic seizures (GTCS) are highly debilitating seizures with significant health risk, including sudden unexpected death in epilepsy. For patients resistant to antiseizure medications (ASMs), and especially those for whom surgery is undesirable or not feasible, vagus nerve stimulation (VNS) is a potential treatment option. VNS carries different practical management requirements than ASMs, therefore we aim to examine the real-world experience with VNS for the treatment of GTCS.

Methods

Patients were enrolled into a prospective, multicenter observational registry called CORE-VNS (NCT03529045). We selected patients with GTCS and excluded patients who had focal seizures or GTCS in the context of Lennox-Gastaut Syndrome. After a 3-month baseline and implantation, participants were followed for up to 36 months. At 3, 6, and 12 months, seizure diary information and patient-reported outcomes were collected.

Results

We identified 61 participants who fulfilled the inclusion/exclusion criteria and who received a new VNS implant for the study (not a battery replacement). For the entire cohort, the responder rate (≥50% reduction from baseline) for GTCS at 12 months was 62.3% (95% CI: 50.1% to 73.4%) and the median seizure frequency change was -71.4% (95% CI: -93.3% to -40%). 34.4% (n=21) of participants experienced at least one adverse event and the most frequent side effects associated with VNS stimulation were dysphonia (13.1%, n=8), dyspnea (4.9%, n=3), cough (3.3%, n=2), and implant site pain (3.3%, n=2).

Conclusion

In this prospective study, VNS was well tolerated and effective in reducing the frequency of GTCS.

Abstract #16

Epilepsy in Adults with Neurofibromatosis Type 1: Prevalence, Phenotype, and Genotype

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Rationale

Neurofibromatosis type 1 (NF1) is a neurocutaneous disorder with various neurological manifestations, including seizures and epilepsy. There is currently a paucity of data on the prevalence of epilepsy in adult patients with NF1.

Methods

Patients ≥18 years-old at a multidisciplinary neurofibromatosis clinic were prospectively enrolled and offered routine EEG, MRI, and genetic testing. The lifelong and point prevalence of epilepsy in patients with NF1 were calculated. Demographic, genetic, radiological, and clinical features found to be statistically associated with a diagnosis of epilepsy were incorporated into a logistic regression model.

Results

113 of 132 patients enrolled met criteria for NF1. Lifelong prevalence of epilepsy was 11% and point prevalence 7%. 73% were diagnosed with epilepsy before the age of 18 and achieved seizure-freedom by the time they reached adulthood. A routine EEG with epileptiform discharges had sensitivity of 25% and specificity of 99% for identifying unresolved epilepsy. Parenchymal low-grade glioma (OR: 38.2; $p<0.01$), learning disability (OR: 5.7; $p<0.05$), and absence of plexiform neurofibroma (OR: 0.05; $p=0.04$) were associated with a history of epilepsy. No single mutation type was associated with the development of epilepsy.

Conclusion

The proportion of NF1 patients with epilepsy appears to peak in childhood and decrease into adulthood, owing to lower rates of new diagnosis and the resolution of epilepsy in a significant proportion of patients. Epileptogenesis in NF1 likely requires a combination of multiple genetic and environmental factors and suggests involvement of a network that spreads beyond the borders of a well-defined parenchymal lesion.

Abstract #17

High Health Care Use is Partially Reversed by a Diagnosis of Late Onset Epilepsy

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Rationale

To delineate the trajectories of health care use before and after diagnosis and compare them to those of people without late onset epilepsy (LOE).

Methods

We performed a retrospective observational linked electronic health records cohort study in England covering years 1998-2019. Patients were matched 1:10 to controls by age, sex, and primary care physician. Primary outcome was weighted annual median per-person health care use (wHCU) for the 4-years before and 4-years after diagnosis of LOE using an interrupted time series analysis. We then used an adjusted mixed effects negative binomial regression to compare annual wHCU after diagnosis/matching date between LOE and controls.

Results

We identified 2,569,874 people 65+ years old and 1,048 (4%) developed incident LOE. Median age of onset was 69 (IQR 6) and 474 (45%) were female. For LOE, wHCU increased by a median of 5 interactions per person per year (95%CI 1-9; p=0.026) up to diagnosis. The wHCU increased by a median of 10 interactions (95%CI 5-14; p=0.003) at the year of diagnosis, and then declined by a median of 8 interactions per person per year (95%CI 4-11; p=0.001) thereafter. There was no pre-post matching date change in median annual wHCU interactions for controls (p=0.254). Despite the decline, wHCU remained higher for LOE (adjusted IRR 1.91; 95%CI 1.80-2.04; p<0.001) compared to controls following diagnosis/matching date.

Conclusion

Health care use progressively increases over the 4-years prior to diagnosis of LOE but declines significantly afterward. Despite this, it remains higher for all aspects, including emergency and hospital admissions, compared to controls.

Abstract #18

Perampanel for Treatment of Focal and Generalized Epilepsy in Everyday Clinical Practice: Evidence from PERMIT Extension

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Rationale
This study evaluated perampanel (PER) when used to treat focal and generalized epilepsy in everyday clinical practice.

Methods
PERMIT Extension pooled patient data from PERMIT, a pooled analysis of 44 PER clinical practice studies worldwide, and PROVE, a Phase IV study of PER. Retention was assessed after 3, 6 and 12 months. Effectiveness assessments (evaluated by seizure type at last visit [last observation carried forward]) included 50% responder (≥50% seizure frequency reduction) and seizure freedom (no seizures since at least the prior visit) rates for focal and generalized seizures and responder rate (seizures under control) for status epilepticus. Adverse events (AEs) were also evaluated.

Results
Full Analysis Set included 6822 patients (baseline characteristics: 51.1% female; mean age, 36.9 years; mean epilepsy duration, 21.4 years; focal seizures only, 79.2%; generalised seizures only, 15.8%; focal and generalized seizures 3.8%; status epilepticus, 1.2%). At 3, 6 and 12 months, retention rates were 88.0%, 77.6% and 61.4%, respectively. At last visit, responder and seizure freedom rates were, respectively, 46.6% and 16.7% for focal seizures, and 71.5% and 48.8% for generalized seizures; 52.7% of patients with status epilepticus were responders. AEs were reported for 49.2% patients (most commonly: dizziness/vertigo [13.4%], somnolence [8.8%], irritability [7.4%]) and 18.3% patients discontinued due to AEs. Psychiatric AEs were reported for 21.5% patients and 10.8% of those with psychiatric AEs discontinued.

Conclusion
PER was effective and generally well-tolerated when used in a large cohort of patients with focal and generalized epilepsy in everyday clinical practice.

Supported by Eisai.

Abstract #19

Efficacy And Safety of Perampanel in a Placebo-Controlled, Phase III Study With an Open-Label Extension in Patients With Seizures Associated With Lennox-Gastaut Syndrome (LGS)

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Rationale

Study 338 (NCT02834793) was a Phase III study, assessing the long-term clinical outcomes of adjunctive perampanel in patients aged ≥2 years with uncontrolled seizures associated with LGS, a severe refractory childhood-onset epilepsy.

Methods

Patients diagnosed with LGS receiving 1–4 concomitant anti-seizure medications and experiencing ≥2 drop seizures/week during baseline were randomized into the double-blind, placebo-controlled, 18-week Core Study; followed by open-label 52-week Extension A. The primary endpoint was median percent change from baseline in drop seizure frequency/28 days during Core Study. Secondary endpoints included responder rates, seizure-freedom rates, and safety outcomes.

Results

Of the 70 Core Study patients, 58 entered Extension. Median percent reduction in drop seizure frequency/28 days with perampanel was 23.1% (vs 4.5% [placebo]) during Core Study and 29.5% during Extension A. The 50% and 75% responder rates for drop seizures were 44.1% (vs 25.0% [placebo]) and 26.5% (vs 13.9% [placebo]) during Core Study, and maintained at 37.9% and 20.7% during Extension A, respectively. Drop seizure-freedom rates were 2.9% (vs 0.0% [placebo]) during Core Study and 1.7% during Extension A. All seizure types demonstrated higher reduction, responder, and seizure-freedom rates with perampanel (vs placebo) during Core Study. Overall, two deaths (both unrelated to perampanel; Core Study, n=0; Extension, n=2) and 11 discontinuations from treatment-emergent adverse events occurred, the commonest being somnolence during Core Study (23.5%) and Extension A (19.0%).

Conclusion

Adjunctive perampanel could reduce seizure frequency in some patients with LGS long-term and was well-tolerated in patients aged ≥2 years.

Abstract #20

ELEVATE Study 410: Assessment of Cognition (EpiTrack®) Following Perampanel (Monotherapy/First Adjunctive) in Patients With Epilepsy and a History of Psychiatric/Behavioral Events

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Rationale

We present a post hoc analysis of change from baseline cognition (EpiTrack®) scores in patients with epliepsy, specifically a subgroup with a history of psychiatric/behavioral events, from the multicenter, open-label, Phase IV ELEVATE Study of perampanel monotherapy/first adjunctive therapy (Study 410; NCT03288129).

Methods

Patients were aged ≥4 years with focal-onset seizures (FOS), with/without focal to bilateral tonic-clonic seizures (FBTCS), or generalised tonic-clonic seizures (GTCS). The Titration, Maintenance, and Follow-up Periods lasted ≤13, 39, and 4 weeks, respectively. Perampanel was up-titrated in 2-mg increments at ⩾2-weeks intervals from 2 mg/day to 4-12 mg/day, depending on response and tolerability. Endpoints included 3, 6, 9 and 12-month retention rates, seizure-freedom rates, seizure frequency reductions, cognition changes, and treatment-emergent adverse events (TEAEs).

Results

In the Safety Analysis Set, 54 patients received perampanel monotherapy/first adjunctive therapy. Twenty-four patients (FOS, n=17; FBTCS, n=2; GTCS, n=4) with a history of psychiatric/behavioral events were included in this post hoc analysis. There were no clinically meaningful changes from baseline in EpiTrack® total score at 12 months and end of treatment (mean [SD], -1.1 [3.14] n=11 and 0.5 [2.61] n=23), respectively (increase=improvement). Median percent reduction in seizure frequency/28 days during the entire Maintenance Period was 73.2% (n=22). The incidence of TEAEs in this subgroup was 95.8% (n=23/24); dizziness (25.0%, n=6/24) and vomiting (20.8%, n=5/24) were the most common.

Conclusion

Perampanel as monotherapy/first adjunctive therapy was generally safe and efficacious in patients from ELEVATE with a history of psychiatric/behavioural events; EpiTrack® scores were consistent with the overall patient population.

Abstract #21

Withdrawn

Abstract #22

Women With Epilepsy: What Can We Do Better?

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Rationale

Women with epilepsy (WWE) face difficulties with fertility, family planning, contraception, teratogenicity, management during and after pregnancy, child care, hormonal influences on seizure frequency, and bone health. There is very little research on the care WWE receive during these times. The aim of this study is to evaluate whether WWE receive the care recommended in Provincial guidelines and by epilepsy experts for gender-specific and sex-specific health issues.

Methods

A Canadian cross-sectional anonymous survey open to patients seen in Epilepsy Clinic or admitted to the Epilepsy Monitoring Unit at London Health Sciences Centre and who identify as a woman or who were assigned the female sex at birth was launched in December 2022. Participants were 18 years old or older.

Results

Preliminary results of 80 participants, mean age of 37.2 (range 18-66). Of the WWE who reported menses affecting their seizure frequency, 81% (n=21) discussed this with their physician, with no treatment changes for 70.6% (n=17). Only 37.7% (n=69) used contraception, from which 38.5% (n=26) used IUDs. 63.2% (n=68) were advised to take folic acid, the most common doses were 1mg used by 25.6% and 5mg used by 25.6% (n=43). 50% (n=38) of pregnancies were unplanned. 88.5% (n=61) of participants were not diagnosed with a bone condition. 61.7% were advised to take vitamin D and 35% received no bone health counselling (n=60).

Conclusion

Most WWE receive recommended counselling for some issues, e.g., bone health, but not for other issues, e.g., contraceptive use. Continued research and training are needed to improve the care WWE receive.

Abstract #23

A Protocol for Multimodal Prediction of Seizure Recurrence After Unprovoked First Seizure to Guide Clinical Decision Making

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Rationale

Epilepsy is a common neurological disorder characterised by recurrent seizures. Almost half of patients that have an unprovoked first seizure (UFS) have additional seizures and develop epilepsy. No current predictive models exist to determine who has a higher risk of recurrence to guide treatment. Emerging evidence suggests alterations in cognition, mood, and brain connectivity exist with the UFS. Examining the baseline brain changes present following an UFS will enable the development of the first multimodal biomarker-based predictive model of seizure recurrence in adults with UFS.

Methods

200 patients and 75 matched healthy controls (aged 18-65) from the Halifax and Kingston First Seizure Clinics will undergo neuropsychological assessments, structural and functional magnetic resonance imaging, and electroencephalography. Seizure recurrence will be assessed prospectively. Regular follow-ups will occur to monitor recurrence.

Results

Comparisons will be made between UFS and healthy control groups and those with and without seizure recurrence after UFS. A multimodal machine learning model will be trained to predict seizure recurrence at 12 months.

Conclusion

Initiation of anti-seizure medications (ASM) after UFS in people at risk for further seizures can help prevent seizure recurrence, whilst unnecessary treatment with ASM in people at low risk exposes patients to harmful side-effects. Early prognostic biomarkers will inform the first multimodal predictive model of seizure recurrence following UFS to significantly alter and optimize clinical decision-making about treatment in this population.

Abstract #24

Identifying a Cognitive Profile of Drug Resistant Focal Insular Epilepsy

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Rationale

Recent advances in neuroimaging techniques have revealed the significant role of the insula in focal epilepsy. Research in insular epilepsy has provided ample opportunities to study the function of this region in patients with well-localized abnormalities. The role of the insula in epilepsy-related cognitive dysfunction has, however, been obscured by its tendency to mimic the functions of other cortical regions.

Methods

We conducted a retrospective review of the health records and preoperative neuropsychological test scores of 19 patients who were identified to have drug resistant focal insular epilepsy. Patients were categorized by side of seizure onset (dominant vs. non-dominant hemisphere) and compared on their frequency of impairment in IQ, language functions, visuospatial processing, verbal memory, visual memory, motor skills, and attention.

Results

Patients with non-dominant hemisphere insular epilepsy were more likely to have scores in the impaired than in the normal range in visual memory. Patients with dominant hemisphere insular epilepsy showed mild impairments in verbal memory and motor skills, which did not reach significance. Finally, both groups demonstrated subtle weaknesses across most cognitive domains relative to normative data.

Conclusion

Memory appears to be the cognitive domain most sensitive to focal insular dysfunction in epilepsy. To determine the diagnostic utility of this finding, future research will involve comparing cognitive profile of people with insular epilepsy to those with other focal epilepsies, especially temporal lobe epilepsy.

Abstract #25

Calling All Women: The Shared Lived Experiences of Epilepsy Women Professionals

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Rationale

Sex and gender disparities remains a problem that impacts experiences of women professionals. Our study collected the lived experiences of women working in epilepsy fields to summarise for the first-time the sex/gender-related problems faced.

Methods

A global cross-sectional survey investigated the personal experiences of women working in various professions within the epilepsy field. Online surveys were available in English, French, and Spanish. 239 responses were analyzed.

Results

The mean age of the participants was 39.0 years (IQR=46.5-32), residing in 33 different countries. 99%(n=117) identified as female. When asked if they feel the need to work harder than male colleagues to be respected or treated equally, 53%(n=115) said “yes”, and one participant said, “there is an automatic respect for the male physicians. For the females in the group, there is almost a trial period…”. 75.6%(n=82) recounted they had experienced Imposter Syndrome, and one participant said they are, “almost daily questioning if [they are] good/smart/talented enough”. 26.5%(n=117) stated they had experienced gender-based discrimination at their workplace. For those who were parents, 67.3%(n=55) reported feeling that their academic/clinical role had been impacted by having children. 51.3%(n=117) answered “yes” when questioned if they think men earn more than women do in a similar professional role. 50.9%(n=116) of participants reported having a woman mentor. 45.3%(n=117) had a woman supervisor/chair.

Conclusion

This is the first study investigating the impact of gender disparities in the epilepsy workplace. Preliminary results suggest that professional women are subject to sex-related disparities, which opens the conversation for opportunities and changes in the workplace.

Abstract #26

Electropositive Epileptiform Discharges After Cardiac Arrest

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Rationale

Epileptiform discharges generally appear electronegative in polarity when assessed with conventional scalp electroencephalography (EEG), secondary to a vertically oriented dipole representing organization of large pyramidal cells. However, we present a rare case of a 40-year-old male who experienced electropositive seizures following brain injury from cardiac arrest. He was admitted after being assaulted with the blunt side of an axe and developed pulseless electrical activity cardiac arrest secondary to respiratory failure during admission.

Methods

Case Report.

Results

EEG telemetry demonstrated frontally predominant and generalized surface electropositive generalized spikes and polyspikes, on a suppressed background with frequency of approximately 4-6 hz, without a clinical correlate. Electrographic seizures were seen from the left hemisphere with clinical correlate consisting of right arm clonic movements, lasting up to 4 minutes. By day 9 post arrest the EEG became diffusely suppressed.

Conclusion

The underlying pathophysiology of electropositive seizures remains uncertain, but it could involve altered dipole orientation with injury to pyramidal neurons, or altered site of origin of epileptiform activity. This pattern may also reflect altered membrane function of cortical neurons with spontaneous firing. Intrinsic bursting of multiple interconnected neurons as recorded on the scalp, associated with myoclonus, probably arises from pyramidal cells of the neocortex. We suggest that their resting membrane potential is altered, allowing for depolarizing currents to trigger such synchronized discharges. As the neurons die, the spiking diminishes until electrographic silence occurs. The significance of this pattern for prognosis is unclear due to limited data.

Abstract #27

Evaluating the Management and Assessment of Seizures on the Epilepsy Monitoring Unit: A Quality Improvement Project

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Rationale

This retrospective quality improvement review aimed to evaluate the quality of ictal assessments in the QEII EMU and identify areas for improvement. The effectiveness and safety of assessments were evaluated based on standardized protocols.

Methods

We reviewed video telemetry records of thirty seizures (including ten convulsive seizures) from thirty EMU patients between March 2021 and March 2022. Collected data included staff response time, safety practices, video optimization, ictal assessment, and postictal review.

Results

Safety measures were well-performed in the EMU. Event call buttons were almost always within reach (87%) and pressed (97%). Staff responded at the bedside to events in 2.75sec +/- 3.85sec and clinical onset of seizures in 17.6sec +/- 14.65sec. We identified several areas for improvement to meet our current quality standards for ictal assessments: Adequate exposure of patient (46%), providing physical stimulation if responsiveness could not be gauged (22%), and testing recall words (73%) were not consistently performed. Finally, we identified areas for improvement for the EMU to reach international consensus standards: Naming objects (50%) and asking patients to read/write (0%) during assessments.

Conclusion

We confirmed that vital safety measures are being well-performed in the EMU. Additionally, we identified opportunities for improvement to meet our current standards as well as benchmark standards that the EMU. We are designing a standardized training program, in the hopes that we can further minimize risks while maximizing benefits for patients admitted to the EMU, and we plan to reassess in one year.

There was no funding source for this project.

Abstract #28

Focal to Bilateral Tonic-Clonic Seizure Detection Based on Respiration Using a Wearable

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Rationale

Recent studies have reported promising performances regarding the detection of convulsive seizures using physiological data (e.g., heart rate variability, acceleration) recorded with wearables. To our knowledge, no studies have explored seizure detection based on respiration signals recorded with respiratory inductive plethysmography. In this work, we aimed to determine whether focal to bilateral tonic-clonic seizures (FBTCS) could be detected using a patient-specific threshold algorithm based on respiration signals recorded with the Hexoskin smart shirt.

Methods

Patients admitted to the CHUM epilepsy monitoring unit were asked to wear the Hexoskin shirt. Linear detrending and low-pass filtering (2 Hz) were performed. Breathing rate and breathing amplitude (thoracic and abdominal) were extracted from raw respiratory signals. Patient-specific threshold cut-off values were determined for each feature using 1.05x the highest value of a two-hour interictal period from each patient's first seizure recording. The algorithm was retrospectively run on 24h of continuous data and tested on 5 window sizes (3, 5, 7, 9, 11s). Detection sensitivity, 24h false alarm rate (FAR) and seizure detection latency from seizure electrical onset and from generalization were computed to assess performance.

Results

23 FBTCS (19 patients) were analyzed. The best performing algorithm, based on abdominal breathing rate (9s window), yielded a 78.26% sensitivity, 1.57/day FAR, and 65.5s and 27.5s latency from seizure onset and generalization, respectively.

Conclusion

Our findings suggest that FBTCS can be detected with good sensitivity and FAR using patient-specific thresholds based on respiration. Further analyses on a larger cohort of patients are required to confirm our suggestions.

Abstract #29

Fostering Continuous Education in Epilepsy: A Virtual Teaching Initiative by the Canadian League Against Epilepsy

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Rationale

Since 2021, the CLAE organizes an accredited continuous virtual education program in epilepsy run by the "Canadian Epilepsy Teaching Network." Monthly virtual rounds by national and international experts are offered.

Methods

A satisfaction questionnaire addressed to participants was conducted at the end of each webinar using a 5-point Likert scale. Additionally, open feedback was collected.

Results

23 webinars were conducted between March 2021 and March 2023, with a median of 115 participants [109.5-136]. On average, 40% of the participants responded to the survey. Responders were mostly physicians (58.1%) or trainees (24.7%). The average rate of returning registrants was 91.8%. Median scores were 4.72 [4.64-4.81] for attainment of learning objectives, 4.69 [4.63-4.78] for knowledge enhancement, 4.71 [4.61-4,79] for meeting expectations, 4.53 [4.47-4.67] for provision of relevant information in clinical practice, 4.60 [4.44-4.64] for allocation of adequate time to discussion, 4.79 [4.74-4.81] for being free from commercial bias, 4.77 [4.72-4.85] for content relevance and 4.69 [4.56-4.77] for using effective teaching methods.
Most of the responders reported perceiving improvement in therapeutic (21.9%) or diagnostic (20%) management of epilepsy, as well as in handling anti-seizure medications (9.5%). From 2022, sessions were designed based on the topics suggested by learners.
Overall, the extent to which they would recommend the course to other colleagues was rated 4.90 [4.83-4.95].

Conclusion

The program generated by the attendees' requests seems to appeal to the audience as it shows a high level of appreciation and a high rate of willingness to recommend our sessions.

Abstract #30

Frontal Lobe Phasia: Intact Language Despite Secondary Seizure Generalization

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Rationale

Generalized seizures usually cause impaired awareness. However in our case, a 61-year-old male patient had a generalized electrographic seizure on video EEG without clinical signs such as altered level of consciousness. This calls for an in-depth analysis of why certain generalized seizures do not impair awareness while the majority do.

Methods

This is a case report. We correlate clinical presentations with technical findings from the routine video EEG.

Results

A routine EEG of our patient showed an electrographic seizure lasting 12 minutes, with an ictal onset of low amplitude rhythmic spikes at the right frontal region, spreading to right frontocentral, midline and later left frontal region. This then evolved into diffuse generalized sharp waves at 2Hz until offset. During the entire duration of seizure, the patient carried out a normal conversation with the technologist at the bedside. There was no indication of a clinical seizure. The conversational interactions were captured by the video EEG.

Conclusion

Generalized seizures usually impair awareness. However, as they do not involve the whole brain, i.e. involving certain cortical-subcortical networks while sparing others, in rare cases consciousness is preserved. In seizures that affect bilateral association cortex such as frontal neocortex and related subcortical structures, information processing can be severely disrupted. Similarly, in seizures that affect the default mode network, awareness tends to be lost. Our patient's preserved awareness demonstrates the selective disruption of brain circuitries to allow information reception and processing despite generalized seizures.

Abstract #31

Keep Calm and Carry On: Panic Attack Induced Focal Seizures in a Patient With a Large Parietal Arteriovenous Malformation

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Rationale

Panic attack associated hyperventilation can induce focal seizures in patients with Arteriovenous Malformations (AVMs). This is not a commonly considered seizure etiology and may be misconstrued with ictal panic. Video EEG monitoring can help characterize these events and guide further management. This case is described in order to demonstrate the clinical significance of this phenomenon.

Methods

We present a case of a 26-year-old ambidextrous male with focal lesional left parietal lobe epilepsy secondary to a Spetzler-Martin Grade 5 AVM diagnosed in 2016. The case reviews the patient's clinical course, including worsening of focal seizures in 2021 which were found to be triggered by panic attacks based on video EEG monitoring. Video recordings (or screenshots thereof) are included as part of this case.

Results

Video EEG recordings demonstrate baseline left focal parietal slowing with no epileptiform correlate throughout the extent of his prolonged panic attack. This is followed by panic attack cessation and left posterior quadrant discharges which evolve into generalized seizure activity. He was treated with psychotherapy and both his panic attacks, and his focal seizures, decreased in frequency dramatically.

Conclusion

Hyperventilation can have ictal implications through a variety of proposed mechanisms including hypocapnia induced vasoconstriction and thalamocortical projection PH sensitivity. In this case, panic attack related hyperventilation is thought to have triggered focal vasoconstriction, amplifying the vascular steal phenomenon already present. This case demonstrates the importance of video EEG monitoring for event characterization in refractory epilepsy associated with AVMs. It reflects the importance of considering hyperventilation as a focal seizure etiology in patients with AVMs.

Abstract #32

Localizing and Lateralizing Value of Auditory Phenomena in Seizures: A Narrative Review

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Rationale

Auditory seizures (AS) are classically thought to involve a seizure onset zone (SOZ) in the temporal lobe, but there remain uncertainties about their localizing and lateralizing value. We conducted a narrative literature review with the aim of providing an up-to-date description of the lateralizing and localizing value of AS.

Methods

The databases PubMed, Scopus, and Google Scholar were searched for literature on AS in December 2022. All cortical stimulation studies, case reports, and case series were analyzed to assess if the auditory phenomena were suggestive of AS and if the lateralization and/or the localization of the SOZ could be determined. We classified AS according to their semiology and the level of evidence with which the SOZ could be predicted.

Results

A total of 174 cases comprising 200 AS were analyzed from 70 articles. Across all studies, the SOZ of AS were more often in the left (62%) than in the right (38%) hemisphere. Unilaterally heard AS were more often due to a SOZ in the contralateral hemisphere (74%). The SOZ for AS is not limited to the auditory cortex, nor to the temporal lobe. The areas more frequently involved were the superior temporal gyrus and mesiotemporal structures. Extratemporal locations included parietal, frontal, insular, and rarely occipital structures.

Conclusion

Our review highlighted the complexity of AS and their importance in the identification of the SOZ. Due to the limited data and heterogeneous presentation of AS in the literature, the different patterns associated with different AS semiologies warrant further larger studies.
Funding sources: None

Abstract #33

National Consensus for Epilepsy Fellowship Education in Canada (Delphi Round 1): At What Stage Should Learning Objectives be Met?

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Rationale

No standardized epilepsy fellowship curriculum or learning objectives exist in Canada. The study-objective is developing consensus-based learning objectives, which may lead to standardization of epilepsy fellow training in Canada.

Methods

Literature review was completed to determine current epilepsy education standards in North America, followed by serial meetings with expert panelists, consisting of epilepsy fellowship program directors and epileptologists. Meeting transcripts led to questionnaire development, including training eligibility and objectives in Diagnostics, Therapeutics/Counselling, and Surgery/Emergencies/Epilepsy-biology, and timing of acquisition of objectives (prior to fellowship, or after one or two-years of fellowship. Previous studies using Delphi technique for healthcare consensus led to consensus definition. Equivocal items in the first Delphi round are to be carried forward into subsequent Delphi rounds.

Results

All agreed that certification in neurology should be mandatory, a minimum number of EEGs and surgical cases are required during training, and fellowship external reviews are required. There was 80% agreement in 13/44 (30%) of Diagnostic, 8/51 (16%) of Therapeutics/Counselling and 15/38 (49%) of Surgery, Emergencies and Epilepsy-biology objectives, and 100% agreement regarding knowledge of ordering lab tests, medical emergencies and diagnosing status epilepticus.

Conclusion

After Delphi-round-1, no strong consensus exists regarding timing of achieving training goals. All agree mandatory neurology training, a set number of cases and program external reviews are important. Further Delphi rounds will occur to obtain a national consensus statement for epilepsy education in Canada.

Abstract #34

Patient Safety in Canadian Epilepsy Monitoring Units: A Survey of Current Practices

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Rationale

Guidelines on epilepsy monitoring unit (EMU) standards have been recently published. We aimed to survey Canadian EMUs to describe the landscape of safety practices and compare these to the recommendations from the new guidelines.

Methods

A 34-item survey was created by compiling questions on EMU structure, patient monitoring, equipment, personnel, standardized protocol use, and use of injury prevention tools. The questionnaire was distributed online to 24 Canadian hospital centers performing video-EEG monitoring (VEM) in EMUs. Responses were tabulated and descriptively summarized.

Results

In total, 26 EMUs responded (100% response rate), 50% of which were adult EMUs. EMUs were on average active for 23.4 years and had on average 3.6 beds. About 81% of respondents reported having a dedicated area for VEM, and 65% reported having designated EMU beds. Although a video monitoring station was available in 96% of EMUs, only 48% of EMUs provided continuous observation of patients (video and/or physical). A total of 65% of EMUs employed continuous heart monitoring. The technologist-to-patient ratio was 1:1-2 in 52% of EMUs during the day. No technologist supervision was most often reported in the evening and at night. Nurse-to-EMU patient ratio was mostly 1:1-4 independently of the time of day. Consent forms were required before admission in 27% of EMUs.

Conclusion

Canadian EMUs performed decently in terms of there being dedicated space for VEM, continuous heart monitoring, and adequate nurse-to-patient ratios. Other practices were quite variable, and adjustments should be made on a case-by-case basis to adhere to the latest guidelines.

Abstract #35

Real World Practices for the Care of Women With Epilepsy – A Canadian Perspective

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Rationale

Approximately 150,000 Canadian women live with epilepsy, a population who present unique aspects of providing care. Our objective was to capture demographic and real-world practice characteristics of Canadian healthcare professionals, providing care for women with epilepsy (WWE) with specific focus on reproductive considerations to identify potential gaps in knowledge and translational care.

Methods

A questionnaire developed by the Canadian League Against Epilepsy WWE workgroup was distributed to healthcare professionals from February 2021 to October 2022 to capture participant demographics and practice patterns in key areas of the reproductive cycle in WWE.

Results

A total of 156 participants completed the questionnaire, most being physicians (81.4%), epilepsy specialists (69.0%), those who cared for adult patients (86.5%), and those who work in an academic setting (65.4%). Among respondents, 76.9% routinely reviewed contraception with patients and an intrauterine device was the most popular recommended method (85.3%). The majority of participants (89.7%) counselled on folic acid supplementation and 68.0% of respondents performed a pre-pregnancy baseline drug level. Participants selected lamotrigine and levetiracetam most frequently for either focal or generalized epilepsies during pregnancy, and 85.9 % performed therapeutic drug monitoring during pregnancy. Most respondents recommended breastfeeding for WWE on anti-seizure medications (92.3%) and routinely provided safety counseling for women in the postpartum period (84.6%).

Conclusion

Overall, our study demonstrates that Canadian practice patterns conform reasonably well to evolving evidence and guidelines. Importantly, reproductive health counseling is essential for all WWE of childbearing age and neurologists must maintain knowledge of advancing evidence to provide optimal care.

Abstract #36

Scalp Electrodermal Activity as Localizing Sign in Epileptic Seizures

Kia Gilani, Apameh Tarazi, Richard Wennberg

University of Toronto

Rationale

A novel high-amplitude infraslow EEG waveform representing scalp electrodermal activity (EDA) is described, which may be triggered by seizures (s-EDA) or occur independently of seizures (ns-EDA).

Methods

Epilepsy Monitoring Unit (EMU) recordings were screened for EDA in a previously identified "s-EDA Group" (8 temporal lobe epilepsy (TLE) patients; 2 MEG-EEG, 1 simultaneous scalp-sEEG) and a "Control Group" (12 consecutive EMU plus 5 simultaneous scalp-sEEG patients). An additional patient was studied during hypothalamic deep brain stimulation (DBS).

Results

The s-EDA Group had 479 EDA events (mean 3.57/day, range 0-32); 249 s-EDA, 230 ns-EDA. Eleven of 17 Control Group patients had 106 EDA events, mostly during sleep (mean 2.1/day, range 0-14), all ns-EDA. Mean EDA waveform duration was 27.1±18.9 and 21.3±9.8 seconds, and mean amplitude was 515.0±482.2 and 521.8±501.5 uV, in s-EDA and Control Groups, respectively.

s-EDA onset was ipsilateral to seizure onset in 78.9% of seizures and bilateral in 21.1%. s-EDA preceded scalp EEG ictal onset in 72.7% of seizures (mean 18.8±9.4 seconds before), and followed ictal onset in 27.3% (mean 20.6±12.6 seconds after).

EDA was not visible in MEG or sEEG recordings, was not correlated with palmar EDA, and could be transiently abolished by skin scraping. Unilateral ns-EDA was seen at onset of high-frequency DBS of the ipsilateral hypothalamus.

Conclusion

s-EDA is a rare entity discovered in a subset of TLE patients. ns-EDA also occurs in humans, primarily during sleep. Unilateral onset s-EDA localizes to the hemisphere of seizure onset, possibly due to ictal activation of the ipsilateral hypothalamus.

Funding resources: No funding was available for this study.

Abstract #37

Screening and Management of Depression in People With Epilepsy: A Quality Improvement Study

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Rationale

Due to the high prevalence of depression (10-20%) in people with epilepsy (PWE), the "International Consensus Clinical Practice Statements for the Treatment of Neuropsychiatric Conditions Associated with Epilepsy" recommended implementing routine screening for depressive symptoms. Thus, the Centre Hospitalier de l'Université de Montréal (CHUM) epilepsy clinic decided in 2017 to administer the Neurological Disorders Depression Inventory for Epilepsy (NDDIE) at each visit. In this study, we sought to review our experience with this approach.

Methods

We reviewed 1929 NDDIE questionnaires and examined whether neurologists used these screening results to make any change in management.

Results

Out of the total NDDIE questionnaires assessed, 13.6% screened positive for depression (NDDIE≥16). Among patients with positive screening results, 24.7% were referred to a psychiatrist, 12.2% to a psychologist and 5% were referred to their family physician for further assistance. For 13.3% of these patients, the antiseizure medication was changed to improve their symptoms. Additionally, 3% of these patients received another form of treatment and 7.2% declined suggestions made by the neurologist. 34.6% of patients did not receive any treatment.

Conclusion

In our epilepsy clinic, 13.6% of NDDIE questionnaires screened positive for depression. This led to a change in management in a significant proportion of cases. The next step will be to assess wether actions taken were beneficial.

Abstract #38

Successful Treatment of Temporal Lobe Status Epilepticus with Short Course Acetazolamide Monotherapy in a Patient with Anti-LGI1 Encephalitis

Kia Gilani, Apameh Tarazi, Richard Wennberg

University of Toronto

Rationale

To describe the successful treatment of focal status epilepticus with acetazolamide in a patient with anti-LGI1 encephalitis.

Methods

A 43-year-old with worsening pilomotor seizures in the setting of antibody-positive relapse of anti-LGI1 encephalitis, unimproved after >18 months of immunotherapy, chronically receiving phenytoin and cycling acetazolamide (2-days-on/4-days-off), was hospitalized for video-EEG monitoring. Acetazolamide was stopped and phenytoin rapidly weaned. The video-EEG data and 3 years of detailed pre-admission seizure diary data were analyzed.

Results

The first week of monitoring documented daily electroclinical seizure counts of 8, 7, 5, 8, 7, 10, 9 right temporal lobe seizures; serum phenytoin undetectable by day 7. Seizures then rapidly progressed to focal aware right temporal lobe status epilepticus: 84 seizures on day 8, 246 on day 9. Acetazolamide was commenced (500mgbid) and continued for 5 total doses. Daily seizure counts fell to 117, 33, 2, 0, 0, 0, 5, 0, 0, 1, 0, 0, 0, 0, 0 on days 10-24.

From 1079 days of pre-admission seizure diary, 1203 pilomotor seizures were documented. Seizure occurrence percentages correlated strongly with the 6-day cycling acetazolamide regimen: 6% on day 1, 2% on day 2, ON acetazolamide; 3%, 13%, 31%, 45% on days 3, 4, 5, 6, respectively, OFF acetazolamide.

Conclusion

Chronic cycling of acetazolamide has been reported to provide remarkable control of pilomotor seizures in patients with anti-LGI1 encephalitis, for reasons still not understood. In this novel case a short course of acetazolamide monotherapy was demonstrated to definitively abort focal status epilepticus, with an unexpectedly enduring effect.

Funding resources: No funding was available for this study.

Abstract #39

The Canadian Epilepsy Teaching Network (CETN), Virtual Electroencephalography Training Program Experience

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Rationale

Electroencephalography (EEG) is an essential tool for the diagnosis and management of epilepsy. EEG education in Canadian neurology residency programs reveal a disparity in exposure and classroom teaching. There is no standardized EEG curriculum among Canadian epilepsy fellowship programs. To address these gaps, the CETN established a National EEG online teaching program.

Methods

We conducted two iterations of a structured virtual EEG course, with weekly sessions in June-October 2021, and March-June 2022. Trainees were enrolled via Canadian neurology residency and epilepsy fellowship programs. - Videos from all didactic sessions were available online for further reference, to registered trainees and all CLAE members. We obtained pre- and post-course demographic information of participants and analytical data of video recordings posted on the CLAE website. Post-course trainee satisfaction survey was completed.

Results

A total of 77 trainees registered for the courses; most trainees were adult neurology residents (34%) and adult epilepsy fellows (32%). Prior exposure to EEG teaching was reported by 53% of trainees. The average number of unique viewers per recorded video in 2021 was 29.7 interquartile range (16-35.5) while in 2022 the average was 22.5, interquartile range (16-28). Post-course, 82% of participants strongly agreed that the course enhanced their knowledge. All participants were either likely (27%) or very likely (73%) to recommend the course to their peers.

Conclusion

Virtual EEG education is both feasible and contributory to high-quality EEG education among Canadian neurology trainees. This is a promising modality of teaching to address unequal exposure to EEG to date.

Abstract #40

AnxEpiVR: Designing Virtual Reality Exposure Scenarios to Treat Anxiety in People With Epilepsy in a 3-Phase Clinical Trial

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Rationale

People with epilepsy (PwE) commonly experience comorbid anxiety characterized by fears and avoidance behaviours related to their condition. Virtual reality (VR) exposure therapy (ET) has been successfully used to treat anxiety disorders, however the AnxEpiVR Study represents the first effort to design and evaluate VR-ET for treating epilepsy/seizure-specific anxiety.

Methods

This was a mixed-methods study with three phases: 1) an anonymous online questionnaire (>18 years) to collect information about epilepsy/seizure-specific anxiety that would inform the design of VR-ET scenarios; 2) a participatory design approach to create customizable VR exposure scenarios using 360deg-video; and 3) piloting the VR-ET scenarios with PwE to evaluate the intervention and protocol through self-report questionnaires and semi-structured interviews.

Results

Phase 1 participants (n=18) described anxiety-provoking scenes which were categorized by: Location, Social Setting, Situational, Activity, Physiological, and Previous Seizure. Factors found to increase anxiety included: potential for danger, social factors, and specific triggers. This feedback guided the development of three exposure scenarios (Dinner Party, Subway, and Shopping Mall), each comprising seven 5-minute scenes. Scenarios were piloted with PwE (n=3), whereby scenes within each scenario were arranged into a customized hierarchy for each individual. Participants reported that the VR-ET effectively captured their epilepsy/seizure-related fears and that the at-home intervention was easy to follow.

Conclusion

VR-ET is an accessible and feasible intervention for treating epilepsy/seizure-specific anxiety in PwE. The efficacy of VR-ET in reducing anxiety will be further evaluated in a larger clinical trial in an Epilepsy Monitoring Unit in 2024.

Abstract #41

Disrupted Signal Flow and Functional Connectivity Subspaces in Declarative Memory Networks of Temporal Lobe Epilepsy

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Rationale

Temporal lobe epilepsy (TLE) affects declarative memory processes. Functional evidence implicates large-scale networks involved in different forms of memory[1]. However, whether networks subserving such function in TLE may undergo selective reorganization remains incompletely understood. This study investigated the reorganization[2] of episodic and semantic networks and examined the directionality of signal flow[3] between brain regions using task-based fMRI data.

Methods

We studied 20 TLE (left/right=15/5, age=36±12 years; F/M: 10/10) and 60 healthy controls (age=34±8 years, F/M: 30/30) who underwent episodic and semantic fMRI. Connectome gradients were derived using diffusion mapping[4]. The signal flow between regions was analyzed by computing the effective connectivity[3]. Group differences were evaluated using surface-based analysis, controlling for age and sex (FDR <0.05)

Results

The results revealed an atypical organization of declarative memory systems in TLE. Patients with TLE exhibited reduced sensory- transmodal gradient differentiation in episodic but not semantic tasks. Analysis of signal flow demonstrated significant changes in afferent and efferent flow patterns during episodic but not semantic states. Gradient alterations and signal flow disruptions were associated with compromised episodic memory function.

Conclusion

The study revealed disrupted signal flow and gradient reorganization of declarative memory systems in TLE. Memory network reorganization in TLE appears to be state-dependent, with more pronounced alterations in episodic tasks. The observed changes in connectome gradients and signal flow patterns provide novel insights into mechanisms underlying memory impairments in TLE.

1Irish,2020.CurrOpinBehavSci,32(),43-49 ;2Margulies,2016.PNAS(),201608282 ; 3Frässle,2017. NeuroImage, 155, 406–421, 4 Vos de Wael,2020. Commun Biol 3, 103

Abstract #42

Health-Related Quality of Life in Transgender Persons With Epilepsy

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Rationale

The effects of epilepsy and transgender identity on health-related quality of life (HRQoL) have been studied independently, but their interaction remains unexplored. We evaluated the association of epilepsy and identifying as transgender on HRQoL.

Methods

We used 2017-2019 data from the Behavioral Risk Factor Surveillance System (BRFSS), an annual population-based survey through the Centers for Disease Control. We extracted data on demographics, gender identity, epilepsy diagnosis and HRQoL, measured using the Healthy Days Measure. The outcome assesses number of days (over 30 days) of poor physical and mental health and limited activity because of poor physical/mental health. We evaluated associations between epilepsy, transgender identity and their interaction on HRQoL through negative binomial regressions. Reported incidence rate ratios (IRR) represent the coefficient of interaction between epilepsy and transgender identity adjusted for confounders.

Results

The weighted sample of 41,852 individuals surveyed over 3 years revealed 1.9% had epilepsy and 0.6% identified as transgender. Among people with epilepsy (PWE), 1.8% identified as transgender. Epilepsy and transgender identity were independently associated with poorer physical and mental health, and limitations in usual activities. PWE who identified as transgender experienced significantly worse physical (IRR=2.69 [95%CI, 1.01-7.11]) and mental health (IRR=3.41 [95%CI, 1.50-7.77]) and limitations in activities (IRR=2.49 [95%CI, 1.09-5.67]) than PWE who did not, adjusting for covariates.

Conclusion

Findings suggest PWE who identify as transgender experience poorer physical and mental health and limitations in usual activities compared to PWE who are not transgender. Future research should focus on identifying strategies to address HRQoL disparities for transgender PWE.

Abstract #43

Implementing WHO's Intersectoral Global Action Plan on Epilepsy and Other Neurological Disorders (IGAP) 2022-2031 Using Community-University Partnerships: An Example Targeting Mental Health in Children With Epilepsy and Their Parents

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Rationale

WHO's member states endorsed a 10-year Intersectoral Global Action Plan on Epilepsy and other Neurological Disorders (IGAP) (WHA73.10), a comprehensive, coordinated, intersectoral response to reduce gaps in knowledge and treatment. We aim to promote effective partnerships between community agencies and academic researchers as a way to implement Strategic Objective 5: "148(d) conduct implementation research including the dissemination of lessons learned to accelerate the scale-up of successful strategies to strengthen epilepsy services".

Methods

A community epilepsy agency approached academic researchers seeking an intervention to manage stress and emotions/behaviors for children with epilepsy and their parents. Together we delivered and evaluated a mindfulness-based parent and child program (M3©) designed to improve mental health. The M3-E study, a randomized controlled trial, assessed feasibility of interactive online delivery by agency staff to enable widespread delivery. A focus group with 11 intersectoral stakeholders collected perspectives on benefits and challenges of community-researcher partnerships and M3© implementation.

Results

Six themes emerged through content analysis: mutual goal, shared decision-making, communication, relationship building, sharing knowledge, and sustainability. The patterns and relationships observed pointed to key facilitators including shared goals from the outset of the partnership and co-developed principles to drive all components of the process. Collective reflection highlighted the value of viewing partnerships as highly dynamic and cyclical rather than as a linear path.

Conclusion

This intersectoral partnership demonstrates one example of a strategy to implement the IGAP's Strategic Objective 5, accelerating uptake of evidence-based programming. Findings outline specific facilitators to overcome barriers to achieve this IGAP objective.

Abstract #44

Improving Epilepsy Care in Ontario, Canada: The Impact of the Provincial Strategy for Epilepsy Care

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Rationale

In 2016, the Ontario Ministry of Health and Long-Term Care implemented the Provincial Strategy for Epilepsy Care to increase epilepsy surgery use. The objectives of this study were to assess whether the rates of epilepsy surgeries and assessments for candidacy, as well as neurological consultations, emergency department (ED) visits, and hospital admissions for epilepsy, changed since the Provincial Strategy was implemented.

Methods

We used administrative health data and an interrupted time series design. Annual cohorts were created for July 1st to June 30th of each year between 2007 and 2019, comprising patients with drug-resistant epilepsy eligible for the Ontario Drug Benefit program with no history of cancer. We used segmented Poisson regression models to assess whether the annual incidence of each outcome changed between the period before the Provincial Strategy was initiated (July 2007 to June 2016) and the period after.

Results

The Provincial Strategy immediately increased the rates of epilepsy surgeries and assessments for candidacy by 48% (95% CI: 0%, 118%) and 41% (95% CI: -1%, 99%), respectively. The Provincial Strategy was also associated with a 10% per year decline in the rates of both neurological consultations (95% CI: -15%, -5%) and ED visits (95% CI: -20%, 1%), and a 7% per year decline in the rate of hospital admissions (95% CI: -12%, -1%).

Conclusion

These findings suggest that the Provincial Strategy increased the use of epilepsy surgery and assessments for candidacy and was associated with a declining incidence of neurological consultations, ED visits, and hospital admissions.

Abstract #45

Physiological Changes in Focal Impaired Awareness Seizure Recorded by a Smart Shirt

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Rationale

Seizure detection with wearables has been a prominent research subject in the last few years. However, the focus has often been set on detecting generalized or focal to bilateral tonic-clonic seizures. In this work, we investigated whether respiratory and cardiac changes associated with focal impaired awareness seizures (FIAS) as measured with a smart shirt can be leveraged to detect them.

Methods

Patients recruited at the CHUM epilepsy monitoring unit were asked during their stay to wear the Hexoskin smart shirt (Carré Technologies Inc.) which continuously measures electrocardiography, respiratory and accelerometry signals. Breathing rate and amplitude were extracted from both abdominal and thoracic respiratory bands and heart rate was extracted from the electrocardiography band. A Wilcoxon signed-rank test with Bonferroni correction was used to assess the existence of significant differences between ictal and interictal samples.

Results

We analysed 40 FIAS from 10 patients. Average ictal feature values were compared to the average value during the hour before the seizure. Ten minutes prior to the seizure onset were discarded to ensure that interictal periods were not affected by the preictal state. Both abdominal and thoracic breathing amplitudes showed significant differences between interictal and ictal samples ($p<0.001$). Heart rate and both abdominal and thoracic breathing rates were not found to change significantly ($p>0.05$).

Conclusion

Our preliminary investigation showed that abdominal and thoracic breathing amplitudes measured by a smart shirt seem to change during seizures, which could be promising for the detection of FIAS. Our next step is to develop machine learning algorithms for the detection of FIAS.

Abstract #46

Prognosis After Whole Genome Sequencing of Adult Patients with Lennox-Gastaut Syndrome

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Rationale

Lennox-Gastaut syndrome (LGS) is an epileptic encephalopathy that manifests in childhood in most cases. The objective of this study is to assess and compare long-term outcomes among distinct etiological groups. Additionally, we conducted an extensive analysis of potential genetic variations in a substantial cohort of LGS patients.

Methods

A cross-sectional evaluation in a cohort of adult LGS patients was performed at the Adult Genetic Epilepsy (AGE) Clinic. Mean age was 31.60 ± 9.26 (Range: 19 to 55 years). Seizure outcomes and genetic data were examined. To assess the long-term adaptive behavior of LGS patients, Vineland Adaptive Behavior Scales, Version II (VABS-II) was used.

Results

- 43 adult patients diagnosed with LGS were evaluated.
- 49% of patients had a genetic etiology, 21% had a structural etiology, and 30% had an unknown etiology.
- No significant differences were observed in long-term seizure outcomes among the three groups.
- The ages of seizure onset were lower in the genetic and unknown etiology groups compared to the structural group.
- All individuals exhibited varying degrees of adaptive deficiency, ranging from mild to severe.
- Whole genome sequencing revealed 15 likely pathogenic or pathogenic variants. These variants included 8 single-nucleotide variants (SNV) and 7 copy number variants (CNV). Notably, we identified four potentially novel LGS-related variants: HMBS, KMT2A, PKP2 and 3q29 duplication. Not all patients with genetic etiology had a gene identified (i.e., some patients with lissencephaly and a few other malformations of cortical development).

Conclusion

LGS patients present with persistent unfavorable outcomes regarding seizure control and adaptive behavior throughout their lives, irrespective of the underlying etiology. We uncovered four potentially novel genetic associations with LGS, thereby broadening the spectrum of associated genes/chromosomal abnormalities. However, further investigations are imperative to elucidate the specific relationship between these variants and LGS.

Abstract #47

Slow Wave Sleep and Sleep Spindles in Patients With Drug Resistant Focal Onset Epilepsy – A Prospective Study

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Rationale

Sleep disturbances are commonly encountered by people with epilepsy (PWE), more so among those with drug resistant epilepsy (DRE). Non-rapid-eye-movement (NREM) sleep is known to be an activator of interictal spikes as well as seizures and seizure spread (generalization). The aim of this study was to conduct in-depth objective evaluation of NREM sleep in a population of PWE with focal onset DRE.

Methods

Consecutive patients with focal onset DRE admitted to this center's epilepsy monitoring unit (2019-2022) were included in this study. On the first night, medications were not tapered and full polysomnography (PSG) was conducted in addition to the 18-channel EEG with continuous video monitoring. Advanced manual and automated NREM sleep analysis was conducted. Statistical analysis was conducted using tests appropriate for type and distribution of data.

Results

A total of 46 participants (M:F 25:21, mean age 43 +16, 35(81%) temporal lobe epilepsy) with median epilepsy duration of 14 years, were included. Very short sleep onset latency (median 2.7 min) was observed, along with frequent periods of wake after sleep onset (mean 23 +14). Slow wave sleep (N3%) was abnormal in 17 (42.5%), specifically >30% in 7 (17.5%) patients. Sleep spindle density was low both during N2 (median 0.27) and N3 sleep (median 0.6). Age was found to be the only factor associated with sleep latency, N3% and spindle density abnormalities.

Conclusion

Conclusion: Unique NREM sleep disturbances are common in drug resistant focal onset epilepsy, with frequent observation of high slow wave sleep percentage and reduced spindle density.

Abstract #48

Smart Shirt-Based Nocturnal Sleep Analysis and Machine Learning for Seizure-Day Forecasting

Tian Yue Ding[1], Laura Gagliano[2], Amirhossein Jahani[1], Manon Robert[1], Denahin H. Toffa[1], Dang K. Nguyen[1], Elie Bou Assi[1]

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Rationale

Wearable devices may offer practical and accessible solutions to seizure forecasting for people with epilepsy (PWE). The bidirectional relationship between sleep and epilepsy has motivated the use of sleep quality as a non-invasive biomarker of seizure susceptibility. We investigated the possibility of seizure-day forecasting based on nocturnal sleep recordings of a smart shirt (SS).

Methods

Seventy-eight PWE admitted to the CHUM epilepsy monitoring unit wore the Hexoskin biometric SS which continuously measures cardiac, respiratory, and accelerometry activity. For each night recorded, 10 sleep features (sleep efficiency, latency, and duration, time in NREM and REM, wakefulness after sleep onset, average heart and breathing rates, high frequency heart rate variability, and number of position changes) were automatically computed by the Hexoskin sleep algorithm and then normalized using a reference night for each patient. A support vector machine classifier was trained for pseudo-prospective seizure-day forecasting with 16-hour and 24-hour forecasting horizons. The algorithm performance was assessed using a nested leave-one-patient-out cross-validation approach.

Results

Improvement over chance (IoC) was achieved for 46% and 40% of patients using 16-hour and 24-hour forecasting horizons respectively. In these patients, mean IoC was 36.7% and 34.2%, mean sensitivity was 90.1% and 64.4%, and mean time in warning was 53.8% and 30.2% for the 16-hour and 24-hour horizons.

Conclusion

SS-based nocturnal sleep shows promise for non-invasive seizure-day forecasting in PWE. Further studies in a residential setting with long-term recordings could lead to the development of novel and practical seizure advisory devices.

Pediatric Epilepsy

Abstract #49

Withdrawn

Abstract #50

Clinical Features and Therapeutic Implications of Epilepsy of Infancy With Migrating Focal Seizures Associated With Pathogenic Variation in GABRB3: A Case Series Study

Rayya Almarwani, Katherine Muir

University of Ottawa

Rationale

This study aims to provide a comprehensive review of previously reported cases with GABRB3 mutations in Epilepsy of Infancy with Migrating Focal Seizures (EIMFS). The objective is to describe the genetic and phenotypic characteristics associated with GABRB3 pathogenic variants taken from the existing literature and comparing the findings with a new case identified in our out-patient clinic.

Methods

The study involved a retrospective case series (one new and three previously reported) with pathogenic variation in GABRB3 and a clinical diagnosis of EIMFS. Clinical features and treatment approaches were collected.

Results

The analysis revealed consistent patterns of clinical features and seizure types associated with EIMFS in the four cases. The affected individuals exhibited similar phenotypic characteristics, including developmental delays and refractory epilepsy. Antiepileptic drugs showed limited effectiveness in controlling these seizures.

Conclusion

This study enhances our understanding of the genetic and phenotypic characteristics of epilepsy of infancy with migrating focal seizures associated with pathogenic variation in GABRB3. The findings support the existing literature and confirm the consistent clinical features and seizure types observed in affected individuals. The dynamic nature of migrating focal seizures poses diagnostic challenges and traditional anti-seizure drugs may have limited efficacy. Further research is warranted to explore additional genetic factors, underlying mechanisms, and novel therapeutic approaches to enhance outcomes and quality of life.

Abstract #51

Clinical Significance of a Unique Pediatric EEG Configuration: Bi-Frontal Spikes With Simultaneous Bi-Occipital Positivity

Anita Datta

University of British Columbia

Rationale

Frontal-predominant epileptiform discharges (ED) include generalized spike-wave (GSW) and frontal spikes (FS). However, negative bi-frontal ED with simultaneous occipital positivity (BFOD) are rare, leading to questions regarding physiological generators.

Methods

To determine the clinical significance of BFOD, electro-clinical features of children with BFOD (n=40) were compared to control patients with GSW (n=102) and FS (n=100).

Results

Results are presented in the following order: BFOD, GSW and FS. Epilepsy was prevalent among the groups: 95.0%, 90.2%, and 77.0%, respectively. The median age of seizure-onset did not significantly differ between groups: 3.00, 4.00 and 2.25 years, respectively. Regarding EEG background features, the BFOD group had more disorganized sleep architecture than other groups, $p<0.005$.

There was a significant difference in the proportion of developmental delay (DD) between the groups ($p<0.005$). BFOD had much higher odds of DD compared to GSW and FS groups: OR [CI] 19.44 [5.64, 64.05] and 3.98 [1.16, 13.34]. Furthermore, BFOD had much higher odds of severe DD compared to GSW and FS groups: 9.60 [2.75, 33.45] and 2.73 [1.03, 7.27]. A Gross Motor Function Classification System (GMFCS) score of ≥ 4 was more prevalent in BFOD (22.5%), than GSW (0%) and FS group (9%). On neuro-imaging, BFOD had more structural ($p<0.005$) and multi-lobar structural ($p<0.05$) abnormalities than control groups.

Conclusion

Children with BFOD had particularly severe significant DD, considerable motor deficit (GMFCS≥4), and brain structural abnormalities, often multi-lobar. This suggests BFOD is a marker of severe underlying brain dysfunction and not benign when encountered on routine EEG review.

Abstract #52

Outcome of Absence Epilepsy With Onset at 8 to 11 Years of Age: Watershed Ages When Syndromes Overlap

Anita Datta

University of British Columbia

Rationale

Absence seizures occur in various epilepsy syndromes, including childhood and juvenile absence epilepsy and juvenile myoclonic epilepsy. When children present with absence seizures at ages when syndromes overlap, initial syndrome designation is not always possible, making early prognostication challenging. For these children, the study objective is to determine clinical and initial EEG findings to predict the development of generalized tonic-clonic seizures (GTC's) , which is a factor that affects outcome.

Methods

Children with new-onset absence seizures between 8-11 years of age with at least 5 years of follow-up data were studied through the review of medical records and initial EEG tracings.

Results

Ninety-eight patients were included in the study. The median age of absence seizure-onset was 9 years [Interquartile Range (IQR) = 8.00, 10.00] and follow-up was 15 years [IQR = 13.00, 18.00]. Forty-six percent developed GTCs and 20% developed myoclonic seizures.
On multiple-regression analysis, a history of myoclonic seizures, anxiety, as well as bi-frontal slowing and mild background slowing on initial EEG ($p<0.05$) were associated with GTCs. Although not statistically significant, a shorter duration of shortest EEG burst on baseline EEG was also associated with GTCs.

Conclusion

On initial EEG bi-frontal and background slowing, and myoclonic seizures and anxiety are associated with developing GTCs, which is of prognostic significance when early syndrome designation is difficult.

Abstract #53

Evaluating a Framework of Social Competence in Paediatric Epilepsy

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Hospital for Sick Children

Rationale

Successful social competence is critical for navigating the social world. Theoretical models of social competence (e.g., Cavell, 1990, J.Clin.Child.Psychol) include social- adjustment (i.e., achieving societally determined goals), social-performance (i.e., appropriate responses in social situations), and social-skills (i.e., underlying cognitive abilities). Although similar frameworks have been proposed for children with brain injuries (e.g., Yeates et al., 2007, Psychol.Bull), the extent to which this model apply to paediatric epilepsy have not been examined. Given the detrimental social problems in paediatric epilepsy, having a comprehensive model of social competence in epilepsy is essential for clinical and research purposes.

Methods

Seventy children with epilepsy (6-12 years; male-39; GAI 71-119) enrolled in the Epilepsy Classroom at SickKids participated. As part of routine clinical practice, standardized parent-questionnaires evaluating well-being, adaptive functioning, and social skills were completed: Behavior-Assessment-System-for-Children-Third Edition (BASC3), Scales-of-Independent-Behavior–Revised (SIBR), and Social-Skills-Improvement-System (SSIS). Exploratory factor analysis was completed using the maximum likelihood algorithm and varimax rotation.

Results

A three-factor model explained 53% of the overall variance ($\chi 2/df = 1.05$). Highest loadings were: (1) SIB-R personal-living, community-living skills, social/communication, and motor-skills; (2) SSIS problem-behaviors, BASC3 conduct, hyperactivity, aggression, atypicality, depression, attention, and anxiety; and (3) BASC3 functional-communication, leadership, and SSIS-social-skills. Factors generally align with the model's dimensions, with our results accentuating psychological wellbeing, functioning independent, and social engagement

Conclusion

Evaluating the suitability of social competence models is crucial for establishing the groundwork for future clinical assessments/interventions and research practices. The tri-component model of social competence was generally supported in paediatric epilepsy.

Abstract #54

Trajectories of Well-Being of Parents and Families of Children with Drug-Resistant Epilepsy treated with Surgery or Anti-Seizure Medications

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Rationale

Families of children with epilepsy experience high rates of stress and parents have elevated rates of depression and anxiety symptoms. Our objectives were to 1) identify trajectories of family well-being (parent depressive symptoms, parent anxiety symptoms, and family resources) over the first two years after the child's evaluation for candidacy for epilepsy surgery, and 2) identify baseline, clinical and demographic characteristics associated with these trajectories.

Methods

Parents (n=259) completed questionnaires at the time of their children's surgical evaluation (baseline), 6 months, 1 year, and 2 years later. Trajectories of parents' depressive and anxiety symptoms, and family resources were jointly estimated using multigroup latent class growth models. Multinomial logistic regression evaluated factors associated with each trajectory group, including age of seizure onset, number of antiseizure medications, child's quality of life (QOL), treatment (surgery vs. medical therapy), seizure status at final follow-up, parent sex, parent employment status, and household income.

Results

Three trajectories were identified: optimally stable, mild-decreasing-plateau and moderate-decreasing trajectories. Parents of children with higher QOL, fathers, and those with a higher household income were more likely to have better trajectories of family well-being. Treatment type was not associated with the trajectory groups but parents whose children were seizure-free at time of last follow-up were more likely to have better trajectories (optimally-stable or mild-decreasing-plateau trajectories).

Conclusion

A number of child and demographic factors are related to parent and family well-being. Identification of trajectories can help in determining which families are in need of support to optimize their function.

Abstract #55

Utilization, Yield and Optimization of Continuous EEG Monitoring in Critically Ill Children: A Single-Centre Retrospective Cohort Study

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Rationale

Electroencephalography (EEG) is a valuable resource in the paediatric critical unit (PCCU). The specific indications and standard monitoring duration for continuous EEG (CEEG) monitoring varies across institutions. Institutions aim toward maximizing CEEG yield, while minimizing the associated resource consumption. Our primary objective is to describe the utilization and yield of CEEG of at least 1 hour duration in the PCCU in our tertiary children's hospital.

Methods

CEEG reports over the last 5 years were collated for children admitted to PCCU. We included CEEGs with a duration >1 hour initiated for detecting electrographic seizures (ESz). Clinical and CEEG information was obtained from patient medical records.

Results

A total of 94 children met these criteria and 80 (85%) presented with clinical seizures. Of all children, approximately 40% (38/94) had ESz detected on CEEG. ESz were detected in 59% (23/39) with prior epilepsy diagnosis, 47% (17/36) with age <1 year, 41% (30/74) with altered mental status, and 19/51 (37%) with acquired structural brain injury. ESz were also reported in 22% (2/9) of patients without an identified cause for their seizure. CEEG results guided patient management in at least 60/94 (64%) patients.

Conclusion

This study provides important insights into CEEG monitoring strategies and utility based on the heterogenous clinical characteristics of critically ill children in our tertiary academic centre. This provides us and other centres with similar resources the opportunity to use patient risk factors to optimize CEEG use by enhancing the yield of ESz detection, while preserving valuable hospital resources.

Abstract #56

Comparative Analysis of Spike Duration and Morphology in Dogs and Humans with Juvenile Myoclonic Epilepsy

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Rationale

Juvenile Myoclonic Epilepsy (JME) is characterized electrophysiologically in both humans and dogs by electroencephalography (EEG). The spike-and-wave complex (SW), an abnormal EEG pattern characteristic of JME, is also common to both species. This study compared EEG-recorded SWs in JME between species, particularly spike duration and morphology.

Methods

Archival search at Toronto SickKids (2019-2023) and Ontario Veterinary College (2013-2023) to retrieve EEGs recorded in people (HJME: seizure onset 4-12 years old, generalized 3-5 Hz SW) and dogs (CJME: seizure onset < 1 year of age, generalized 3-6 Hz SW). Consensus (AD, MC, FJ) selection of 5-10 representative spikes from SWs in each patient. First-half spike (FHS), second-half spike (SHS) and total durations (TD) were averaged. The Shapiro-Wilk tested normality, the Wilcoxon Mann-Whitney tested the differences in the means and the one-way ANOVA tested the differences in variances.

Results

62 spikes collected from 6 HJME were compared with 199 spikes collected from 12 CJME. None of the FHS, SHS, or TD were normally distributed. The mean value and variance of SHS and TD were statistically different ($P < 0.05$), whereas FHS durations for both groups were statistically similar.

Conclusion

The two species show a significant difference in the duration and morphology of the spikes. Dogs demonstrated shorter spike durations than people. This opens new pathways for evaluation of similarities and differences, enhancing the value of canine models in the etiopathogenesis of epilepsy. This further informs future diagnostic approaches and AI algorithm design for automatic spike detection in dogs.

Abstract #57

Investigating Components of Empathy in Pediatric Epilepsy

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Rationale

Adolescents with epilepsy (AWE) experience peer and social difficulties; however, the cognitive mechanisms contributing to these social difficulties have not been evaluated. Empathy is critical for social functioning and includes two related but distinct components: (1) cognitive empathy, the ability to understand others' mental states and emotions, and (2) emotional empathy, the ability to share the affective state of others. The objective of this study is to delineate the different component of empathy among AWE.

Methods

95 AWE, 45 controls and parents were recruited from SickKids, the Canadian Epilepsy Support Centers and from the community. Youth completed the Empathy Questionnaire for Children and Adolescents, and a performance-based measurement, The Multifaceted Empathy Test. Parents completed the Griffith Empathy Measure. Listed below are the mean difference scores and 95%CI between AWE and controls.

Results

AWE and controls reported similar emotional and cognitive empathy scores on the questionnaire (emotional: 0.002, 95%CI -0.14, 0.14; cognitive: 0.12, 95%CI -0.07, 0.31), and performance-based measure (emotional: -0.46, 95%CI -1.11, 0.19; cognitive: 0.01, 95%CI -0.02, 0.04). Parents reported lower cognitive empathy among AWE (4.14, 95%CI 1.19, 7.09), but similar emotional empathy (-3.86, 95%CI -8.67, 0.95) relative to controls.

Conclusion

Parents and AWE do not report difficulties with emotional empathy, but they differ in their report of the AWE's cognitive empathy, with parents noting challenges for their children. Understanding the specific components of empathy and from different perspectives may provide insights in supporting AWE in overcoming social difficulties and fostering healthy social relationships.

Abstract #58

Transition in Epilepsy: The Healthcare Practitioner Perspective

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Rationale

Moving from pediatric to adult health care can be troublesome, and epilepsy transition guidelines have been suggested, although rarely implemented.
This study aimed to understand the perspectives and attitudes of healthcare practitioners on the challenges of transitioning epilepsy patients to adult care.

Methods

A questionnaire was distributed to practitioners worldwide through ILAE Chapters in 8 languages. The responses were then analyzed descriptively and as qualitative summaries.

Results

1. 184 practitioners from 38 countries completed the questionnaire.
2. 70 practitioners from 25 countries reported not having a transition program in their country.
3. 58% of respondents were adult practitioners, and 42% were child practitioners.
4. Factors impacting transition:
    a. Availability of an adult neurologist with knowledge of the condition (58%)
    b. Patient and family will not have the same level of support in the adult system (42%)
    c. Patient is too complex for the adult system (27%)
5. Adult (40%) and child (43%) practitioners agreed that the transition age for patients with epilepsy and ID should differ from those without ID.
6. The three most common practitioner-perceived barriers to building and sustaining transition programs found were:
    a. Lack of multidisciplinary teams (90%)
    b. Patients feel attached to the childcare system (89%)
    c. Absence of adapted adult clinical settings for adults with special needs (87%)

Conclusion

This ILAE Transition Task Force survey aids in identifying barriers, such as lack of funding, multidisciplinary teams, and accessibility, preventing satisfactory transition while examining the elements needed for successful transitions.

Status Epileptics / Critical Care

Abstract #59

Incidence of Status Epilepticus and its Associated Risk Factors in Adult Residents of Ontario, Canada

Grace Couper, Tresah Antaya, Piotr Wilk, Jorge Burneo

Western University

Rationale

The incidence of status epilepticus (SE) and its associated risk factors have been infrequently reported in Canadian populations. Therefore, the objectives of this study were to (1) estimate the incidence of SE in Ontario, Canada, and (2) estimate the associations between sociodemographic and health-related factors and SE.

Methods

A population-based retrospective cohort study was conducted using linked Canadian datasets. Participants were included in our sample if they completed the long-form 2006 Canadian Census, lived in Ontario, were between 18 and 105 years, and had no history of SE. The incidence rate of SE was estimated by identifying hospital admissions or emergency department (ED) visits with an ICD-10 code for SE (G41) over the three years following the census date. A Cox proportional hazards regression model was used to estimate the hazard ratios associated with each potential risk factor.

Results

The final sample included 1,301,700 participants, 140 of whom were hospitalized or had an ED visit for SE in the three years following the 2006 census, for an incidence rate of 3.51 per 100,000 person-years. Risk factors for SE included older age (HR=1.35, 95% CI=1.33, 1.37) and certain comorbidities, including dementia (HR=1.42, 95% CI=1.36, 1.48), chronic kidney disease (HR=1.32, 95% CI=1.29, 1.36), brain tumour or cancer (HR=1.14, 95% CI=1.12, 1.15), and diabetes (HR=1.11, 95% CI=1.09, 1.12).

Conclusion

We estimated an incidence rate of SE in a sample of Ontarians that was lower than in other high-income countries. Older age and certain comorbidities were associated with a higher risk of SE.

*Funding: Jack Cowin Endowed Chair in Epilepsy Research at Western University.

Abstract #60

Cognitive Abilities in Epilepsy Patients and the Trajectory of Cognitive Recovery for Status Epilepticus Patients

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Western University

Rationale

Cognitive deficits are common among people with epilepsy (PwE) and people with a history of status epilepticus (PwSE). However, further research is required to determine which cognitive domains are most impaired in these populations and the extent of these impairments.

Methods

Cognitive performance is being assessed in two groups, PwE and PwSE, using a validated online cognitive testing battery of 12 tasks that tap a broad range of cognitive domains. PwE complete cognitive testing once while in an Epilepsy Monitoring Unit, whereas PwSE complete testing while in the Intensive Care Unit as well as 1-,3-,6-, and 12-months post-SE onset. Since December 2022, 25 PwE (38.7 ± 17.2 years; 18 females) have undergone cognitive testing, and longitudinal data has been collected for three PwSE (median 25 years; 3 females). Patients' cognitive performance is compared to age- and sex-matched norms using one-sample t-tests of z-scores computed for each participant and a corrected alpha of ≤0.05. For PwSE, the trajectory of cognitive recovery will be analyzed using a repeated-measures ANOVA.

Results

PwE were impaired in tasks that evaluate response inhibition (t=-6.86), attention (t=-6.05), verbal reasoning (t=-4.91), episodic (t=-4.84) and working memory (t=-6.10), visuospatial processing (t=-4.32), planning (t=-4.40), spatial (t=-4.99) and verbal (t=-6.96) short-term memory, and mental rotation (t=-3.80). The most up-to-date data, including longitudinal results from PwSE, will be presented.

Conclusion

This study provides a deeper understanding of cognition in PwE and PwSE crucial for the development of targeted interventions to optimize cognitive function and quality of life for these populations.

Basic Science / Engineering

Abstract #61

Association of BDNF Val66Met With Idiopathic Generalized Epilepsy

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Rationale

Brain-derived neurotrophic factor (BDNF) is a key gene that plays role in the development and sustentation of neuronal populations in the central nervous system (CNS). BDNF directly influence the structure and function of inhibitory cells known as GABA-ergic neurons thus involved in synaptic transmission. Reduction of BDNF level in the brain can result in neurodegenerative and neuropsychiatric diseases. Polymorphism (rs6265) in this gene thought to be an important contributor to epilepsy susceptibility. We investigated the association of this polymorphism with idiopathic generalized epilepsy in Pakistani population.

Methods

This study included 209 subjects, of which 101 were IGE patients and 108 were healthy individuals. Blood samples were collected from all the subjects and DNA was extracted by the modified organic method. For genotyping of the targeted SNP, Sanger's sequencing was done. Chi-square test was applied to check the association of the studied SNP with the IGE. In silicio analysis was also carried out to check the probable pathogenic role of identified SNPs by PolyPhen-2 software.

Results

The missense variant rs6265 resulted in Val66Met in prodomain of BDNF protein. Allelic and genotypic frequency of rs6265 significantly differed in case and control group. The mutant allele A was found in higher frequency in case than in control group. Polyphen-2 also predicted this polymorphism as possibly damaging with a high score (0.822).

Conclusion

rs6265 of BDNF gene was found significantly associated with the IGE susceptibility.

Abstract #62

Association of the rs3773364 Polymorphism in Synapsin-2 Gene With Idiopathic Generalized Epilepsy in Pakistani Patients

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Rationale

Synapsins are neuronal phosphoproteins that are found attached to synaptic vesicles in the Central nervous system and play a role in the formation of synaptic vesicles and their transmission across the synapses. Epilepsy occurs when the amount of synapsin disturbs and vesicles keep on releasing neurotransmitters leading to hyperexcitation and seizures. Synapsin 2 (SYN2), particularly is considered to be an important component of the synaptic vesicle cycle through its involvement in vesicle docking. Therefore, the current study aimed to determine the polymorphism of the SYN2 gene and its association with IGE onset in the Pakistani population.

Methods

For a case-control, study blood samples were collected from 150 patients with idiopathic generalized epilepsy (IGE) and 150 controls. Genomic DNA was extracted and targeted SNP rs3773364 was amplified using polymerase chain reaction (PCR). The amplified products were subsequently genotyped by Sanger's sequencing

Results

Genotyping results showed that intronic polymorphism rs3773364 (A>G) existed in homozygous and heterozygous forms in the targeted population. The overrepresentation of mutant allele G in IGE patients showed that it acts as a risk factor for the onset of IGE. The allelic and genotypic frequencies varied significantly among the control and case groups.

Conclusion

SYN2 rs3773364 (A>G) gene polymorphism is significantly associated with IGE in the Pakistani population. However, this gene should be screened at a larger scale to be affirmative of the findings.

Abstract #63

Neural Homogenization of Medial Prefrontal Cortex Pyramidal Neurons Accompanies Epileptogenesis

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Rationale

Recent studies have reconceptualized epileptogenesis to involve a progressive loss of neuronal heterogeneity (ie. neural homogenization), predisposing neuronal networks to enter an information-poor, highly-synchronized state. Empirical evidence and computational models support this, suggesting that neural homogenization seen in human cortex' layer 5 pyramidal cells(L5Py), reduces network resilience to seizure-like activity. Yet studying neural homogenization over time is needed to understand its role in epileptogenesis. We hypothesize that a progressive loss of biophysical heterogeneity in L5Py- medial prefrontal(L5Py- mPFC) cortex accompanies epileptogenesis.

Methods

Six-weeks following Kainic acid(KA) or saline injection(control), whole-cell patch-clamp recordings were used to characterize L5Py- mPFC's intrinsic biophysical and spontaneous synaptic properties.

Results

We quantified 25 biophysical properties from L5Py-mPFC in KA and controls. When comparing the Coefficient of Variation values, a restricted set of biophysical features found were homogenized with KA: Average firing rates and interspike interval coefficient of variation (ISI-CV) ($p=0.007$ and $p=0.04$) means did not differ. These findings complement homogenization observed in CA1's dorso-ventral axis in KA-mTLE, and our human cortex findings. E/I as a proxy for the extent of "synchrony filtering" was computed with total charge flow at 0mV and -70mV over 20 min. L5py -mPFC trended towards increased E/I from KA-mTLE mice.

Conclusion

Our results reflect a start-point for understanding protective functions neuronal heterogeneity have against seizure-like activity generation. As a potential factor in seizure propagation over time, heterogeneity loss may be an innovative line for improving treatments that aim to restore neural circuits' heterogeneity. By targeting this underlying mechanism, it may be possible to improve patient outcomes and advance the field of epilepsy research.

Abstract #64

SCN1A Polymorphism (rs2298771) and Idiopathic Generalized Epilepsy in Pakistani Patients

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Rationale

Voltage-gated sodium channels play an important part in the excitation of membranes in the central nervous system (CNS) and peripheral nervous system (PNS). Mutations in SCN1A and SCN2A were found to be the most common and cause idiopathic generalized epilepsy (IGE). These channels are normally open after depolarization and nerve impulse travel. Any mutation in sodium channel genes was found to cause slow inactivation of channels because of which inward movement of sodium ions amplifies, leading to hyperexcitation and seizures occur.

Methods

To find out the role of rs2298771 a case-control study was designed. Blood samples were collected from 150 patients with idiopathic generalized epilepsy (IGE) and 150 controls. Genomic DNA was extracted and targeted SNP SCN1A (rs2298771) was amplified using primer-specific polymerase chain reaction (PCR). The amplified products were subsequently genotyped by Sanger's sequencing.

Results

Because of genetic analysis, it was found that there is no significant difference for mutant allele A between the case and control group at the allelic and genotypic levels. The polymorphism c.3184 G>A (rs2298771) is a missense variant that changed the sequence of amino acids from alanine to threonine due to a change of codon (p.Thr1067Ala) that may cause conformational or functional changes in the protein.

Conclusion

SCN1A (rs2298771) polymorphism is not significantly associated with IGE onset in the targeted Pakistani population. However, this gene should be screened at a larger scale within different ethnicities in Pakistan to be clearer about its role in epilepsy onset.

Abstract #65

An Investigation of the Validity of Cognitive Assessment Via Robotics in People With Epilepsy

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Rationale

Cognitive impairment from epilepsy is well-recognized. Neuropsychological assessment can detect cognitive impairments through clinical criteria and quantitative measures. In this study, we test the validity of robotic assessment to measure cognitive ability beyond motor function in people with epilepsy by comparing it to a brief neurocognitive assessment.

Methods

Participants with temporal lobe epilepsy (TLE, n=33) and genetic generalized epilepsy (GGE, n=25) underwent a brief neurocognitive assessment and robotic assessment. Five cognitive and sensorimotor tasks were added to the Repeatable Battery for the Assessment of Neuropsychology Status (RBANS) to form a brief neuropsychological assessment across a range of cognitive domains. The Kinarm Endpoint robot was used for robotic assessment with 9 standardized tasks assessing domains integrating motor, cognitive, and sensory function. Robotic assessment measurements were converted to composite task scores which are adjusted for age, sex, and handedness.

Results

In the cognitive domains of complex attention (3/6 tests, $p<0.05$), executive function (3/7 tests, $p<0.05$), memory (2/4 tests, $p<0.05$), visual-motor coordination (5/12 tests, $p<0.05$), and visuospatial skill (1/7 tests, $p<0.05$) moderate ($r \sim .30$) to strong ($r \sim .50$) associations exist between our brief neurocognitive assessments and robotic assessments.

Conclusion

These results demonstrate that robotic assessment can measure cognitive ability beyond sensorimotor function, similar to a brief neurocognitive screening for people with both general and focal epilepsies.

Abstract #66

Bridging Pediatric Epilepsy Surgery With Basic Science: From sEEG to Intracellular Recordings

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Rationale

Pre-surgical evaluation from refractory pediatric epileptic patients is crucial in order to identify epileptogenic zone (EZ) and increases the chances of post operative seizures free. High frequency oscillations (HFOs) expressed during sEEG recordings are commonly used as biomarkers to identify EZ. In this study, we performed electrophysiological recordings on acute slices from pediatric patients to better understand the physiopathology of EZ.

Methods

Electrophysiological recordings were performed in acute slices from surgical resections containing maximal HFOs recorded in sEEG evaluation from pediatric patients with refractory epilepsy. Spontaneous excitatory post-synaptic currents (sEPSCs) and spontaneous seizures like events (sSLEs) were analyzed. Immersion chamber bath application of in vitro pro-convulsivants (4-aminopyridine (4AP) and bicuculline methobromide (BMO)) was performed to investigate pharmacological properties from induced interictal epileptiform discharges (IEDs).

Results

sEPSCs (n=10) and sSLEs (n=10) were completely abolished by application of NBQX. Application of 4AP and BMO induced transient recurrence of GABAB outward currents (GABOCs; n = 55) before neuronal network synchronization and the generation of IEDs. GABOCs were completely blocked by the GABAB receptors antagonist CGP-55845 (n=11). Levetiracetam reduced amplitude and frequency (n=14) but failed to block IEDs and Lacosamide strongly reduced (n=4) and completely abolished (n=16) IEDs.

Conclusion

Using sEEG for exact localization of EZ and target resection increases identification of sEPSCs and sSLEs electrophysiological ex vivo recordings, thus providing unique scenario for better epileptogenesis comprehension in pediatric epilepsy. GABOCs play a major role in neuronal network synchronization and cadence of IEDs. Lacosamide shows better effect in blocking IEDs compared to Levetiracetam.

Abstract #67

Correlated Input Drives Population Homogenization and Synchronization

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Rationale

In recent years it has been shown that reductions in neural diversity are conducive to the onset of seizure-like activity, leading to a high synchrony regime and correlated dynamics. What is less clear are the contributions of correlated input to the homogenization of neuron populations. While experimentally intractable, computational approaches allow exploration of the contribution of underlying dynamics to the onset of seizure-like activity and epilepsy pathologies.

Methods

We analytically and numerically analyze a non-linear sparse neural network evolving over long time. Exposing the network to various levels of correlated input, we examine its influence on the neural diversity expressed by the f-I curves of the population. This diversity is regulated through intrinsic plasticity mechanisms, which serve to adjust neuron excitability based on the statistics of its input.

Results

Sparsely connected neurons with heterogenous f-I curves, when driven with highly correlated spike trains, intrinsic plasticity mechanisms can facilitate the homogenization of these f-I curves, and hence alter neuron excitability, over time. In line with what is expected of epileptogenic regimes, as the f-I curves become more homogenous, the firing of the affected neurons becomes more synchronous. Conversely, homogenous neurons driven with uncorrelated spike trains diversify toward a heterogenous state.

Conclusion

Correlated input can homogenize a heterogeneous network, suggesting a possible avenue for the onset of reduced heterogeneity observed in epileptogenic brain regions. Computationally exploring this demonstrates its potential candidacy in the onset of epilepsy, furthering our understanding of how to approach treatment. Funding: NSERC, CIHR

Abstract #68

Detection of Simulated Motor Seizures With Machine Learning Using Electromyography Signals From Wearable Sensors

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Rationale

Recent research has investigated seizure detection based on wearable devices. Electromyography (EMG) signals can be used to detect motor seizures. Existing devices have high false alarm rates and are only effective in detecting generalized tonic-clonic seizures (GTCS) and focal to bilateral tonic-clonic seizures. We hypothesize that simulated motor seizures can be detected using EMG signals acquired with small and lightweight picoEMG sensors (Cometa Systems, Inc.) placed on different muscles.

Methods

Six healthy subjects were recruited at the CHUM research center. Eight miniaturized sensors were placed on left and right trapeze, deltoids, biceps and tibialis anterior. Each subject simulated 11 seizures: 5 tonic, 4 myoclonic, 1 atonic, and 1 GTCS. Sports activities were also recorded. Extracted features on each muscle included root-mean square, zero-crossing rate, median frequency, coherence, integral, and variance. Five classifiers were trained and compared: Naïve Bayes (NB), Support Vector Machine (SVM), Random Forest (RF), Multilayer Perceptron (MLP), and Adaboost.

Results

MLP reached a sensitivity of 93.7% and a precision of 88.5% for the classification of seizure and non-seizure rest epochs using all sensors. Using only trapeze and deltoids, MLP showed a sensitivity of 91.6% and a precision of 82.9%. Adding sports activities to non-seizure epochs, the best performance was achieved by the RF classifier (sensitivity of 90.7% and a precision of 62.8% using all sensors).

Conclusion

Preliminary results suggest that subsets of muscles could be efficient for detecting motor seizures. Proposed algorithms should be tested on real seizures recorded from patients with epilepsy.

Abstract #69

Febrile Seizures and Lipid Peroxidation within the Hippocampus of Neonatal Rats

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Rationale

Febrile seizures in neonatal rat models result in a hyperoxic response in the hippocampus. Hyperoxia can cause oxidative stress and the formation of reactive oxygen species (ROS) which can lead to long term changes in neuronal functioning. Febrile seizures have been shown to cause long-term recognition memory impairments in female adult rats that are ameliorated with a transient receptor potential vanilloid 1 (TRPV1) inhibitor by decreasing hyperoxia. Therefore, this study examined the effects of TRPV1 inhibitor on hyperoxia and ROS production in the hippocampus of neonatal rats.

Methods

Pups received surgical implantation of an electrode and an optode into the dorsal hippocampus at postnatal day 8. Pups then received four days of a daily injection of lipopolysaccharide and were exposed to exogenous heat on day 12 until they had a seizure. The brains were harvested, sliced, and stained for lipid peroxidation which is a by-product of ROS. Pups also received AMG9810 (a TRPV1 inhibitor at 200 mg/kg, i.p.) or a vehicle either before or directly after the febrile seizure.

Results

Preliminary results show cells expressing lipid peroxidation in the CA1 and dentate gyrus of the febrile seizure group.

Conclusion

Hippocampal dysfunction due to lipid peroxidation may be implicated in the link between febrile seizures and memory dysfunction.

Abstract #70

Functional Analysis and Drug Repurposing for a Rare De Novo Variant (F325L) of GABRA1

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Rationale

The GABAA receptor (GABAAR) is a ligand-gated chloride (Cl−) channel that primarily mediates neuronal inhibition, and thereby plays a critical role in maintaining the excitation-inhibition (E/I) balance in the central nervous system (CNS). Mutations of the GABAARs have reportedly led to epileptic encephalopathy and neurodevelopmental disorders. Here, we report the identification of a novel de novo F325L (T973C) missense variant of the GABAAR alpha1 subunit from a pediatric patient diagnosed with focal epilepsy, global developmental delay and autism spectrum disorder. The F325 residue is a part of the pore-lining residues, indicating its important role in regulating channel gating.

Methods

We used biochemical techniques, whole-cell and single-channel patch-clamp recordings, and pharmacological
characterizations in HEK293 cells overexpressing the wild-type and mutated human recombinant GABAARs containing the α1/β2/γ2 subunits.

Results

We found that this α1F325L mutation produced a unique functional phenotype that is strikingly different from most of the GABAAR variants previously identified from patients: it markedly increased the GABA-evoked whole-cell currents at all concentrations of GABA. In addition, the α1F325L mutation significantly increased the tonic current revealed by the GABAAR antagonist bicuculline. The gain of function of the mutant receptor appeared to be mediated by decreasing the activation time and prolonging the deactivation and desensitization time of GABAARs, as well as by increasing the open probability of the channel. Moreover, this mutation was able to markedly improve the loss of function caused by the previously reported α1R214C and α1A322D mutations. F325L did not overtly affect either the surface or the total GABAAR expression, suggesting the functional alterations resulted from the changes in channel gating properties.
This is the first observation that a single mutation of GABRA1 can cause an overall augmentation of the GABAAR channel gating properties, which leads to focal epilepsy, global developmental delay and autism spectrum disorder. Based on the functional characterization, we also screened several clinically approved negative modulators of GABAAR and found two drugs that could successfully be restored the gain of function mediated by F325L back to the wild-type level.

Conclusion

Our work highlights the importance of functionally characterizing each individual GABAAR mutation for ensuring precision medicine and the possibility of repurposing drugs for rare variants following functional evaluation.

Abstract #71

iEEGPrep: Towards Standard Preprocessing for the Analysis of Intracranial EEG Recordings

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Rationale

Preprocessing of intracranial electroencephalography (iEEG) recordings is variable from study to study. The automation of these steps in a single tool provides a pathway towards a standardized workflow for iEEG data. This project focuses on the development of the aforementioned tool, called iEEGPrep, which will improve the reproducibility and reliability of iEEG related studies.

Methods

A literature review was conducted to determine common steps employed in the preprocessing of iEEG data. A pipeline that compiles these steps is in development following the Brain Imaging Data Structure (BIDS), a standard for structuring neuroimaging data, to facilitate the open adoption of this tool.

Results

A preliminary version of this tool has been implemented, including the following preprocessing steps: epoch extraction, downsampling, electrical noise rejection, automatic artifact detection, re-referencing (e.g., bipolar), and region identification for each channel/contact electrode.
An initial evaluation of the pipeline has been completed using a dataset of 106 patients with epilepsy who underwent iEEG monitoring at the London Health Science Center's (LHSC) Epilepsy Monitoring Unit. Further analysis with clinical experts is required to assess the quality of the results of the steps available ensuring that relevant clinical information is not being excluded. We will also evaluate performance on other openly available iEEG datasets.

Conclusion

To our knowledge, this is the first automated toolbox for preprocessing of iEEG data. This tool will standardize the preparation of iEEG data prior to experimental or clinical analysis, enhancing the reproducibility, accessibility, and quality control, in iEEG related studies.

Abstract #72

Maximal Electroconvulsive Shock-Induced Seizures Cause Long-Lasting Analgesia

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Rationale

Several acute comorbidities that follow seizures such as motor weakness and amnesia appear to have postictal hypoxia as their mechanism. Among these comorbidities is postictal analgesia - decreased nociceptive perception following a seizure, but its mechanism is unknown. As reduced nociceptive perception can be maladaptive and lead to injury, furthering our understanding of the mechanisms of postictal analgesia may improve the quality of life of individuals with epilepsy.

Methods

The baseline tail flick latency (TFL) of female and male mice was recorded, then mice were either stimulated using maximal electroconvulsive shock (MES) to induce a tonic-clonic seizure or given a sham seizure. The TFL of each mouse was recorded every 15 minutes for 2 hours following the seizure/sham seizure. This was repeated twice more, 48 hours apart.

Results

There was a significant increase in TFL after the first seizure in females and males, and after the third seizure in males. There was also a significant increase in baseline TFL 48 hours after the first seizure in females and males, and 96 hours after the first seizure in females.

Conclusion

These results show that MES-induced seizures cause postictal analgesia, thereby verifying the validity of this model. The effects of a seizure on nociception are not limited to the postictal period, as there was a persistent increase in TFL 48 and 96 hours following the initial seizure in males and females, respectively. Furthermore, the difference in the duration of the increased baseline TFL between females and males indicates that sex influences postictal analgesia.

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Abstract #73

Modulating Epileptogenesis With Cannabinoids in the SSP-Saporin "Trojan Horse" Model

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Rationale

Epileptogenesis is a serious health problem with no effective treatment. Here we exploited a new animal model of epileptogenesis that selectively kills GABAergic interneurons in the dentate hilar area which induces epileptogenesis and dentate initiated seizures without behavioural status epilepticus and associated lethality. The endocannabinoid system dampens neuronal activity and thus may aid in slowing or prevention of epileptogenesis.

Methods

The selective neurotoxin: Saporin conjugated with Stabilized Substance P (SSP-SAP) (0.04 ng/nL) was injected in the hilar region of the rat hippocampus to selectively ablate inhibitory interneurons. Rats also received chronically implanted bipolar recording electrodes in the granule cell layer and an indwelling cannula to the lateral ventricle. Rats began cannabinoid treatment, immediately following cannula implantation and received CB1 agonist WIN55 212-2 (2 mg/mL, i.c.v.) or the FAAH inhibitor URB597 (8.3 mg/mL, i.c.v.) over a 2-week period via osmotic minipump. Continuous 24-hour video-EEG was recorded for a period of either 2 weeks following surgery, or one month, after which brains were extracted and imaged for sclerosis.

Results

Epileptiform activity was observed a day after SSP-SAP administration. Behavioural seizures with associated epileptiform discharges were typically observed on day 4 through 7. The behavioural seizures were again observed after approximately one month. Our preliminary results with the WIN55 212-2 and URB597 show reduced number of behavioural and associated electrographic seizures within the first 2 weeks.

Conclusion

Administration of SSP-SAP to the rat dentate hilar area results in epileptogenesis and a CB1 agonist and FAAH inhibitor both slowed down its progression.

Abstract #74

Pipeline for an Independent Component Analysis (ICA) Approach to Evaluate Electrode Placement in Canine Scalp Electroencephalography (EEG)

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Rationale

Scalp electroencephalography (EEG) non-invasively investigates electrical brain activity in both people and dogs. Proper positioning of scalp electrodes and precise identification of abnormal signals support clinical assessment and therapeutic decision-making. A standardized electrode placement array for canine heads, like the existing standard for people, is challenging due to variation in head morphology. Independent component analysis (ICA) calculates sources from multiple data channels. Our objective was to optimize an ICA method for evaluating the precision and accuracy of electrode placement arrays in dogs.

Methods

A descriptive study using a convenience sample of neurotypical dogs from a single mesocephalic breed (Border Collies). Electrode Cartesian coordinates mapped on a single computed tomography scan (BrainSight) were imported into EEGLAB (MATLAB). A single researcher (RP) placed the 13-electrode array for one-hour EEGs recorded under alpha-2 agonist sedation. EEG sleep data was preprocessed and filtered to remove artifacts, with ICA run on 4-second epochs containing vertex-waves (VWs) selected by consensus (AD and FJ).

Results

Electrode coordinates required transformation between BrainSight to EEGLAB. The strongest ICA decompositions, matching the most active hotspots during slow-wave sleep, did not consistently correspond to the vertex electrode (Cz).

Conclusion

A functional pipeline for ICA of canine EEG data is feasible. Within-researcher electrode placement confounded precision and accuracy during pipeline development. Cartesian coordinates will need transformation for each breed and electrode array tested. This pipeline progresses our understanding of canine EEG source localization from a mathematical perspective, with future enhancements planned for more precise source localization like that in people.

Abstract #75

Potential for Diffusion Tensor Imaging to Detect White Matter Abnormalities in Dogs With Idiopathic Epilepsy

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Rationale

Idiopathic epilepsy (IE) is a common breed specific disease in dogs where ~1/3 are resistant to anti-seizure drugs (ASDs). In otherwise structurally normal brains, IE affects white matter connectivity. Diffusion tensor imaging (DTI) may show microstructural connectivity differences in dogs between controls, IE responsive-to-ASDs (IE+), and resistant-to-ASDs (IE-). A clinically useful DTI biomarker would benefit diagnostics, therapy, and overall understanding of IE in a naturally occurring dog model.

Methods

Retrospective observational study. DTI scans from a single breed with IE diagnoses were retrieved from the Ontario Veterinary College imaging archive. Fractional anisotropy (FA) of the corpus callosum genu (GCC), splenium (SCC), and internal capsule genu (GIC) were acquired by hand-drawing regions-of-interest (ROIs) and agreed upon by two researchers blind to animal groupings. Comparison of ROI FAs was via ANOVA and IE age via Pearson's correlation, significance set at $p < 0.05$.

Results

Fourteen Nova Scotia Duck Tolling Retrievers; 3 controls, 5 IE+ and 6 IE-. No significant differences existed in overall FAs between controls versus IEs or controls versus IE+ versus IE-. There was a significant correlation of GIC-FA with age ($n = 11$, $p = 0.029$, $r = - 0.65$).

Conclusion

This retrospective study had fewer controls than IEs. The relationship between GIC-FA and age was consistent with previous reports. A larger sample is needed to validate results. Additional white matter regions need analyzing. As these results do not align with findings in people, it is important to understand where and how IE diverges in the two species.

Abstract #76

The Transcriptomic and Intrinsic Biophysical Heterogeneity of Subiculum Pyramidal Neurons in the Face of Epileptiform Activity

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Rationale

The subiculum effectively gates the output of the hippocampus, a particularly vulnerable structure in temporal lobe epilepsy (TLE). The pyramidal neurons of the subiculum, which show continuous within-cell type heterogeneity with respect to transcriptomic and intrinsic biophysical properties, demonstrate selective involvement in epilepsy and the propagation of seizures. We hypothesize that these pyramidal neurons undergo epilepsy-induced changes that dissolve the naturally present within-cell type heterogeneity to facilitate seizures.

Methods

Using the kainic acid model of TLE, single nucleus RNA sequencing and whole-cell patch-clamp techniques will be employed to investigate whether an epilepsy-induced loss of heterogeneity occurs in the subiculum pyramidal neurons regarding RNA expression and intrinsic biophysical changes, respectively.

Results

In accordance with previous findings that suggest subiculum pyramidal neurons are not uniformly impacted by epileptiform activity, we anticipate a general trend of reduced heterogeneity in transcriptomic and correlated intrinsic biophysical properties. Through characterizing these changes, we may better conceptualize the subiculum's pathological role in amplifying and facilitating the spread of epileptiform activity from the hippocampus to cortical structures of the brain.

Conclusion

Our findings will hopefully provide insights into the anti-epileptiform effects of heterogeneous populations of pyramidal cells within the subiculum. This investigation may yield therapeutic targets, such as overly expressed genes that have an aberrant impact on intrinsic biophysical properties, for novel interventions to alleviate the burden of refractory manifestations of TLE. Future directions can further investigate circuitry connections of the subiculum to see if a loss of heterogeneity is a pervasive mechanism that may explain how seizures spread.

Epilepsy Surgery

Abstract #77

Application Accuracy in the Era of Robotic Stereoelectroencephalography: Experiences at a Canadian Center

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Rationale
Stereoelectroencephalography (SEEG) is a stereotactic procedure used in patients with drug resistant epilepsy to characterize epileptogenic zones and networks. Accurate implantation of SEEG electrodes is essential for optimal efficacy and safety. In this study, we sought to analyze the factors contributing to the accuracy of robotically implanted SEEG electrodes.

Methods
A retrospective analysis of 145 patients who underwent robotic SEEG implantations was conducted between 2017 to 2022. Euclidean and radial electrode trajectory errors were calculated between the planned target (based on preoperative magnetic resonance imaging) and the actual target (based on postoperative computed tomography). The mean errors with interquartile ranges (IQR) are reported.

Results
145 patients were included (52.4% female, mean age 35.3 ± 13.0 years), with a mean (± standard deviation) of 11.4 ± 2.9 electrodes implanted per patient. The mean Euclidean error was 2.07 mm (IQR: 1.85-2.29 mm) and the mean radial error was 1.57 mm (IQR: 1.32-1.81 mm). Electrodes were most accurately placed in the posterior supplementary motor area (mean radial error 0.86 mm, IQR: 0.63-1.09 mm), and were least accurately placed in the temporal pole (mean radial error 2.66 mm, IQR: 1.80-3.52 mm).

Conclusion
SEEG electrodes can be implanted with millimetric accuracy using robotic assistance. Electrode accuracy was influenced by target location. Future directions include exploring the association between target location and accuracy, with covariates such as trajectory angle and length. This framework can be applied prospectively to patients requiring SEEG, enabling tailored investigations and optimization of factors influencing accuracy.

Abstract #78

Long-Term Outcomes of Radiofrequency Ablation for Temporal Lobe Epilepsy

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Rationale

Radiofrequency ablation (RFA) is a minimally-invasive procedure that has been used for treating medically-refractory epilepsy. However, the long-term efficacy of RFA is unknown. We aim to characterize the long-term outcomes of patients who underwent stereotactic RFA for temporal lobe epilepsy (TLE).

Methods

Consecutive patients who underwent stereotactic RFA for temporal lobe epilepsy at our institution were retrospectively analyzed. Baseline demographics, procedural details, and post-operative seizure outcomes at 3, 6, 9, 12, 24, 60 months, and/or last follow-up were abstracted. Information about additional treatments was collected, if available.

Results

27 patients who underwent RFA from 1994 to 2002 were analyzed. There were 14 female (52%) patients and 19 (70%) had mesial temporal sclerosis on MRI. Mean age at time of RFA was 33.1 years (range 12-45 years). Mean time to treatment was 19.6 years (range 5-39 years). 17 (63%) patients underwent left-sided RFA and a mean of 24.3 lesions were made. 4 (15%) patients underwent repeat RFA and 9 (33%) underwent subsequent ATL. Mean follow-up time was 85.5 months (range 2.6-276 months). At last follow-up, 8 patients were seizure-free with 4 of these patients having undergone subsequent ATL. 4 (15%) patients had visual field deficits and 2 (8%) had post-op hematomas.

Conclusion

Based on this series, stereotactic RFA is a safe, minimally-invasive procedure with a favourable safety profile and seizure outcome. With resurgence of interest in ablative techniques, it remains to be determined what the role of stereotactic RFA will be as part of the treatment armamentarium for TLE.

Abstract #79

Neuromodulation as a Treatment for Refractory and Super-Refractory Status Epilepticus: A Systematic Review and Individual Participant Data Meta-Analysis

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Rationale

Refractory (RSE) and super-refractory status epilepticus (SRSE) are associated with significant morbidity and mortality. In patients who are not candidates for resective/ablative surgery, neuromodulation may offer a promising alternative to control SE. This study investigates the safety and efficacy of acute neuromodulation in patients with RSE and SRSE.

Methods

A systematic review and meta-analysis was performed according to the PRISMA guidelines. The primary outcome was SE control, defined as cessation of clinical and electrographic SE.

Results

36 case reports and case series on 42 patients who underwent DBS (23.8%), VNS (50%), RNS (9.5%) and cortical stimulation through subdural electrodes (14.2%) were included. One patient (2.4%) underwent VNS, followed by DBS due to failure of VNS to control SE. 89.5% of patients were in SRSE at the time of surgery. The median time between SE onset and surgery was 32.5 days (IQR:19.25-59.5). 50.0% presented with generalized SE, of which 95.2% underwent VNS or DBS. SE was aborted post-operatively in 90.5% of the patients, and 28.6% were clinically seizure free (Engel I) at last follow-up. Median time to SE abortion after stimulation onset was 9.5 days (IQR:5.75-10.25). VNS achieved the highest rate of clinical seizure freedom (42.9%), although this superiority did not reach statistical significance.

Conclusion

Our results suggest that neuromodulation may be an effective alternative in patients with SRSE who are not candidates for resection/ablation. However, most of this evidence comes from small retrospective studies with inclination to publication bias. Further prospective trials are warranted to assess the benefit of these techniques.

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Abstract #80

Withdrawn

Abstract #81

Surgical Treatment of Hypothalamic Hamartomas: A Systematic Review and Meta-Analysis With Individual Participant Data

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Rationale

Although several surgical approaches exist for the treatment of hypothalamic hamartomas (HH), there is no study directly comparing them. This individual participant data (IPD) meta-analysis compares the safety and efficacy of these surgical techniques.

Methods

An IPD meta-analysis was performed according to PRISMA guidelines. Only patients with HH-related epilepsy were included in the analysis. Random-effects models were used to calculate pooled proportions of seizure freedom and major complications. IPD was used to identify predictors of seizure freedom and major complications and perform time-to-event analyses for seizure recurrence.

Results

50 and 57 studies were included in the IPD and study-level analyses, respectively. Seizure freedom was achieved in 49% (95%CI:43%-55%) after first surgery and 60% (95%CI:54%-66%) after all procedures. Laser ablation and radiofrequency ablation (RFA) were the most effective surgical treatments after all procedures with seizure freedom rates of 71% (95%CI:63%-77%) and 73% (95%CI:67%-79%), respectively, which were superior to open surgery (55%, 95% CI:46%-63%). Prior epilepsy surgery was associated with lower rates of seizure freedom (OR=0.439, 95%CI:0.211-0.0.910, P=0.027). Complications occurred in 37.2%, and 15.5% experienced major complications. RFA (OR=0.037, 95%CI:0.004-0.344, P=0.004) and radiosurgery (OR=0.037, 95%CI:0.004-0.344, P=0.004) were associated with lower risk of major complications, while pre-operative precocious puberty increased odds of post-operative major complications (OR=3.106, 95%CI: 1.040- 9.276, P=0.042).

Conclusion

Our results suggest that RFA and laser ablation are most effective for seizure control, while radiosurgery and RFA are the safest approaches, and should be considered in patients with a higher baseline functioning.

Funding source: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Abstract #82

The Effect of Cortical Stimulation on SEEG-recorded Interictal Epileptiform Discharges

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Rationale

Finding robust biomarkers of epileptogenicity will help clinicians to accurately localize the Seizure Onset Zone (SOZ) in patients with focal drug resistant epilepsy (DRE). SOZ is one of the most important factors for obtaining a successful surgical outcome.
We evaluated the effect of Cortical stimulation (CS), a tool used during phase II of presurgical investigation, on interictal epileptiform discharges (IEDs) to find biomarkers of epileptogenicity to accurately delimitate the SOZ.

Methods

The intracranial signals were recorded from five DRE patients implanted with depth electrodes for presurgical evaluation. Bipolar and high frequency (50 Hz) CS was performed with a pulse width of 300 µs and current spanning 1–6 mA. After preprocessing, IEDs were automatically detected and their frequency and morphology were compared before and after stimulation. We analyzed IEDs' changes in channels that generate seizures, after discharges (AD), and ones that had less epileptic activity.

Results

The number and synchrony of IEDs significantly increased in channels in which CS triggered seizures. The spike amplitudes showed varying changes across patients. In the detected spike waves, the amplitude of waves increased significantly. However, no significant changes in IEDs' characteristics were observed in channels with AD or the contacts that had no electrographic changes during the CS.

Conclusion

These results suggest that tracking the changes in IEDs' characteristics after CS would provide clinicians with insights into SOZ localization. Our preliminary results showed that the areas with an increased number and waveform feature changes of IEDs after CS are associated with areas where seizures were triggered.