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E-Poster Abstract Supplement

AUTONOMIC FUNCTION AND ITS DISORDERS

Combining autonomic activity recordings with clinical data for estimating seizure-risk

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Introduction: Predicting seizure likelihood, the next day from prior data can inform the timing and duration of EMU (EEG monitoring unit) stay. The combination of standardized clinical with wearable data could have high practical relevance as they are easy and fast to collect. As a first step toward likelihood forecasting, we tested the feasibility of distinguishing between patients with and without impending seizures based on clinical data and short autonomic measurements.

Methods: We enrolled pediatric patients admitted to the EMU at Boston Children's Hospital and collected clinical data (age, sex, age at first seizure, MRI findings, epilepsy diagnosis, seizure before measurement) and heart rate (HR), heart rate variability (RMSSD), and electrodermal activity (EDA) with wearable sensors. We compared wearable data between two groups, patients with and without impending seizures at two-time points, morning (6:00 to 6:15 am) and evening (9:00 to 9:15 pm). We used Mann Whitney U Test for group comparisons and classical machine learning to classify patients with and without impending seizure.

Results: Eighty of 147 patients had no seizures, and 67 had at least one seizure during the recordings. Compared to patients without impending seizures, seizure patients had lower HR (evening $p < 0.01$; morning $p = 0.06$), lower EDA (evening $p < 0.01$; morning $p = 0.02$), and higher RMSSD (evening $p = 0.04$; morning $p = 0.03$) at both time points. For evening and morning analyses respectively, the mean group classification accuracy was 65% and 75%, and AU-ROC was 0.72 and 0.77.

Conclusion: Short-term ANS recordings in combination with clinical data have the potential to build an easy-to-use seizure likelihood assessment tool. This method's utility is twofold, allowing for both EMU seizure risk estimation and seizure forecasting in the outpatient setting.

Autonomic changes after physical exhaustion in well controlled epilepsy patients

Franziska van den Bongard, MA; Jessica Coenen, MSc.; Claus Reinsberger, MD

Introduction: Dysautonomic reactions are prevalent in people with epilepsy (PWE). Most of this data, however, was derived from patients with drug refractory epilepsy, who resemble a minority within PWE in general. Therefore, we aimed to investigate peripheral sympathetic and parasympathetic ANS reactivity after complete physical exhaustion in a group of well controlled PWE in relation to activity within the central autonomic network (CAN).

Methods: An exhaustive bicycle ergometer test was performed with 21 PWE (38.04±11.5 yrs., female n=12, seizure free for 6 months n=16) and 21 healthy matched (age, sex, BMI) controls (39±11.6 yrs., female n=12). Resting state EEG (128 channels), meanEDA and RMSSD were recorded 5 min pre- and post-exercise. Functional connectivity (phase-locking-values (PLV)) in the CAN was analyzed (alpha frequency band, 8-12 Hz). Group differences were calculated by t-test or Mann-Whitney-U-/Wilcoxon-Test, correlations by Spearman Rank correlations, correlation coefficients differences by Fisher's z-transformation.

Results: MeanEDA increased significantly ($p=0.001$) and RMSSD decreased significantly in both groups ($p=0.001$) post-exercise (no between-group differences). No within and between-group differences for PLV. Post-exercise, correlation analysis showed a significant positive association of meanEDA and PLV in healthy controls ($r=0.597$, $p=0.007$) but not in PWE ($r=-0.278$, $p=0.223$), however, correlation reversed direction compared to pre-exercise. The correlation coefficients differed significantly ($p=0.003$). All other correlations between autonomic parameters and PLV and correlation coefficients did not differ.

Conclusion: The association of functional CAN connectivity and sympathetic response to exercise were different in well controlled PWE in comparison to healthy controls. The reversed correlation in PWE post-exercise may indicate a centrally driven sympathetic response despite clinical seizure freedom.

BASIC NEUROPHYSIOLOGY

Making Neurophysiology Fun!: Interactive quizzes to engage resident learning

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Introduction: Training during residency on electroencephalography (EEG), electromyography (EMG), and evoked potentials (EPs) varies significantly in quality and quantity across different programs. Barriers to learning include exposure during residency, lack of dedicated teaching, and resident burnout. Solutions have included video lectures, "EEG rounds", and "EEGs of the day/week" etc. We sought to improve teaching in our program by delivering a series of interactive quizzes based on EEG, EMG, and EP topics, aiming to stimulate active learning and make a positive impact on neurophysiology teaching.

Methods: A survey was designed to evaluate the current residents' perceptions of neurophysiology teaching. Questions included confidence with EEG/EMG interpretation, barriers to learning, and improvement ideas. Several changes were implemented, including the introduction of a regular quiz with examples of Neurophysiologic studies. The residents were surveyed again for feedback on the impact of the quizzes.

Results: About half of survey respondents felt "not so confident" with interpretation of EEG/EMG and were "not at all familiar" with EPs. 64% felt neurophysiology teaching in our program was only "moderately sufficient". Identified barriers included institutional issues, as well as "lack of energy" to undertake independent learning. Suggestions included more review time during didactics. Following the introduction of the quizzes, 80% reported a positive impact on teaching. 60% felt their knowledge of EEG interpretation and peripheral anatomy improved.

Conclusion: Our residents found the quizzes to be fun and engaging, and confidence in study interpretation has improved. Barriers to learning remain, but overall the residents have felt that neurophysiology teaching has improved significantly. This project demonstrates that teaching "dry" topics that residents struggle with can be made more enjoyable for both the teacher and the learner.

CRITICAL CARE MONITORING

Validation of a Model for Targeted EEG Monitoring Duration in Critically Ill Children

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Introduction: Validate previously published findings regarding the optimal continuous EEG monitoring (CEEG) duration to identify electroencephalographic seizures (ES) in critically ill children.

Methods: We evaluated 1399 consecutive critically ill children with encephalopathy in a prospective observational cohort study, including a previously published generation cohort (N=719) and a new independent validation cohort (N=680). We validated the findings from a multistate survival model developed with the generation cohort using the validation cohort. The model aimed to determine the CEEG duration at which there was <15%, <10%, <5%, or <2% risk of experiencing ES if CEEG were continued longer. The model included baseline clinical risk factors (age and prior clinically-evident seizures) and emergent EEG risk factors (epileptiform discharges and periodic-rhythmic patterns).

Results: ES occurred in 345 children (25%) in the full cohort. A model aiming to determine the CEEG duration at which a patient had <10% risk of experiencing ES if CEEG were continued longer was stable across the generation and validation cohorts. Patients without emergent EEG risk factors would undergo 7 hours of CEEG in both cohorts, while patients with emergent EEG risk factors would undergo 44 and 36 hours of CEEG in the generation and validation cohorts, respectively. The targeted model aiming to achieve <10% risk of ES would yield a 28% or 64% reduction in CEEG hours compared to guidelines recommending 24- or 48-hour of CEEG, respectively.

Conclusion: This model enables implementation of an data-driven management strategy in which patients undergo varying durations of CEEG based on readily available clinical and EEG variables. This targeted approach could identify most critically ill children experiencing ES while optimizing CEEG utilization.

Periodic Patterns and Outcome in Critically Ill Children

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Introduction: We aimed to identify clinical and EEG characteristics associated with generalized, lateralized, and bilateral independent periodic discharges (GPD, LPD, and BIPD), and determine which patterns were associated with unfavorable short-term outcomes in critically ill children.

Methods: We performed a prospective observational study of consecutive critically ill children undergoing CEEG including standardized scoring of GPD, LPD, and BIPD. We identified clinical and EEG variables associated with GPD, LPD, and BIPD. Outcomes were assessed at discharge from the PICU. Unfavorable outcome was defined as a reduction in GOS-E-Peds or PCPC score from pre-admission to discharge. We determined whether GPD, LPD, and BIPD were associated with unfavorable outcomes.

Results: 1399 patients underwent CEEG, including 43 with GPD, 34 with LPD, and 14 with BIPD. Multivariable logistic regression indicated that comatose mental status (OR 3.45; 95%CI 1.55, 7.68; $p<0.01$) and abnormal EEG background category (OR 6.85; 95%CI 3.37, 13.94; $p<0.01$) were at increased risk for GPD. GPD were associated with mortality (OR 8.79; 95%CI 4.70, 16.45; $p<0.01$), unfavorable GOS-E-Peds (OR 2.54; 95%CI 1.35, 4.81; $p<0.01$), and unfavorable PCPC (OR 2.48; 95%CI 1.33, 4.63; $p<0.01$). No patients with acute non-structural acute encephalopathy category experienced LPD (perfectly predictive of LPD not occurring). LPD were not associated with mortality, unfavorable GOS-E-Peds, or unfavorable PCPC. BIPD were associated with mortality (OR 3.68; 95%CI 1.14, 11.92; $p=0.03$), unfavorable GOS-E-Peds (OR 5.00; 95%CI 1.39, 18.00.; $p=0.01$), and unfavorable PCPC (OR 5.96; 95%CI 1.65, 21.46; $p<0.01$).

Conclusion: Patients who were comatose or had more abnormal EEG background had an increased risk for GPD, and patients with acute non-structural acute encephalopathy etiology had no risk of LPD. GPD and BIPD were associated with mortality and unfavorable outcomes, while LPD were not.

EEG Findings in Cardiac Arrest Patients Undergoing Hypothermia

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Introduction: Many post-cardiac arrest patients are connected to EEG during targeted temperature management (TTM). Our objective was to characterize the EEG findings during TTM and their impact on management.

Methods: We retrospectively reviewed 34 cardiac arrest patients undergoing TTM between 5/1/19 and 5/1/21. TTM was 32-36°C. We collected this data: in-house or outside arrest, rhythm leading to arrest, brainstem reflexes (BSRs) and motor response pre- and post-cooling, brain imaging, sedation used, timeframe of EEG, EEG findings, and 2HELPS2B score based on the first 24 hours.

Results: 4 of 34 (11.76%) patients had seizures; 2 had anoxic brain injury (ABI) on imaging. EEG guided ASM management in 6 of 19 patients. Of the 4 patients with seizures, 3 had PEA arrest and 1 had VFib arrest. Initial EEG findings of the 34 patients: 1 seizure, 11 burst suppression, 13 background suppression, 9 generalized continuous slowing, and 1 background slow. 1 of the 11 EEGs began with burst suppression and did not improve. Of the 13 EEGs that began with background suppression, 3 progressed to seizures and 3 didn't change while the rest improved. Of the EEGs that began with generalized continuous slowing, 4 didn't change throughout the recording, 2 worsened to a burst suppression pattern while the rest improved. 2HELPS2B score was 0 except for 2 patients and neither of them developed seizures. 11 of the 34 patients had ABI; 6 had background suppression and 5 had burst suppression.

Conclusion: 11.8% of patients on EEG during TTM had seizures. Most patients' initial EEG pattern was background suppression (38.2%) or burst suppression (32.4%) and all patients with ABI had one of these patterns. 2HELPS2B score wasn't predictive of seizure activity. Limitations of this study include: 2HELPS2B score not based on initial hour of recording, timeframe of EEG was not uniform and EEG reports aren't described based on timing of TTM. In the future, a prospective study may provide more information with less limitations.

Unilateral Cyclic Alternating Pattern of Encephalopathy: A Case Report

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Introduction: Cyclic Alternating Pattern of Encephalopathy (CAPE) is a newly defined entity in the updated 2021 ACNS Standardized Critical Care EEG Terminology. CAPE is defined as changes in background patterns, each lasting ≥10 seconds and alternating for ≥6 cycles. The clinical significance of CAPE is currently unknown.

Case Report/Case History: A 71-year-old man admitted for resection of a right frontotemporal glioblastoma developed acute agitated encephalopathy on post-operative day 2. Long-term EEG initially captured background asymmetry with attenuation and slowing on the right hemisphere, consistent with known structural abnormality. Later, criteria for CAPE were met, but only clearly seen on the left. The slow phase consisted of higher amplitude 4-6 Hz theta and delta, lasting 15 to 26 seconds, and the fast phase consisted of 6-8 Hz theta and alpha, lasting 13 to 25 seconds. In total, CAPE lasted for about 65 minutes, but would remit and recur intermittently over approximately 2 hours. No obvious clinical correlation was identified. A few hours later, CT head with and without contrast revealed expected postsurgical changes, with increased vasogenic edema and intraparenchymal blood in the right temporal lobe, and 5 mm right-to-left midline shift measured at the third ventricle. The patient remained encephalopathic, ultimately developed a right middle cerebral artery infarction, and was discharged to hospice 9 days later.

Conclusion: CAPE is a new term introduced in 2021 and currently, is of unknown clinical significance; however, the current definition does not include laterality. As such, we sought to describe a case of CAPE only clearly seen contralateral to a known brain lesion. This could be due to attenuation over the diseased hemisphere, obscuring detection of the pattern, versus pathology of the hemisphere rendering it incapable of generating the pattern. The possibility of unilateral CAPE may need to be considered in the future.

Clinical Correlates of Cyclic Alternating Pattern of Encephalopathy

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Introduction: The updated 2021 ACNS Standardized Critical Care EEG Terminology introduced CAPE as a new term, defined by changes in background patterns each lasting ≥10 seconds and spontaneously alternating in a regular manner for ≥6 cycles. The clinical significance of CAPE is currently unknown.

Methods: This is a retrospective study on adult patients admitted to UF Health Gainesville from 10/1/2020-10/31/2020 that underwent LTM for evaluation of encephalopathy for 12 or more hours. If cyclic pattern was present on q-EEG analysis, one of two groups of two board-certified encephalographers independently reviewed the raw EEG to confirm CAPE. Chart review was performed to evaluate for patient clinical characteristics of interest.

Results: During October 2020, 69 patients were admitted and underwent LTM monitoring for evaluation of encephalopathy. Seventeen (25%) patients developed CAPE. Patient age ranged from 25-81 years. Five patients were black, 1 was Asian, and 11 were white. Four patients were female and 13 were male. Only 2 patients lacked primary CNS insult as reason for admission. Pre-existing neurologic comorbidities included seizures, stroke, dementia, sleep disorders, and history of VP shunt. Fifteen out of 17 patients were in the ICU when CAPE was identified. The most common frequency in the fast phase was 6-8 Hz theta (10/17) followed by alpha (8/17), and the most common frequency in the slow phase was delta (16/17) followed by 4-6 Hz theta (6/17). In terms of outcomes, 3 patients died in the hospital, 3 were transferred to hospice, 3 were discharged to long term care facilities, and 8 were discharged home/short-term rehabilitation units.

Conclusion: CAPE is not an uncommon EEG finding in patients with encephalopathy, however, little information exists on its etiology or clinical significance. A better understanding of the clinical factors associated with CAPE is needed to further investigate its implications and prognosis.

Cyclic Seizures vs. Non-Cyclic Seizures in Critically-Ill Patients

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Introduction: Cyclic seizures (CS), while rare, can be seen in hospitalized patients with diverse neurological conditions. CS is defined as seizures that recur >3 per hour in a relatively regular interval (1, 2). In this study, we aim to compare patients with CS vs. non-cyclic seizures in their demographic, clinical and EEG characteristics, and clinical outcome.

Methods: We reviewed our University of Pittsburgh Medical Center database and identified patients with CS (recurrent seizures > 3 per hour in relatively regular interval) and non-cyclic seizures (NCS) (noncyclic seizures > 1 per day, but <1 per hour). Univariate analysis was used to analyze and variable with significant level of 5% were then entered in a multi-variable logistic and linear regression models to access patient death and length of stay in ICU outcome, respectively.

Results: Out of 7414 continuous EEG recorded from 1/1/2018 to 5/31/2020, 112 (1.51%) CS and 120 (1.62%) NCS patients were identified. After adjusting all co-variates, CS patients were older (63 ± 17 vs. 58 ± 19; p=0.02), were 11 times more likely to show sleep spindles (87[77.7%] vs. 35[29.2%]; p=0.00) on EEG despite an 80% decreased in odds of using anesthesia than NCS patients (24[21.4%] vs. 62[51.7%]; p=0.00). There were no statistical differences between CS and NCS in intubation rate, and clinical outcome in length of stay in ICU and death. In evaluating both groups for survival after adjusting all co-variates, we found that older patients were associated with higher mortality (p=0.03).We stratified CS into 3 groups based on seizure frequency (2-5, 6-10 and >10 seizures per hour), and found no statistical different in mortality rate between the three groups (p=0.773).

Conclusion: In this study, we sought to evaluate any potential differences between CS and NCS. This is the largest retrospective study on CS to our knowledge. We found no statistical differences be-tween the 2 groups in length of ICU stay and mortality despite the significantly higher seizure frequency in CS.

Acute Phase Epileptiform Activity and Symptomatic Seizure Predict the Development of Epilepsy in Non-Traumatic Hemorrhage Patients

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Introduction: Epilepsy is a long-term complication of intraparenchymal hemorrhage (IPH) and aneurysmal subarachnoid hemorrhage (SAH) and can result in decreased quality of life. Determining which patients are likely to develop epilepsy has clinical utility and may improve efficiency of anti-epileptogenesis clinical trials. Kim et al. (2018) showed that EEG abnormalities (EA) following traumatic brain injury can predict the development of epilepsy. This study was performed to evaluate if EA and acute symptomatic seizures after non-traumatic IPH/SAH can predict epilepsy.

Methods: We performed a retrospective case-controlled analysis with coarsened exact matching to evaluate how the risk factors: 1) EEG irritability, 2) suspected acute symptomatic clinical seizure (SASCS), and 3) modified 2HELPS2B score impact the likelihood of developing Epilepsy following non-traumatic IPH and SAH. Participants had an EEG within 14 days of presentation and 2-years of clinical follow-up. Epilepsy was diagnosed based on ≥1 seizure months 1-24. Matching was performed using relevant covariates.

Results: 132 patients were included in the study – 29 in the Epilepsy group and 103 in the Control Group. After matching, the average effect for all 3 risk factors was significant. 1) EEG irritability (p=0.012 Odds Ratio 3.14), 2) SASCS (p=0.021, Odds Ratio 3.78) and 3) modified 2HELPS2B score (p<0.001, Odds Ratio 4.94). Therapy with anti-seizure medications after the acute phase did not affect the development of epilepsy (p=0.36).

Conclusion: This study shows that EEG irritability, acute symptomatic seizures and particularly the 2HELPS2B score in the acute phase (first 2 weeks) are risk factors for the development of epilepsy after non-traumatic cerebral hemorrhage and could aid in risk stratification for clinical trials and patient prognosis.

Clinician Behavior in Response to Cefepime induced Neurotoxicity on EEG

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Introduction: Cefepime is a widely used antibiotic with known neurotoxicity. The effects of Cefepime on central nervous system have been relatively well described in literature. Our aim is to describe clinician behavior in response to cefepime neurotoxicity in our institute.

Methods: We reviewed our electronic medical record system at our institute from 10/21/2016 to 10/21/2021 and identified a total of 26 EEG studies with generalized periodic discharges (GPDs) while on or recently stopped Cefepime. Demographics, EEG findings, clinician response to EEG findings, length of ICU and hospitalization, and discharge ASMs were reviewed.

Results: 26 EEG studies were identified, with mean age of 40 (17, 87) and 12 male (46%). 1 patient had prior history of epilepsy. Average creatinine was 2.04±1.88(0.5-6.68). All 26 EEG showed GPDs, 13 (50%) with triphasic morphology and frequency of 1.67±0.71(1,3) Hz. Cefepime was stopped the same or day after EEG in 16 cases (62%). 10 (38%) were started on ASM, 3 (12%) had increasing ASM dose. 6 cases (23%) continued cefepime after EEG. Total ICU length of stay was 12.2±17.2 (0,64) and hospitalization length was 25.3±20.0(7, 81) days. 11 (39%) patients were discharged on at least one ASM. There were a total of 8 deaths (31%). 4 patients (15%) with seizures on initial EEG, 3 of which had further seizures on subsequent EEGs, with GPD frequency of 2.25±0.96 (1,3) Hz, 2 of which died during the same hospitalization. All 4 patients had discontinuation of cefepime and ASMs added after EEG.

Conclusion: In this study, we described single-center clinician behavior in response to GPD on EEG related to cefepime neurotoxicity. Our study found that majority of clinicians stopped Cefepime in response to EEG findings. Many clinicians also started ASMs as a result of EEG findings, with many patients being discharged on ASM. However, there is no clear correlation of clinical outcome with cefepime and ASM clinical decisions.

DEEP BRAIN AND CORTICAL STIMULATION

Deep Brain Stimulation of the Centromedian Nucleus of the thalamus for Genetic Generalized Epilepsy: A Case Report and review of literature

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Introduction: There is a paucity of treatment options for individuals with drug resistant genetic generalized epilepsy (GGE). Centromedian nucleus of the thalamus (CM) deep brain stimulation (DBS) is a potential treatment for GGE. Progress has been hampered by inconsistent reporting of patient characteristics and epilepsy classification, and heterogeneity in CM-DBS targeting and stimulation settings.

Case Report/Case History: Here, we present the case of a 27-year-old cognitively normal woman with drug resistant GGE. Seizure onset was at 5 years of age. Seizure semiology are absence seizures and generalized onset tonic clonic seizures (GTC). At baseline she had 4-8 GTC seizures per month and weekly absence seizures despite three antiseizure medications and vagus nerve stimulation. Epilepsy conference consensus recommendation was for CM-DBS given concern for seizure related morbidity or mortality. Over 12 months of CM-DBS (continuous monopolar stimulation: 60 Hz, 90 microsecond pulse width, 4.5 V) she experienced a marked reduction in GTC seizures. She had two GTC seizure days after initiating stimulation, which were in the setting of medication withdrawal and illness, and no GTC seizures in the last 6 months. There was no significant change in absence seizures

Conclusion: This report describes the case of a cognitively normal patient with drug resistant GGE treated with CM-DBS. Her case is notable for a marked reduction in GTC seizures. At present there are only two studies which clearly document CM-DBS in cognitively normal individuals with GGE (in contrast to studies of cognitively impaired individuals with developmental and epileptic encephalopathies and GGE overlap syndromes). Our results support that CM-DBS can be an effective treatment for cognitively normal individuals with GGE and underscore the need for prospective studies.

EEG

The International Electroencephalography and Epilepsy Course at UH Cleveland Medical Center: Pre- and Post-course performance

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Introduction: The first EEG/Epilepsy course was offered in Cleveland, Ohio in 1979, organized by professor Hans Lüders. The students are assumed to have no prior knowledge. The course is 2 months-long, free of charge, and offered twice a year at the University Hospitals Cleveland Medical Center (UHCMC). The average class size is ~25 (Pre-pandemic), composed of individuals from around the world, as well as UHCMC neurology PGY-3 residents, epilepsy fellows, research scholars, and newly-hired UHCMC EEG technologists. This study aimed to objectively evaluate effectiveness of the course.

Methods: Thirteen students completed the curriculum. One student could not take the pre-course exam. After a comprehensive orientation, a pre-course exam as given: 5 "EEG unknowns" (EEGUKN) (see below) and 30 multiple-choice questions (MCQs). The questions were taken directly from the final exam of additional 5 EEGUKN and 37 MCQs. The students were previously unaware of the pre-course exam. "EEG unknown": A 15-second page of a de-identified patient's EEG is shown on paper without the montage. The montage is one of 6 runs (Fig.1), including a "double banana" bipolar run and a reference run. A montage sheet is included with all exams for reference. Students are expected to figure out the montage, age of patient, level of consciousness, presence of artifacts/normal variants, normal and abnormal EEG features, and the most likely clinical diagnosis.

Results: Two-tailed pared t-tests were used, and ps $< .05$ was considered significant. Average pre-test score: 31±11% (range:13-47%). Average post-test score: 66±14% (range:38-89%). Improvement from pre-test to post-test: $p < .001$. The mean difference in exam scores: 35±9% (range: 25%-50%). Average percentage change: 112.9%, indicating the average student improved by 112.9%. The average student improved on the EEGUKN by 239.17% and on the MCQ by 36.23%.

Conclusion: This study objectively demonstrated effectiveness of the EEG/Epilepsy Course curriculum at UHCMC.

Concordance of MRI lesions and seizure onset zones in patients with history of viral brain infection

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Introduction: Invasive EEG evaluation often is necessary before therapeutic epilepsy surgery to localize the seizure onset zones (SOZ) in patients with history of viral brain infection (HVBI). We analyze concordance of MRI lesions with SOZ localized by stereo-EEG (SEEG) evaluation in patients with HVBI.

Methods: We included patients with HVBI who underwent SEEG evaluation at our center. SOZ localized with SEEG, and brain MRIs were analyzed.

Results: Twelve patients were identified. Average age at SEEG was 33 (18-45) years, at time of viral brain infection (VBI) - 15 (2-36) years. The onset of intractable focal epilepsy was at time of VBI in 10 patients, and in two patients – 9 and 24 years after VBI. SOZ localized with SEEG was multifocal in 11 (7-bilateral), 1–broad unilateral; extratemporal only – 2, temporal and extratemporal – 2 (1–bilateral), 8 – different combinations of mesial and neocortical unilateral and bilateral temporal. Two patients had normal MRI, 6 had MRI lesions related to SOZ, 2 of them also had lesions outside of SOZ, 4 had lesions outside of SOZ only (one – post-encephalitis encephalomalacia of temporal lobe). All lesions related to SOZ were localized to the temporal lobes: 3 patients had unilateral mesial temporal sclerosis (MTS), 1 – bilateral MTS, 1 – bilateral hippocampal atrophy, and 1 – unilateral temporal lobe atrophy. Only one patient had SOZ completely concordant with MRI lesion - patient with bilateral MTS who had seizures arising from bilateral hippocampi localized with SEEG. All the other patients had partial concordance of MRI lesions and SOZ.

Conclusion: In our patients with HVBI, all SOZ related lesions were located in the temporal lobe(s), 5/6 - mesial temporal. But, the presence of encephalitis-related lesion does not exclude possibility of SOZ localization outside of this lesion. Larger studies are needed to optimize pre-surgical evaluation strategy in patients with HVBI.

Delay to Hook-Up Conventional EEG Monitoring during hospitalization- Estimate of patients with missed seizures

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Introduction: There is frequent delay between ordering and placement of conventional EEG. The advent of rapid-EEG technologies makes it possible to shorten this duration. Here we estimate how many patients had seizures missed due to this delay.

Methods: 250 consecutive adult patients who underwent conventional EEG monitoring at UW Hospital were retrospectively chart reviewed for demographics, time of cEEG order, clinical and other EEG related information. Patients were stratified by use of anti-seizure medications (ASM) prior to cEEG and into LOW, MED, HIGH risk groups based on 2HELPS2B score (0, 1, or >1) calculated from the 1st hour of EEG. Three Monte Carlo simulations (500 trials) were performed, one for each risk groups. Covariates analyzed for influence on delay were place of EEG, time of EEG and if patients went on to have seizures or not. The effects of ASM on time to 1st seizure was performed using Cox survival analysis with log-rank test.

Results: The mean delay from EEG order to start was 2.00H (0.25-5.00H) in the total cohort, 2.14H (0.25-4.40H) in patients who had a seizure, 1.94H (0.25-5.00H) in those who did not (p=0.43). In EEG ordered after-hours, the mean delay was 1.90H (0.25-4.65H) and during business hours was 2.14H (0.25-6.0H) (p=0.16). The place of EEG: ICU, Floor, and ED did not have a significant difference (p=0.83). ASM did not affect time to 1st seizure in the LOW (p=0.37), MED (p=0.44), or HIGH (p=0.12) risk groups and was therefore not used in adjustment. Estimated % of patients who had a missed seizure in the delay period: LOW risk group 0.8% (95% CI 0.0-3.2%), MED risk group 10.4% (95% CI 3.3-18.3%) and HIGH risk group 17.1% (95% CI 2.8-36.1%).

Conclusion: UW Hospital with 24-hour in-house EEG technologists has a mean delay of 2H from order to start of cEEG. In high-risk patients, around 17.1% have a seizure missed during the delay. Timely EEG is necessary for efficient diagnosis and treatment of patients at risk for seizures.

Alternating patterns in EEG recordings in patients with encephalopathy: description of clinical and electroencephalographic findings.

Olga Fedirchyk, MD; Guillermo Martin Palomeque, MD; Lesly R. Araque Colmenares, MD; Antonio Jesús Pedrera Mazarro, MD; Isabel Saez Landete, MD; Ignacio Regidor, MD, PhD

Introduction: The term encephalopathy encompasses a wide variety of clinical syndromes due to a large number of toxic, metabolic or degenerative alterations. The cyclic alternating pattern of encephalopathy (CAPE), recently defined in the ACNS Standarized Critical Care EEG Terminology (2021) consists of two differentiated and independent EEG patterns, which alternate cyclically throughout the recording at a stable interval of 10 to 60 seconds.

Methods: We revised EEG recordings with final diagnosis of encephalopathy performed in the ICU/hospitalization ambit in the last three years in the EEG section of our department.

Results: We found two patients who met the criteria defined for CAPE pattern. In the first case, it was a man without comorbidities with a structural alteration as a cause of encephalopathy, and in the second case of a woman with low level of consciousness after recovered cardiorespiratory arrest, with practically overlapping EEG in both cases and satisfactory evolution. On the other hand, we found 8 patients with two alternating EEG patterns in their recordings who did not met CAPE criteria. In all of them, we found no relationship between EEG and etiology or symptoms. However, in 8 of the 10 patients included (CAPE vs. not CAPE) one of the two patterns has been defined as generalized rhytmic delta activity (GRDA).

Conclusion: Despite the differences between the two patients with CAPE pattern, both had good clinical evolution so we suggest that more clinical studies are needed to evaluate the final outcome in these cases. Also, the finding of GRDA as one of the alternating patterns in almost all of our patients, makes these studies even more necessary. Using an unified criteria to describe EEG recordings in hospitalized patients will be helpful to achieve this aim.

Adult neurology resident epileptiform discharge identification training– a randomized controlled educational trial.

Fabio A. Nascimento, MD; Jin Jing, PhD; Christopher Traner, MD; Erik Duhaime, PhD; Jeremy Moeller, MD; Brandon Westover, MD, PhD

Introduction: Reading EEGs is a skill that every neurologist is expected to learn before completing residency. The objective of this work was to evaluate the effectiveness of a novel educational method in teaching neurology residents to identify interictal epileptiform discharges (IEDs).

Methods: This is a prospective randomized controlled educational trial investigating the effectiveness of a novel teaching method consisting of two pre-recorded video-based didactics and testing with instant feedback. All participants completed a pre-Spike Test with 500 EEGs with marked candidate IEDs and a survey before randomization to one of the three arms: control (no intervention), intervention#1, and intervention#2. The intervention arms consisted of two pre-recorded lectures and a "Spike Test" with instant feedback: hosted on our MGH server (intervention#1) or an iOS app - DiagnosUs (intervention#2). All participants completed a post-Spike Test and perception survey at the end of the study. Answers to marked IEDs were determined by expert consensus.

Results: Ten participants (adult neurology PGY1-2 at MGB or Yale) completed the entire program: controls (n=4), intervention #1 (n=4), and intervention #2 (n=2). The average completion time was 30 days. All but two (intervention#1, n=1; intervention#2, n=1) participants had no prior EEG experience. Intervention#1 and intervention#2 pre- and post-intervention Spike Test mean scores ± SEM were 67±3% and 75±1% ($p<0.05$) and 70±1% and 77±0.5% ($p=0.33$), respectively. Control pre- and post-intervention Spike Test scores were 66±3% and 66±5% ($p=0.89$).

Conclusion: A series of two short pre-recorded video-based lectures in addition to practicing with instant feedback seem to be an effective method to teach adult neurology trainees with none to minimal prior EEG experience how to identify IEDs.

European neurology trainee EEG education.

Fabio A. Nascimento, MD; Jay Gavvala, MD; Hatice Tankisi, MD, PHD; Sandor Beniczky, MD, PhD

Introduction: To detail current European EEG education practices and compare European and U.S. EEG teaching systems.

Methods: A 19-question online survey focused on EEG clinical practices and residency training was emailed to all 47 Neurological Societies affiliated to the European Academy of Neurology.

Results: Thirty-two (68%) out of the 47 European National Neurological Societies completed the survey. EEGs are read by general neurologists in half of countries. The number of weeks devoted to EEG learning required to graduate ranged from none to 26, and EEG learning was expected to be continuous throughout residency in 2 countries. In most countries (n=16/32), trainees read >40 EEGs per EEG rotation, and the most commonly interpreted studies are routine and prolonged routine EEGs. These rotations are generally completed by PGY2-4s, and they involve clinic/outpatient (90%), EMU/inpatient (60%), or both (50%). Requirements for successful completion of an EEG rotation range from none to 800 EEGs interpreted and passing an oral examination, and half of countries do not use objective assessment measures. The most commonly reported educational methods are teaching during EEG rotation and yearly didactics, and the most commonly reported education barriers are insufficient EEG exposure and didactics.

Conclusion: Similar to the U.S., European resident EEG education practices are highly variable. We suggest worldwide neurology educators, especially in countries where EEGs are read by general neurologists (such as the U.S.), consider ensuring that residency EEG learning is mandatory and establishing objective measures in teaching and evaluating competency.

EEG Talk - a new and fun way to learn EEG

Fabio A. Nascimento, MD; Irfan Sheikh, MD; Jin Jing, PhD; Brandon Westover, MD, PhD

Introduction: Neurologists should be fully capable of reading an EEG upon residency graduation per the ACGME milestone project. Nonetheless, graduating neurology residents feel uncomfortable in reading EEGs independently. We created a novel, free, online EEG educational resource (EEGTalk) targeted at neurology trainees to supplement EEG education.

Methods: EEGTalk consists of a series of 5-25-minute videos wherein the authors talk through a pre-selected EEG focusing on teaching points deemed to be high yield. Episodes are recorded through Zoom and edited afterwards. All personal health information is removed from the footage. Videos are available on the author's YouTube channel and episodes are shared through social media.

Results: Data was collected from 12/2020 to 10/2021. Total number of viewers was 18,099 with 1,034 subscribers. Traffic source arose from channel pages and external sources (Twitter, Facebook, Google Search), both at 21.5%. Average view duration was 4:13 min. The videos more mostly consumed in the US, Brazil, and India (descending order). Roughly half of viewers watched on mobile phone followed by computer (41%) and tablet (4.5%). Viewers watching on computer had longer average view duration when compared with mobile phone (5:01 vs 3:16). Average age of viewers was 25-34 years (84.5%) with a watch time of 86.6%, and 2/3 were male. Modules were shared 503 times: 36% through copy to clipboard, 18.3% through WhatsApp, and 16.5% through Twitter. After controlling for the time a particular episode was available online, episodes covering basics of EEG were viewed more frequently than those covering nuances of EEG interpretation.

Conclusion: Improving EEG education requires novel methods of EEG teaching. We believe this format has potential for disseminating EEG knowledge in a rigorous but entertaining fashion. Based on our 1-year experience, we learned that this educational tool has been well received by our community and learned specific characteristics of how EEG Talk is consumed by our audience.

Unique Electrographic Findings in Costello Syndrome

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Introduction: Costello syndrome is a congenital disorder due to HRAS gene mutation characterized by failure to thrive in infancy because of severe postnatal feeding difficulties; short stature; developmental delay or intellectual disability, sleep disorders and dysmorphic features. So far there has been only three reported cases of refractory epilepsy in Costello syndrome. There has not been description of electrographic (EEG) findings in Costello syndrome. Here we describe case of Costello syndrome presenting with infantile spasms with EEG findings.

Case Report/Case History: This is a 10-month-old born at 37 wks via vaginal delivery, requiring NICU admission for respiratory distress. Patient was diagnosed with infantile spasm at 6 months of age. EEG showed spasms with electro decrement on EEG, high amplitude (250-500mV), multifocal spikes maximum over P3, P4, O2, T2, hypsarrhythmic background with pseudo burst suppression pattern during sleep, generalized slowing. He was treated with vigabatrin with resolution of hypsarrhythmia. However, there was no improvement in his clinical and findings and there was recurrence of epileptic spasms. He is now being treated with ACTH.

Conclusion: Costello syndrome is a rare, and there is limited data on EEG and epilepsy. Our case describes unique electrographic findings of Costello syndrome.

Misconceptions regarding EEG in Pediatric Residents

Prasanna Kumar Gangishetti, MD; Zahra Haghighat, MD

Introduction: Children have many types of paroxysmal events that may be concerning for seizures. EEG is one of the mainstay tool to confirm and management of seizures. However, EEG has its own limitation and if appropriate expectations have not been set, will lead to improper management of the patients with seizure disorder. We decided to test EEG knowledge and misconceptions among our Pediatric residents.

Methods: We sent 5 questions to our Pediatric Residents. Two were multiple choice questions asking about sensitivity and specificity range of the EEG. Two yes and no questions regarding abnormal EEG and one question whether we should delay treatment awaiting EEG result.

Results: 26 % of the responders had an appropriate knowledge about sensitivity, however 52 % had a correct information about the specificity of the EEG. 91% of Pediatric residents answered normal EEG does not exclude Epilepsy. 52% of them responded that abnormal EEG with epileptic discharges does not indicate Epilepsy. 78 percent answered not to delay the treatment of seizures waiting for EEG.

Conclusion: Results showed, majority of the responses were right regarding the specificity of EEG, but the sensitivity of EEG had varied responses. Most of the Pediatric residents agreed that normal EEG does not exclude diagnosis of epilepsy, but had mixed responses regarding interpretation of abnormal EEG. Many residents agreed not to delay the treatment of episodes while waiting for EEG. We believe, educating the residents regarding the low sensitivity of routine EEG and the fact that children who do not have epilepsy disorder may have abnormal EEG findings and on the other hands, children with epilepsy may have a normal EEG, will improve overall patient management. Also, it's very important to pay attention to the detailed clinical history and presentations to avoid misinterpretation of the EEG findings.

A Case of Subtle Focal Seizures in a Patient with Limited EEG Montage and Clinical Presentation of Complex Hallucinations

Bindi Nia, DO; Padmaja Kandula, MD

Introduction: Here we present a patient with a history of craniotomy resulting in breach artifact and limited montage (missing F8/T4) due to surgical site having subtle electroclinical seizures with semiology of brief left head deviation and complex visual hallucinations.

Case Report/Case History: Patient is a 61 year-old male with a history of right temporal glioblastoma multiforme status post resection one year prior to admission who was admitted for headaches and visual hallucinations. Patient had been experiencing visual hallucinations for the two weeks prior to admission with MRI brain demonstrating increased nodular enhancing foci in the right temporal lobe suspicious for tumor recurrence. VEEG was connected and demonstrated several right temporal onset seizures, however there were limitations in localization of seizure onset due to limited montage and significant breach artifact from prior craniotomy. Clinically, the patient had endorsed formed hallucinations of people in the room and left head deviation seen with right centrotemporal semirhythmic activity. His home dose of Levetiracetam was increased and he was additionally started on Lacosamide, which improved seizure control. Patient was then taken for tumor resection with right anterior temporal lobectomy. Post-operatively, the patient was seizure free but did have prominent interictal discharges seen in the right temporal chain on vEEG and therefore dual antiepileptic therapy was maintained.

Conclusion: This case demonstrates subtle electrographic seizures captured despite a limited right temporal electrode placement and breach artifact. While some events were subclinical, many were accompanied with left head deviation with or without behavioral arrest and well-formed hallucinations of people in the room, suggestive of a temporal lobe focus of seizures rather than mimickers such as Charles Bonnet, delirium, and migraine related events.

Four cases of atypical subclinical rhythmic electrographic discharge of adults (SREDA)

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Introduction: Subclinical rhythmic electrographic discharge of adults (SREDA) is an uncommon EEG pattern. We describe four patients with SREDA, with both typical and atypical features.

Case Report/Case History: P1 is a 57yo man referred for suspicious spells. Video-EEG showed runs of rhythmic sharply contoured bilateral synchronous theta/delta activity maximal over centro-parietal regions, with shifting lateralization without a recruiting pattern emerging from NREM and REM sleep. P2 is a 84yo woman with two events of loss of consciousness. EEG showed 10-15 seconds runs of bilateral temporo-occipital monomorphic 3-3.5Hz activity, with notched morphology, during wakefulness and drowsiness, blocked by eye opening. P3 is a 73yo woman with episodes of unexplained bruises. After hyperventilation, EEG showed polymorphic alpha/theta activity predominantly over the left, maximal in the temporal-parietal region, quickly spreading to contralateral regions, with waxing-and-waning pattern, lasting 45 seconds. P4 is a 75yo woman with history of seizures during childhood. EEG revealed runs of alpha/beta/theta activity lasting up to 44 seconds during wakefulness, without clear spatial-temporal evolution, with abrupt onset and offset, blocked by eye opening.

Conclusion: Our patients' EEG findings of SREDA showed some atypical features such as variable frequencies including delta range (P2), asymmetric presentation (P1 and P3), emergence from NREM/REM sleep (P1), diffuse distribution with mixed frequencies from alpha to delta range (P4) and notched morphology (P2). Interestingly in P2 and P4, SREDA was blocked by eye opening. Reactivity to eye opening and termination upon alertness or talking, as previously reported in the literature, support a benign etiology for this EEG variant. The atypical EEG SREDA pattern could have easily led to misdiagnosis of epilepsy in some of our patients, considering that they had a history of suspicious events with loss of consciousness and P4 had prior history of epilepsy.

Analysis of spectral behavior of individual sleep spindles

Evdoxia Kokkinou; Andreas M. Koupparis, MD, PhD; George K. Kostopoulos, MD, PhD; Athanasios P. Kakarountas, PhD; Vasileios Kokkinos, PhD

Introduction: Sleep spindles are the hallmark of NREM stage II of human sleep. Although their oscillation occupies a specific band, a detailed analysis of their intraburst frequency behavior at the individual spindle level is missing.

Methods: We analyzed the overnight sleep EEG of a 19 y.o. female, free from neurological disorder. 1322 fast NREM stage II spindles of parietal distribution were selected and marked at their oscillation onset over Pz. Time-Frequency analysis (TFA) by means of fast Fourier transform (FFT) was applied between 11-16 Hz, within a -1sec to +2sec time window, with a step frequency of 0.05Hz, a processing window of 1024 samples and a 1000-sample overlap. 344 individual spindles were excluded as mixed background frequencies interfered with the boundaries of the sleep spindle. Frequency and time measurements were performed for each of the remaining 978 individual sleep spindles.

Results: Analysis identified four categories of sleep spindles in terms of their frequency profile: a) spindles with a stable frequency profile: 86.70% (848/978) [mean start/middle/stop frequency: 13.08±0.39Hz / 13.09±0.36Hz / 13.08±0.38Hz; mean duration: 1.22±0.26sec]. b) spindles that end their oscillation with increasing frequency: 5.11% (50/978) [mean start/middle/stop frequency: 12.63±0.41Hz / 12.98±0.38Hz / 13.33±0.38Hz; mean duration: 1.37±0.31sec]. c) spindles that end their oscillation with decreasing frequency: 4.90% (48/978) [mean start/middle/stop frequency: 13.51±0.39Hz / 13.20±0.37Hz / 12.82±0.39Hz; mean duration: 1.36±0.31sec]. d) spindles occurring simultaneously and oscillating at separate frequencies: 3.27% (32/978).

Conclusion: In this study, we demonstrate outlier spindles that dynamically change their frequency of oscillation during their course. Moreover, we identified spindles that oscillate simultaneously. These findings reshape our understanding of the cortico-thalamic network, as well as the design of automated spindle detectors.

2HELPS2B Score: Appraisal of the Validity and Utility, A Single Center Study

Dong-Hee Kim, MD; Jessica Yen, MD; Ji Yeoun Yoo, MD

Introduction: The 2HELPS2B score is a tool for seizure risk stratification and to guide the need for further EEG monitoring. Our aim was to study the applicability of this score to our center and explore limits of prior studies. We studied the score's reliability in predicting risk of seizures, as well as if it could predict the need for Anti-Seizure Medication (ASM) escalation. We also evaluated its applicability to cardiac arrest pts (excluded from prior studies as EEGs were considered usually for prognostication but may need monitoring for other indications).

Methods: This was a multi-site single center prospective study from 12/2020-6/2021. Clinical history and ≥24h vEEG data were collected from pts ≥18 yo, excluding studies in the EMU and with seizures in the 1st hr. The 2HELPS2B score was based on the 1st hr on EEG (adjusted if increased within 12h). The presence/onset of seizures and escalation of ASMs were recorded. Violations were noted with seizures/escalation of ASMs in any low risk pts (0), or after 24h in medium risk pts (1). Violations were not called in high risk pts (≥2) due to lack of guidelines.

Results: The study included 149 pts (monitored 55h avg). 131 were non-cardiac arrest pts: 14 low risk (10.7%, 46h avg), 45 medium risk (34.4%, 49h avg), and 72 high risk (55.0%, 60h avg). 18 of these pts had seizures but without violations, and 31 pts required escalation of ASMs with only 1 violation (due to anesthetic weaning). There were 18 cardiac arrest pts: 5 low risk (27.8%, 62h avg), 8 medium risk (44.4%, 54h avg), and 5 high risk (27.8%, 58h avg). Two of these cases were violations (due to rewarming).

Conclusion: The 2HELPS2B score reliably predicted the risk of seizures and need for ASM escalation in most pts. Although limited by small numbers, this study underscores the need for longer monitoring when weaning anesthetic medications or rewarming cardiac arrest pts.

A Prospective Randomized Controlled Trial: Alternative approach to EEG application to reduce electrode-induced skin injury among ambulatory EEG patients.

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Introduction: Ambulatory electroencephalography (AEEG) is a technique of continuous EEG recording of patients in their natural setting, outside the controlled environment of the hospital. Electrode-induced skin injury is an unavoidable complication of prolonged EEG monitoring. This randomized study aimed to investigate the performance of two methods of electrode application (Ten20® with Tensive® gel versus Ten20® with Tensive® gel and hydrogel electrodes) in reducing electrode-induced skin injury among patients undergoing 4-day-AEEG monitoring.

Methods: A randomized intervention study was conducted from November 2020 to May 2021 in the Neurosciences Ambulatory Care Unit at a metropolitan hospital, Sydney, Australia. We enrolled patients into two groups: i) Group 1 (standard care group), which received Ten20® conductive paste with Tensive® adhesive gel as the primary approach to electrode application; ii). Group2 (intervention group) received Ten20® conductive paste with Tensive® adhesive gel and hydrogel electrodes on hairless locations as the primary approach to electrode application.

Results: A total of 79 patients participated in this study. The group which received the addition of hydrogel electrode use(Group 2) performed better than the standard care group on electrode site inflammation for frontal electrodes (FP1, FP2, F8, F7 and the GRD). Self-reports of patient comfort and mood and EEG quality did not differ significantly between the two groups.

Conclusion: The addition of hydrogel electrode used to a Ten 20 ® conductive paste with Tensive ® adhesive gel protocol resulted in reduced inflammation at frontal lobe electrode sites.

Correlation of continuous electroencephalogram findings after stroke with chronic anti-seizure medication use

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Introduction: Continuous EEG (cEEG) findings in acute settings influence anti-seizure medication (ASM) use. However, the association with chronic ASM use remains uninvestigated. We aimed to fill this knowledge gap in acute stroke population.

Methods: We performed a retrospective cohort study of acute stroke patients who had cEEG monitoring and at least 3 months of follow-up. Patients were divided into chronic ASM(on ASMs at last follow-up) and non-chronic ASM groups. EEG findings were classified as electrographic seizures(ESz), epileptiform abnormalities(EAs; sharp waves, LPDs, LRDA, GPDs) and non-epileptiform activity. Multivariable logistic regression model was used to see the association of primary predictor(EEG finding) with chronic ASM use at last follow-up.

Results: A total of 483 patients[52% female, age=61.7(SD 13.9)years], with a mean follow-up of 46.5(SD 26.6)months, qualified for the study. A total of 181(37.5%)were discharged on ASM. At last follow-up, 113(23.4%) patients were on ASM(chronic ASM group). On univariate analysis, chronic ASM group patients was significantly($p<0.05$) more likely to have acute convulsive seizures(30.1%vs.8.9%), ESz(23.9%vs.3.0%), EAs(44.2%vs.14.6%), prior stroke(20.4%vs.7.6%). A total of 47(41.6%) chronic ASM patients had no seizure during follow-up while the rest(58.4%) developed epilepsy. Convulsive seizures most significantly associated with chronic ASM use on multivariable analysis. In addition, after adjusting for age, sex, stroke type, NIHSS at presentation, and admission duration, the presence of ESz[Odd's ratio 4.65(1.4–15.2), p=0.01], and EAs[OR 3.07(1.32-7.08), p=0.008] significantly increased odds of chronic ASM use.

Conclusion: Around 40% of patients on chronic ASM after undergoing cEEG in acute stroke setting remain on them despite lack of late seizures. Multivariable analysis suggests that acute cEEG findings increase the odds of chronic ASM use.

Benign Variants on Intracranial EEG - A Systematic Review

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Introduction: Approximately 30% of epilepsy patients have drug-resistant epilepsy and may be candidates for epilepsy surgery. icEEG interpretation is crucial for the success of the surgical intervention. Benign variants on icEEG may mimic epileptiform discharges and result in misinterpretations. Understanding such variants is essential to successfully guide the resection of epileptogenic focus while sparing eloquent cortex.

Methods: We conducted a PubMed search for human studies investigating normal/benign icEEG patterns that were published in English until August 2021. We conducted 48 searches using different keyword combinations and screened 5191 articles. Reasons for exclusion were animal studies (5%), other imaging modalities (7.4%), purely pathological reports (9.6%), and other (78%).

Results: We included 57 studies. The design was prospective cohort (10%), prospective non-randomized controlled (20%), retrospective cohort (50%) and case studies (20%). The stated objectives were to study High frequency oscillations (HFOs) (40%), identify background rhythms (10%), classify epileptic from physiological patterns (30%), describe a questionable pattern (10%), or other (10%). The icEEG was recorded from subdural electrodes/Electrocorticogram (ECOG) (40%), stereo-EEG (SEEG) (20%), a combination of SEEG/ECOG (30%) or other types (10%). Most of the articles studied physiological HFOs (40%), other reported rhythms included: high voltage 14 & 6 Hz, alpha rhythms, small sharp spikes, rhythmic temporal theta bursts of drowsiness, and other physiological patterns. (15.8%) of the studies evaluated sleep icEEG. As we conclude our analysis, we will construct a comprehensive atlas of normal icEEG background rhythms and mimics.

Conclusion: Our study could increase the accuracy of EEG guided surgical resections by limiting icEEG misinterpretation, which otherwise could lead to resection mistakes and suboptimal surgical outcomes.

EEG Signatures of Frequency-Tuned Non-invasive Brain Stimulation over the Course of Stroke Recovery

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Introduction: Exposure to extremely low frequency and low intensity electromagnetic fields (ELF-EMF) modulates neuroplasticity-related processes with associated clinical improvements. The current EEG analyses are from a double-blind sham-controlled clinical trial of a novel non-invasive portable device that transmits ELF-EMF treatment (BrainQ; BQ) primarily for improving upper extremity motor function in moderately impaired sub-acute ischemic stroke patients. EEG collected over the course of treatment has the potential to elucidate the mechanism of the action at the network level and establish objective measures for recovery monitoring and personalization.

Methods: Continuous EEG was recorded from 21 patients twice a week for 8 weeks while performing alternating grip, reach and rest blocks as part of a randomized controlled trial. Participants were randomized to receive BQ (n = 13) or sham (n = 8) treatment in conjunction with physiotherapy. Treatment was with a proprietary brain computer interface device involving exposure of the brain to spectral patterns associated with motor function. Spectral and complexity features related to plasticity/recovery in motor learning were extracted for the rest blocks and compared between the groups.

Results: As treatment progressed, EEG in the BQ group showed greater beta relative power over centro-parietal regions of the affected hemisphere (p=.04) and greater signal complexity (p<.03) compared to sham. Moreover, increased beta relative power was correlated with larger clinical improvement on the Fugl-Meyer – Upper Extremity (FMA-UE) scale (rs=0.47, p=.03).

Conclusion: Spectral EEG features indexing plasticity-related changes during recovery may facilitate tuning of the treatment for optimal delivery of non-invasive brain stimulation in neurotrauma. Such personalization may lead to better outcomes in motor and other functional domains.

Surgical treatment of MRI negative right temporal lobe epilepsy: intra-operative electrocorticography vs ictal onset zone

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Introduction: Standard anteromesial resection (SAMR) can be performed in MRI negative right temporal lobe epilepsy (RTLE), based on acute intra-operative electrocorticography (IO-ECoG). We present a case of MRI negative RTLE with IO-ECoG not fully concordant with Ictal onset zone (IOZ).

Case Report/Case History: 34-year-old male with epilepsy onset at 19 years, on 3 antiseizure medications (ASMs), sought surgical evaluation. He had failed 6 ASMs. Seizure semiology consisted of rising epigastric sensation, piloerection in nuchal region, right or bilateral arms followed by behavioral arrest and confusion. Presurgical work up included normal MRI, vEEG with right temporal localization, Wada with left hemispheric dominance for language & memory. He underwent ICEEG with 4x8 right temporal grid (RTG) and 4 right-sided strips in subfrontal (RSF), anterior temporal tip (RATT), anterior sub-temporal (RAST), mid-subtemporal (RMST) and depth in hippocampus (RHC). Acute IO-ECoG captured typical mesiobasal (MB) spikes, suggesting MB-RTLE. During 8-day ICEEG monitoring the interictal zone (IIZ) initially localized to right MB and Basal temporal (BT) areas in two groups (#1: RATT1-2, RAST2, RMST1-3, RHC 1-5 & #2: RMST1) followed by a third neocortical (NC) group in (#3: RTG 5, 12-13 and 18-10). IOZ was identified with 283 electroclinical & electrographic seizures in multiple clusters, all localizing to NC and BT areas (inclusively RGT 5-6, 12-14 and 17-22, RAST 4, with some variability between seizures). Patient underwent right temporal lobectomy, involving NC areas, not otherwise included in SAMR. He is currently seizure free at four months postoperatively.

Conclusion: In our MRI negative RTLE, IO-ECoG localized to MB areas, ICEEG localized to NC & BT areas, IIZ localized to NC, BT & MB areas. Identification of IOZ resulted in modifying SAMR to involve more posterolaterally located neocortical areas.

Role of automatic seizure detection system in the Emergency Department: A pilot study at University of California in Los Angeles

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Introduction: Prompt detection of status epilepticus (SE) in the emergency department (ED) has significant effect on patients' morbidity and mortality. Ceribell is an 8 channel EEG used to detect epileptiform abnormalities (EA) in patients with high suspicion for SE. Clarity is artificial intelligence (AI) software that is designed to interpreter the EEG to help providers manage patients. We evaluated how Ceribell and Clarity affected patient treatment and disposition at UCLA ED. We also evaluated whether our EEG readers agreed with Clarity's interpretation of the tracings.

Methods: We evaluated 20 patients who were evaluated with Ceribell and Clarity between 06/26-08/08/2021 in the UCLA ED for Clarity interpretation, EEG reader's interpretation, whether continuous EEG (cEEG) ordered, administration or an anti-seizure medication (AMS), and disposition from the ED.

Results: Of the 20 patients, 14 had documented altered mental status. Time the device was connected ranged between 30 mins and 4 hrs. Clarity interpreted 8 cases to have EA with a burden range of 20-100%. 12 cases were interpreted as slow/normal. 37.5% of patients with Clarity-identified EA were treated with an anti-seizure medication (ASM) vs 66.7% of those without EA. 25% of patients with AE got cEEG vs. 37.5% of those without. Clarity did not affect disposition from the ED or whether neurology was consulted. When Clarity interpretation was compared to that of an EEG, AE was identified in 2 out of 20 patients. Of these 2, 1 was picked up by Clarity and 1 was not.

Conclusion: Ceribell is a valuable tool in busy EDs. Clarity, the automatic seizure detection system did not appear to change the disposition or treatment of patients, arguing that ED physicians continued to rely on their clinical judgment over the advice provided by AI. Further studies with a larger sample size are warranted.

Active and Passive Knitting Rhythm

Cody L. Nathan, MD; Alexa King, MD; Michael Macken, MD

Introduction: Theta frequency is activity on EEG that ranges between 4-8 Hz and is typically a marker of drowsiness in adults. However, frontal midline theta rhythm is a specific rhythm that arises during tasks requiring concentration such as texting. A similar theta rhythm has been reported once in association with the act of knitting which is distinct from a previously reported knitting artifact identified as sharply contoured slow waves phase reversing at T3/T4. We report a case of a patient in the epilepsy monitoring unit (EMU) who had a reproducible fronto-central theta rhythm captured on video EEG associated with both knitting and reading an instruction manual on knitting.

Case Report/Case History: A 25-year-old right-handed female with a history of left temporal encephalocele was admitted to the EMU for diagnostic evaluation. Her neurologic examination was normal. She underwent continuous video EEG monitoring which captured no definitive seizures but was notable for an incidental rhythm while knitting. On day 3 of her EMU stay, she started to knit a sweater using a printed-out instruction manual as a guide. She knitted the sweater at four distinct time points on that day, ranging from 24-71 minutes in duration. There was a task-specific rhythm identified within these epochs whenever she was knitting or reading the manual for how to knit the sweater. This rhythm was characterized by 6-7 Hz, 80-90 uV rhythmic activity in the frontal-central region, maximal at the Fz electrode lasting 2-3 seconds seen every 3-10 seconds. This rhythm dissipated when the patient stopped knitting/reading about knitting.

Conclusion: This is the first case of a knitting rhythm seen in a patient while both actively knitting and reading about knitting. The fronto-central theta rhythm is potentially due to a combination of mental processing within the prefrontal cortex, motor planning within the supplementary motor area, and visuospatial processing from the occipital cortex.

EMG/NCV TESTING

Acute limb ischemia presenting as a drop foot: a case report.

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Introduction: Foot drop syndrome is defined as a weakness of the dorsiflexor muscles of the foot. It is a frequent neurologic condition usually caused by peroneal neuropathy; other causes include L5 radiculopathies, sciatic neuropathy and lumbar plexopathy. Acute limb ischemia (ALI) is a rapid decrease of the blood flow to the lower limb due to arterial occlusion, presenting with pain, pulselessness, pallor, paresthesia and paralysis. Occlusion may be caused by embolism or thrombosis, and without treatment it can lead to irreversible damage in the nerves and muscle tissue.

Case Report/Case History: A 39yo male with a history of coronary disease treated with dual antiplatelet therapy, who was referred to our lab by his Neurosurgeon for an acute weakness in the dorsiflexion of his right foot that appeared 4 days before admission and a positive Lassegue sign. MRI showed a L5-S1 disc protrusion and signs of L5 root injury. In our lab, examination showed severe weakness of both dorsal and plantar flexors and mild paresthesia in the dorsal foot. Nerve conduction studies (NCS) showed absence of motor and sensory responses of deep peroneal, posterior tibial, sural and superficial peroneal nerves, with mild acute denervation signs of tibialis anterior and gastrocnemious muscles. At the light of these results, a more detailed examination was performed, revealing a mild coldness of the limb and absence of distal pulses bilaterally. An urgent CT angiography showed a complete occlusion of the right femoral artery suggesting acute thrombosis. The patient underwent an urgent thrombectomy, with an immediate recovery of the distal pulse and a progressive recovery of the neurological symptoms.

Conclusion: ALI can be presented with an acute paralysis, especially drop foot, but it can be mistaken with other more common etiologies. An accurate diagnosis is paramount to avoid irreversible changes due to ischemia. NCS/EMG studies are essential in the diagnosis of these patients.

Role Of Lateral Spread Response In The Study Of Hemifacial Spasm.

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Introduction: Lateral spread response (LSR) is an abnormal response elicited by stimulation of one branch of the facial nerve, resulting in the contraction of muscles innervated by other branches of the nerve. The underlying pathophysiologic mechanism is not completely understood, but it is probably explained by the ephaptic transmission between fibers of the facial nerve, along with facial motor neurons hyperexcitability. This response is seen in hemifacial spasm (HFS), being especially useful in the diagnosis of cases produced by vascular compression of the nerve at its origin.

Methods: We systematically reviewed the neurophysiological studies carried out in patients with HFS during the years 2020 and 2021, and selected patients with HFS with a suspected compressive etiology The study of the lateral spread response, through Blink Reflex (BR), was performed as a part of an exhaustive neurophysiological protocol.

Results: We present 5 patients (3 women, 2 men) with ages between 41 and 62 years. We proved the presence of the LSR with BR in all of them. We performed this technique recording the OOc and OOr muscles with surface and needle electrodes respectively and stimulating the supraorbital nerve bilaterally. We recorded the presence of this response in both muscles in all the patients. In 3 patients, magnetic resonance imaging (MRI) revealed a clear vascular compression. In 2 patients the MRI was unclear.

Conclusion: The presence of LSR allows to confirm the facial nerve hyperexcitability in HFS patients, being very useful for the identification of patients with vascular compression, which has an impact in the therapeutic management of these patients.

Electro-clinical spectrum of immune-mediated polyneuropathies in the pediatric population

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Introduction: Acute immune-mediated polyneuropathies include the “classic” Guillain-Barre syndrome or AIDP (acute inflammatory demyelinating polyneuropathy), as well as other less frequent variants such as acute motor axonal neuropathy (AMAN). Both entities are very similar, however there are important clinical and neurophysiological differences.

Methods: we report two cases of young patients with different presentations of acute inflammatory polyneuropathies. Case 1: 14-year-old male, with very mild acute distal weakness and instability for 20 days. He reports a history of gastrointestinal infection one month before the onset of the neurologic symptoms. Physical examination evidenced slight distal weakness with normal deep tendon reflexes. A nerve conduction study (NCS) was performed. Case 2: 16-year-old male, with intense lumbar pain and distal paresthesia for 15 days. He also reports recent distal weakness. Physical examination evidenced the absence of deep tendon reflexes. A NCS was performed.

Results: In case 1, NCS revealed findings compatible with a severe acute motor axonal neuropathy. In case 2: NCS showed slight changes suggesting an acute inflammatory demyelinating polyneuropathy. In both cases, a lumbar puncture was performed, showing albuminocytologic dissociation. Treatment with intravenous immunoglobulin was started with favorable evolution.

Conclusion: Our cases demonstrate the different manifestations of this group of polyneuropathies, and evidence the need of an adequate diagnostic orientation, as well as the importance of neurophysiological studies as an irreplaceable tool for their diagnosis and characterization.

EPILEPSY: CLINICAL

Seizure forecasting and detection with wearable devices and subcutaneous EEG - A Practical Seizure Gauge

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Introduction: Minimally invasive wearable and subcutaneous devices may enable seizure forecasting and provide accurate seizure records to support clinical decision making.

Methods: Patients were recruited for ultra long term monitoring with a wearable device (Empatica E4, Fitbit Charge HR, or Fitbit Inspire) and concurrent ambulatory EEG monitoring (UNEEG SubQ, EpiMinder, NeuroPace RNS). Wearable and EEG data were recorded for 8 months or more. Electronic seizure diaries and periodic mood and symptom surveys were recorded by participants. Recorded data were analyzed to assess the ability to detect seizures, identify circadian and multi-day cycles, and forecast seizures.

Results: Thirty-nine patients with epilepsy recorded over 9300 days (25.5 years) of ambulatory wearable and EEG data, including over 1550 seizures. Nine patients left the study before completion due to complications, poor adherence, poor data quality, or unanticipated seizure freedom. Analysis in this cohort has established the following: · Heart rate circadian and multi-day cycles measured using Fitbit correlated with self-reported seizures in 10 of 19 patients studied. · Actigraphy, HR, and tonic EDA circadian and multi-day cycles measured by Empatica E4 correlated with iEEG confirmed seizures in the majority of 8 patients studied. · Seizure forecasting significantly better than chance in 5 of 6 patients using the wrist-worn Empatica E4 device using a long-short term memory (LSTM) neural network, with iEEG confirmation of seizures. · Seizure forecasting using UNEEG subscalp EEG significantly better than chance in 5 of 6 patients studied using a Bidirectional LSTM neural network.

Conclusion: This project has established the feasibility of forecasting seizures using long-term cycles, wearable devices, and subcutaneous EEG.

Epilepsy Telehealth: Pre and Post COVID Stay at home

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Introduction: The COVID 19 pandemic forced immediate adoption with the use of telemedicine in treating patients with neurology, and in particular epilepsy. This study described the organization and execution among outpatient neurology clinics at UCLA Medical Center, before and after the California “Safer at Home” order, this method saved costs, improved utility, and patient satisfaction.

Methods: This was retrospective, non -randomized study that took place at UCLA Medical Center. The Data collection took place from November 2019 through March 2020. Time based opportunity was assessed. Median travel time was and travel cost was estimated. Time based opportunity savings were valued using Internal Revenue statistics of tax data to approximate hourly earnings by Zip Code. These findings were supported by 7, 194 patient using telemedicine and 9, 189 Video visits. Patients satisfaction and provider satisfaction were collected throughout study. Patient with epilepsy during November 2019 through March 2020 showed 692 visits.

Results: Patient using telemedicine saved 75 minutes of travel time. Based on time-based opportunity savings, patients saved $54 median total cost savings. Among 1,000 surveys, 86% of patients were satisfied with video experience. Among providers survived responses 29/37 surveys, 78.4% were satisfied. Among patients with epilepsy pre COVID 649 visits with 3.1 % being video. Post Safer at home, 696 visits with 83.2% were video. Patients with Epilepsy increased the video use by twenty-eight-fold post Stay home mandate. Total overall visits among patient with epilepsy increased by about 7%.

Conclusion: The option of telehealth offers travel and time savings for neurology patients, showing patient and provider satisfaction. In particular, patients with epilepsy this served tremendous option to inpatient visits showing such a significant increase. Also allows patients whose driving privileges were suspended an option to maintain their independence and continue collaboration with their medical provider.

Outcome After Surgical Ablation of Focal Cortical Dysplasia due to DEPDC5 Mutation

Krystal Sully, MD; Elaine Seto, MD, PhD

Introduction: Literature regarding epilepsy surgery for seizures due to structural cortical malformations is generally favorable. Genetics may help to modify the prognosis of outcome if a specific etiology is identified. DEPDC5 gene mutations has been identified as a cause of familial focal epilepsies and cortical malformations; as well as intellectual disability to a lesser extent.

Case Report/Case History: A now 3 year old girl had seizure onset at age 5months old with focal tonic seizures. She had failed carbamazepine and was on phenobarbital and lamotrigine by the time she was referred to an epilepsy specialty clinic. Brain MRI revealed left frontal cortical dysplasia. Given the correlation of the focal cortical dysplasia with the scalp EEG findings from a phase 1 EMU study, stereoEEG was not necessary, and the patient underwent laser ablation 8/2019 (age 12months old). After which she has been seizure free and is now on lamotrigine monotherapy. An epilepsy gene panel had been sent with initial work up, but results showing a DEPDC5 mutation did not return until after the surgery.

Conclusion: This case is highlights the role of surgical treatment for focal structural abnormalities. It also raises questions of prognosis: specifically, given the genetic DEPDC5 mutation as to whether she might be able to remain seizure free if she were to wean off lamotrigine. The literature is sparse with varied results regarding outcome after surgery for focal cortical dysplasia in patients and children with DEPDC5 mutations.

Clinical response to vigabatrin in relation to time and dose: Parental perception, EEG confirmation.

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Introduction: Epileptic spasms (ES) is an age specific seizure type that occurs usually between (b/w) 3 to 8 months of age, associated with stasis or regression of developmental milestones. There are many causes of ES. Standard FDA approved therapies are adrenocorticotropic hormone (ACTH), oral corticosteroids (OCS), and vigabatrin (VGB). Literatures comparing ACTH, OCS, and VGB make different conclusions regarding best initial therapy and preferred dose. Studies report low VGB response rate for treatment (tx) of ES (not due to tuberous sclerosis complex (TSC)), ranging from 27% to 39.4%. This retrospective study assessed the efficacy of VGB as first-line tx for ES (not due to TSC). Additionally, we assessed parental perception of ES resolution and compared it with objective EEG results to conclude whether or not parental report alone is reliable.

Methods: We performed a single-center, retrospective analysis of newly diagnosed cases of ES b/w Jan 2014 and Oct 2021. All patients underwent a comprehensive evaluation. All patients were followed by a child neurologist or an epileptologist. Duration of follow-up was up to 1 year. Various clinical variables were collected. Monitoring of vision was conducted by a pediatric ophthalmologist. Resolution of ES with or without hypsarrhythmia was defined as sustained absence for 3 months after tx initiation. Children were considered early or late responders and alternatively, non-responders.

Results: Thirty-nine patients were treated with VGB. At the 2, 4 week, 3, 6, and 12 month follow-ups, twenty-one (53%) parent-patient dyads reported complete resolution of ES. The EEGs performed at those visits confirmed that 18/21 (85%) parent-patient dyads were correct with no ES or hypsarrhythmia noted. Of note, not all of the patients had an EEG finding of hypsarrhythmia at time of diagnosis.

Conclusion: Parental report can be utilized as a high reliability source if EEG is not readily available in times such as our recent COVID-19 pandemic.

Electroconvulsive Therapy for Treatment of New Onset Refractory Status Epilepticus and Epilepsia Partialis Continua in a Patient with Autoimmune Encephalitis

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Introduction: We present a case of a patient with new onset refractory status epilepticus from seronegative autoimmune encephalitis that responded to electroconvulsive therapy (ECT). Autoimmune encephalitis (AE) is an increasingly recognized etiology for new-onset refractory status epilepticus (NORSE). In super refractory status cases where status resumes with withdrawal of anesthetics, mortality can be 25% or greater due to the complications of anesthesia, critical illness, and an ongoing ictal state. ECT represents a viable treatment option for super refractory status.

Case Report/Case History: A 23-year-old healthy woman presented with subacute behavioral changes, lethargy, and discrete focal to bilateral tonic-clonic seizures. Clinical semiology included prominent motor component with either right or left hemi body clonic movements and subsequent EPC. Subsequent progression to status prompted anticonvulsant polytherapy, anesthetic drips, ketogenic diet, and concurrent immunotherapy. MRI brain showed claustral hyperintensities. Infectious workup including cerebrospinal fluid (CSF) was unremarkable. Serum and CSF workup for autoantibodies and malignancy workup was negative. ECT was initiated for ongoing super refractory status with combined bitemporal and bifrontal approach with cessation of status epilepticus and sustained clinical and electrographic improvement. At one-year follow up, she is fully independent and seizure free.

Conclusion: We report a case where ECT was employed for the management of NORSE, eliminating the need for ongoing anesthetic coma and achieving a successful, sustained long term outcome.

Change in Epilepsy Semiology after COVID 19 Vaccine Administration

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Introduction: The Role of Preoperative Seizure Duration 23 old male with change in seizure semiology changed 1 week after second dose of the Moderna COVID vaccination.

Case Report/Case History: Patient has a history of non-accidental trauma at the age of 1 and developed epilepsy. His typical seizures were described as having nystagmus towards the left followed by loss of awareness and behavioral arrest. These seizures occurred 2-4 times a month. His previous work-up included routine EEG's that demonstrated abundant left occipital interictal discharges and rare left temporal epileptiform discharges. His MRI brain showed ventricular enlargement due to diffuse parenchymal loss as well as signal abnormality in the bilateral occipital lobes. Based on the data and described semiology, it was felt that the patient was having seizures arising from the occipital region. His anti-seizure medication regimen included Oxcarbazepine600mg daily & Topiramate ER 125 mg daily. On March 4, 2021, one week after receiving the second dose of the Moderna COVID19 vaccination, the patient started having a new seizure semiology that consisted of brief gaze deviation to the left followed by forced gaze deviation to the right with associated right head version. This then progressed to a bilateral upper extremity tonic seizure and then a bilateral asymmetric tonic seizure. He was evaluated in the Epilepsy Monitoring Unit and the EEG captured two seizures of this described semiology with generalized onset and a third seizure with left hemispheric onset. He was discharged with Topiramate ER 150 mg daily and remained seizure free at his follow-up appointment 2 months later.

Conclusion: The Moderna COVID 19 vaccination may temporarily change the seizure semiology of epilepsy patients. Although the exact mechanism is unclear, it appears that in this case there was propagation of an alternative pathway in the epileptogenic network. More data is needed for our post-vaccination patients with epilepsy.

COVID-19 Infection Revealed Underlying Frontal Hemimegalencephaly and Drug-Resistant Epilepsy in a Child

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Introduction: COVID-19 infection has been associated with new onset seizures and provoked seizures in people with epilepsy, but the prevalence of new onset epilepsy in COVID-19 patients is unknown. Hemimegalencephaly (HME), a disorder of cortical development, frequently causes developmental delay and drug-resistant epilepsy (DRE), but localized HME is not as well understood or widely reported. We present a case of explosive onset DRE due to underlying asymptomatic frontal HME in the setting of COVID-19 infection.

Case Report/Case History: An 18-month-old normally developing girl presented with new onset status epilepticus in the setting of a febrile illness. She was found to be COVID-positive. Initial bilateral tonic seizures were controlled with levetiracetam, but she later experienced breakthrough seizures with variable gaze deviation and left-sided tonic posturing. EEG showed right frontal polyspike and wave discharges at seizure onset with evolution to focal repetitive seizures. MRI brain showed extensive right focal cortical dysplasia (FCD), suggestive of frontal HME. Despite trials of multiple anti-seizure medications (ASMs) and ketogenic diet, seizure frequency increased to 60 per day. Intraoperative electrocorticography showed continuous spiking in the right superior and middle frontal gyri. Somatosensory and motor evoked potentials localized eloquent cortex outside of the FCD. She underwent a right frontal lobectomy, resulting in seizure freedom. ASMs were reduced post-operatively and she was weaned off the ketogenic diet. At last follow-up, she remained seizure-free over 7 months and attained new developmental milestones.

Conclusion: This case illustrates how COVID-19 infection may reveal underlying asymptomatic epileptogenic structural brain abnormalities in the setting of new onset DRE. It also provides another example of DRE due to frontal HME which was successfully treated with surgical resection.

The New-Onset Refractory Status Epilepticus (NORSE/FIRES) Family Registry

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Introduction: New-onset refractory status epilepticus (NORSE) is a rare clinical presentation affecting previously healthy children and adults. Febrile infection-related epilepsy syndrome (FIRES) is a subcategory of NORSE and applies when a preceding fever occurs. Information pertaining to disease course and survivorship remains limited. The NORSE/FIRES Family Registry has been developed to gain insight into possible risk factors for NORSE and FIRES, to assess the spectrum of clinical outcomes and the quality of life of survivors.

Methods: Survivors, surrogate/substitute decision makers and physicians can enter patient data into the REDCap-based registry: https://www.norseinstitute.org/norse-registry-2. Information collected in this study includes past medical history, clinical presentation, survivorship, clinical sequelae and quality of life, among others. Participants are invited to complete follow-up surveys for up to two years following presentation of seizures. Enrollment is ongoing in multiple languages and will remain open until 2025.

Results: To date, 56 participants have enrolled in this study (2-78 years, median: 12.5, IQR: 20.5, 20 females and 36 males) from 12 countries across 5 continents. 31/56 participants are survivors of NORSE/FIRES. At >6 months after onset, survivors experience a mean of >12 seizures per month and remain on a median of 4 (IQR: 3) anti-seizure medications. The median quality of life amongst all survivors was rated as 4/10 (IQR: 3.5).

Conclusions: Preliminary data suggests that survivors of NORSE/FIRES have a high seizure burden and poor quality of life. This international multi-lingual family registry will allow for collection of a broad range of variables to help develop hypotheses for future prospective studies. This registry provides an opportunity for families to contribute to the scientific understanding of this devastating disease.

What to resect or what not to resect: Mesial temporal lobe epilepsy related to debilitating benign skull-based epidermoid cyst. Case report and Literature Review.

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Introduction: Intracranial epidermoid cysts (IEC) are rare tumor. Epilepsy is frequently drug-resistant. Complete resection is not always plausible, and an aggressive approach can lead to disastrous complications. We review the optimal surgical timing and strategy in individuals with DRE related to IEC.

Case Report/Case History: A 72-year-old left-handed female was diagnosed 7 years prior with IECs related trigeminal neuralgia. Surgery was deferred initially. Four years later she experienced her first seizure and refractory to Anti-seizure-medication. The EMU confirmed left MTE. MRI showed extension of IEC to middle cranial fossa encasing left more than right mesial temporal structures. The patient underwent craniotomy with amygdalohippocampectomy and partial resection of the anterior temporal pole guided by Electrocorticography (ECOG). Debulking of the IECs was performed. Pathology showed normal mesial temporal architecture. The postoperative course was complicated by aphasia with left temporal hemorrhage. We identified a total of 18 cases (median age 37 years old, 10 females) of temporal lobe epilepsy related to IECs (table 1). Thirteen cases presented with FIAS, while 8 cases were focal to bilateral tonic-clonic seizures (FBTCs). The median duration of epilepsy was 3 years (range 0-18 years) and three underwent surgery after the onset of the seizures. Eleven patients had left-sided IECs and two were bilateral. Four surgical approaches were reported: Removal of IEC only; ATL; Removal of cyst + ATL, and amygdalohippocampectomy + removal full or partial cyst. ECOG was used in 5 out of 7 cases of ATL or amygdalohippocampectomy. Patients achieved seizure freedom (follow up of 3 months to 5 year) in 15 cases.

Conclusion: Cyst resection alone can lead to seizure freedom in majority of unilateral IECs cases, even with the involvement of the mesial temporal structures in the MRI. No conclusion can be made on the bilateral case as our case adds to the very limited body of literature with one additional patient.

Short term outcome of Epileptic Seizure in Children attending at Pediatric Neuroscience Department of Dhaka Shishu Hospital

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Introduction: The optimal response to antiepileptic treatment is the control of seizures. In different studies, it has been shown that childhood epilepsy presents with a variable course, and approximately one-third of epileptic children experience alternating relapse and remission. Some of them do not become seizure-free, despite adequate treatment.

Methods: This retrospective observational study was conducted in the epilepsy clinic of the Paediatric Neuroscience Department of Dhaka Shishu Hospital (DSH) over a period of 3 years, from January 2013 to December 2015. A total of 100 patients from 6 months to 15 years of age were purposively selected for the study if they had 2 or more unprovoked seizures occur>24 hours apart. During this period, a 1-year follow-up record of each patient was analyzed. Information on bio demographic data, clinical and developmental assessment done by a multidisciplinary team was analyzed.

Results: A total of 100 children who had epilepsy were included in this study. Unfavorable outcomes (uncontrolled seizures) were found in children < 5 years of age, children from rural areas, and those whose parents' education was below secondary level (p values were 0.05, 0.03, and 0.04 respectively). Also, the unfavorable outcome was found in children who had H/O perinatal asphyxia (PNA), motor problems, and feeding problems (p-value=0.05, 0.002, 0.05 respectively). After 1 year of regular follow-up milestones, development was improved in more than one domain in 51 children. But there was no improvement found or their condition remained unchanged in 49 children.

Conclusion: In this study, we found several sociodemographic factors, associated comorbidities, and poor adherence with treatment are important factors in predicting an unfavorable outcome of children with epilepsy. In this regard, large-scale multicentre studies are required for further evaluation.

The Role of Preoperative Seizure Duration in Postoperative Epilepsy for Patients Undergoing Low Grade Glioma Resection: A Systematic Review

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Introduction: Seizures are an independent risk factor for decreased health-related quality of life in patients living with brain tumors. This is especially true in those with low-grade glioma (LGG), as their epilepsy is often medically-intractable. Many studies don't capture the heterogeneity of presentations for LGG associated seizures, impairing our ability to draw powerful conclusions from such data. We sought to summarize the current literature regarding the impact of preoperative seizure duration on risk of postoperative epilepsy as well as highlighting gaps in the literature.

Methods: We systematically reviewed literature available as of September 2021 through PubMed to identify papers investigating seizure outcomes in adults following LGG resection. We initially identified 252 papers, 37 met the criteria for full-text review. 14 papers were included for final analysis.

Results: Five papers identified a significant relationship between preoperative seizure duration and postoperative seizure freedom. Two papers identified an association between preoperative seizure frequency and postoperative seizure control. Six found an association between type of seizure and postoperative seizure control. There were significant differences in the ways in which duration of seizures was reported between studies. For all studies, the duration range for each cohort was quite large, which may have influenced the analysis.

Conclusion: There is conflicting evidence surrounding the relationship between preoperative seizure duration and postoperative seizure control following resection of LGG. However, much of this conflict may be attributed to heterogeneity of clinical presentation within the population. Thus, there's a crucial need for further analysis of how features such as semiology, frequency, and duration of seizures prior to surgery may predict postoperative seizure freedom.

Stereoelectroencephalography in Patients with Monogenic Epilepsy Syndromes

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Introduction: Genetic testing for adult patients with intractable epilepsy is not currently standard of care. However, it has been suggested that differences in genetic etiology may inform decisions about surgical treatment. There is a paucity of information about patients who undergo SEEG with genetic testing during surgical evaluation.

Case Report/Case History: We present two cases of patients who were found to have monogenic epilepsy disorders while undergoing evaluation with SEEG. Patient 1 is a 35 year-old male with seizure onset at age 14 years, autism, and family history of epilepsy. Semiology of his typical seizure includes head drop, body stiffening, and unresponsiveness when prolonged. Scalp ictal EEG was non-localizing at the onset with evolution over the left hemisphere. SEEG demonstrated independent bilateral temporal, broad neocortical ictal onsets. Genetic testing revealed a UBE3A mutation, indicative of Angelman syndrome, though the patient did not portray this phenotype. Patient 2 is a 21 year-old female with seizure onset at age 2 years, febrile seizures, learning delay, and family history of epilepsy. Semiology of her seizures consists of hyper-motor movements, unresponsiveness, and right versive head turn when generalizing. Scalp ictal EEG showed left temporal clinical and right temporal subclinical seizures. SEEG demonstrated broad ictal onset over the left temporo-parietal region. Genetic testing revealed a PCDH19 mutation, indicative of X-linked early infantile epileptic encephalopathy in females, consistent with her phenotype. Neuromodulation targeting the thalamus was recommended to both patients after SEEG.

Conclusion: For both patients, SEEG showed broad ictal onset, and led to recommendation for neuromodulating therapies instead of resective surgery. Further studies are needed to ascertain the impact of genetic testing in adult patients undergoing SEEG during surgical evaluation.

A Single-Center Retrospective Analysis of Occipital Lobe Epilepsy Surgery Outcomes at Mayo Clinic, AZ

Luca Farrugia; Sara Dawit, MD; Katharine Henry; Rosenow Christian; Richard Zimmerman, MD; Joseph Sirven, MD

Introduction: Occipital lobe epilepsy (OLE) is a rare focal epilepsy characterized mainly by visual symptoms including flashing lights, visual distortions, hallucinations, and ictal blindness. OLE can be refractory to anti-seizure medications (ASMs) and debilitating to patient's quality of life. Reported beneficial non-medication options include vagus nerve stimulation (VNS) and surgical resection. Further characterization of epilepsy surgery outcomes in this patient population are needed. We provide a single center case series characterizing post-epilepsy surgery outcomes.

Methods: This is a retrospective, single center review of patients who presented to Mayo Clinic AZ for neurosurgery from 1998 to 2020. The primary endpoint was seizure freedom at 4, 12, and 18 months. Secondary endpoints include pre- and post surgery ASM quantity and dosing and visual field outcomes.

Results: IRB was obtained prior to retrospective chart review. We identified 781 procedures with 4 patients meeting criteria (1) intractable OLE diagnosis (2) OLE surgery and (3) greater than 1 year of post-op follow up. 75% of the patients had an abnormal MRI and etiologies included bilateral occipital encephalomalacia, occipital focal cortical dysplasia, and occipital glioma. 50% of patients (n=2) reported no seizures at 12 months. The remaining (n=2) experienced notable reduction in seizure frequency and intensity. The average number of pre-op ASMs of 2.5 was reduced to 1.25 at 12 months. 25% of patients (n=1) experienced no change in visual outcomes and 50% (n=2) demonstrated some degree of visual field decline. 100% of patients with VNS (n=2) had improvement in VNS efficacy.

Conclusion: Our case series shows that occipital lobe epilepsy surgery can be associated with favorable post-op seizure-freedom, with 50% of patients reporting no seizures at 12 month follow up and the other 50% reporting improvement in seizure frequency and intensity.

Regional Epilepsy: Case Description and Literature Review

Shreyashish Roy-Chowdhury; Richard S. McLachlan; Ana Suller Marti

Introduction: Introduction: The classification system for epilepsy is primarily based on the spatial distribution of the seizure onset zone (SOZ). Accurate classification of epilepsy is vital for determining the best approach for the treatment and ascertaining prognosis. Currently, regional epilepsy (RE) is defined as having a SOZ that spans more than 5 electrode contacts (>4 cm), identified through intracranial monitorization. The objective of this study is to develop a holistic understanding of the characteristics of RE.

Methods: Methods: Case report presentation of a patient admitted to the Epilepsy Monitoring Unit at the Epilepsy Program at Western University, with RE. In addition, a literature review will assess whether findings regarding RE are consistent.

Results: Results: Case of a 31-year-old female, with medically resistant focal epilepsy. A diffuse epileptogenic zone was seen in her scalp recording at the seizure onset and she was implanted with depth electrodes. Her SOZ was identified over a large area in her left posterior temporal-parietal region. Neural regions including the insula and orbitofrontal cortex have been identified as common onset zones for RE. Regional seizures may demonstrate retention or impairment of awareness commonly seen through focal seizures. RE "syndromes" have been reported as symptomatic or idiopathic and these patients are not candidates for epilepsy resective surgery. Broad neocortical resections are associated with higher rates of seizure freedom but involve a significant risk of postoperative neurologic deficits. Moreover, patients with extensive epileptogenic networks have an increased risk of seizure recurrence after surgery.

Conclusion: Conclusions: Although patients with RE are not good candidates for resective surgery, other treatments need to be evaluated. Further data concerning diagnosis, management, and impact of RE is needed to improve outcomes.

Utility of the Salzburg criteria and the ACNS Standardized Critical Care EEG Terminology, 2021 version for outcome prediction of nonconvulsive status epilepticus

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Introduction: We evaluated the utility of the Salzburg criteria and the ACNS Standardized Critical Care EEG Terminology, 2021 version (ACNS2021) for outcome prediction of nonconvulsive status epilepticus (NCSE).

Methods: Since 2021 January 1, Department of Neurology and Department of Clinical Laboratory in our hospital made an EEG evaluation agreement of NCSE based on the Salzburg criteria. When the EEG of patients with suspicion of NCSE fulfilled more than 6 consecutive rhythmic delta activities (RDAs), epileptic discharges (EDs), or evolving pattern during record, an EEG technologist immediately consulted a board-certified neurologist to decide antiepileptic drug (AED) infusion. Then, clinical/EEG improvement was evaluated. In this study, we retrospectively evaluated the EEG of patients who underwent AED infusion using ACNS2021 and accessed utility for outcome prediction.

Results: 14 patients (4 males, age 78 ± 11.3 years (mean ± SD)) were included. The semiology of 8 patients was NCSE with coma and that of 6 patients was NCSE without coma, focal with impaired consciousness. After AED infusion, 7 patients showed background alpha rhythm, but no patient showed obvious clinical improvement during EEG record. Of 14 patients, 4 patients showed EDs, 12 showed RDAs, and 6 showed evolving pattern (overlapping). According to ACNS2021, 4 patients showed electrographic seizures, 5 showed brief potentially ictal rhythmic discharges (BIRDs), and 5 showed ictal-interictal continuum. Evolving pattern was significantly associated with death outcome ($p=0.023$, Fisher's exact test) , whereas BIRDs showed a tendency to associate with survival ($p=0.086$). Inter-rater reproducibility between a neurologist and an EEG technologist was $\kappa=0.744$.

Conclusion: Evolving pattern based on the Salzburg criteria and BIRDs based on the ACNS2021 were useful to predict outcome of NCSE.

EEG monitoring as a prelude to poly-neuromodulation following suboptimal response to VNS in patients with drug resistant epilepsy

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Introduction: Vagus nerve stimulation (VNS) is approved by the USFDA as adjunctive treatment in children and adults with drug resistant focal seizures (1) but is also used in a wide range of epilepsies. Roughly one-half will remain non-responders following VNS (2). Emerging use of newer neuromodulatory devices (3,4) are increasingly combined with VNS (5). We aimed to identify the use of EEG as a tool to understand the selection of patients with VNS and either RNS or DBS polytherapy.

Methods: We reviewed the Mayo Clinic database in Florida for patients who underwent VNS implantation for DRE from 10/1998 through 8/2021. Review was cross-referenced with industry-held databases. We retrospectively reviewed the EEG reports for patients with VNS and RNS or DBS to identify electrographic patterns of device polytherapy.

Results: 125 patients (67 females) underwent 157 VNS surgeries and battery or lead replacement. DBS was added in 8 patients (6 anterior thalamic; 2 centromedian), and RNS was implanted in 6. Prior to RNS or DBS, all patients underwent long term video-EEG monitoring. The VNS-DBS group more frequently demonstrated generalized IEDs and seizures ($p=0.209$) on scalp EEG. VNS-RNS patients were more likely to have lateralized ($p=0.165$), localized ($p=0.005$), and especially bitemporal ($p=0.055$) seizures on scalp ictal EEG. VNS-RNS patients more frequently underwent invasive EEG ($p=0.026$).

Conclusion: Approximately 10% of patients with VNS were active with DBS or RNS. VNS-RNS patients were more likely to have a localized, lateralized, and/or bitemporal ictal scalp EEG and undergo invasive monitoring. VNS-DBS patients were more likely to have generalized EEG abnormalities. Prospective multi-center studies are needed to assess outcomes using EEG when selecting patients for poly-neuromodulation following a suboptimal response to VNS.

Epilepsy surgery in a neonate: Resection of Right Temporal Neocortical Focal Cortical Dysplasia in a Three-Week-Old Infant

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Introduction: Epilepsy surgery offers opportunity for seizure remission in patients with focal epilepsy refractory to polytherapy. Traditionally, only few patients with drug resistant epilepsy are referred for surgical consideration. The referred patients on average have had epilepsy for two decades or more, leading to seizure related complications. We present our case report of an infant with severe refractory epilepsy, who underwent right temporal neocortical resection for focal cortical dysplasia at day 21 of life.

Case Report/Case History: Baby born at 38 weeks, on day of life 3 had apneic events associated with movements of her mouth and eye deviation to left. EEG showed focal motor seizures originating from right temporal region. MRI Head revealed area of cortical dysplasia in the right middle and inferior temporal gyrus. The seizures were initially controlled but had breakthrough seizures on polytherapy requiring readmission. Risk of ongoing seizures with potential risks of surgery at young age were reviewed by our multidisciplinary team. As resection of the lesion was deemed curative, parents agreed for the procedure. Patient had the surgery: right sided hippocampal sparing temporal neocortical resection on Day of life 21. Patient was monitored post procedure, there were no seizures, so patient was able to wean off phenobarbital and phenytoin. Patient had repeat EEG, 3 weeks post procedure for facial twitching and they were not epileptic. In the past year, patient was able to wean of Topiramate monotherapy with no further seizures with normal development for age. She has SCN1A variant, likely pathogenic.

Conclusion: We present this case to highlight the use of surgical resection in infants with refractory focal seizures, even within the first month of life. Our patient has had a seizure free first year of life, is now on monotherapy, and her development is normal.

Transient, Alternating Hemi-body Paresthesias as ictal manifestations in Leucine rich Glioma Inactivated 1 Encephalitis

Susmit Tripathi, MD; Tahsin Khan, MD; Seyhmus Aydemir, MD; Pegah Afra, MD

Introduction: LGI1 encephalitis is associated with multiple seizure types including faciobrachial dystonic seizures, cognitive decline (CD), behavioral changes & hyponatremia (HN). We present, a case of transient, alternating hemi-body paresthesias(TAHBP) as symptom of LGI1 encephalitis.

Case Report/Case History: At symptom onset (SO), patient experienced focal aware seizures (FAS) with nausea, rising epigastric sensation (NRES), followed in 3-months with cluster of two GTC, treated with levetiracetam (LEV). He had 2 more GTCs (one with unexplained HN 122) which were treated with increasing LEV and lacosamide (LCM) resulting in resolution of GTCs & FAS-NRES. At 6-7-months PO, he experienced FAS with TAHBP (spreading from head/face to right (R), left or bilateral arm/torso/leg), described as uncomfortable, though not painful. They increased in frequency & duration(F&D). At 9-months from SO, CD started. Neuroradiologically at presentation MRI was normal. After his 4th GTC, serial MRIs showed expansile mass in R hippocampus (HC), followed by resolution, development of RHC atrophy, abnormal signal, and then evolution to R MTS. Neurophysiologically: at presentation EEGs were normal. After 4th GTC, vEEG captured multiple FAS-NRES with no apparent electrographic correlate (NAEC). At about 16-17 months amb/vEEGs showed NAEC for numerous FAS-TAHBP, & multifocal (MF) electrographic seizures (ES). At 19 months after SO, CSF showed LGI positive Ab. CT of chest abdomen and pelvis was negative. Steroids followed by IVIG and Rituximab initiated. FAS-TAHBP gradually decreased in F&D and completely abated at 26 months from SO along with amb-EEG showing no ES. Repeat CSF analysis was negative for LGI-1.

Conclusion: Although FAS-MPs were EEG negative, their temporal association with MF-ES and their response to immunotherapy suggests they are another ictal manifestation of LGI1 encephalitis.

Unique Case of Epilepsy Partialis Continua Due To Post SARS COV 19 Neuroimmune Response

Yash Shah, MD, MPH; JoyceE. Villarreal-Bohsain, MD; Muhammad Zafar, MD; Shital Patel, MD

Introduction: We present a case of 10-year-old previously completely healthy boy who has now developed Epilepsy Partialis Continua (EPC).

Case Report/Case History: After an upper respiratory infection in Jan 2021, the patient developed seizures whose semiology was described as feeling dizzy, right eye twitching with right tonic stiffening and shaking with intact awareness. He was in ICU in an outside hospital where he developed intractable super refractory focal epilepsy and failed most anti-seizure medicine treatments including pentobarbital coma and vagal nerve stimulator. During the hospitalization it was found that he had positive SARS-COV-2 IgG antibody. He was subsequently treated with IVIG and Methylprednisolone which only partially helped in treating his seizures. Extensive work up including autoimmune, inflammatory, metabolic, infectious is unremarkable. During his initial brain MRI signal abnormality in posterior and lateral left frontal lobe was seen. He then underwent left parietal craniotomy to remove epileptogenic focus. This sample was subsequently sent for cytology and molecular analysis at Mayo clinic laboratory. Cytopathology showed Non-specific reactive changes and no evidence of neoplasia. Since hospital discharge, the patient has continued to have seizures and now has been referred to our tertiary care center for further management. EEG findings were consistent with EPC due to no electrographic correlate. His latest brain MRI has shown an increase in the masslike T2 hyperintense signal involving the more medial aspects of the left motor strip and posterior aspects of the left superior and middle frontal gyri.

Conclusion: With positive COVID Antibody Titres, negative extensive CSF and serum autoimmune, infectious, metabolic work up, the cause of his EPC can be related to post COVID inflammatory syndrome or COVID related neuroautoimmune condition.

Evaluation of electrocorticographic changes following the reduction of anti-seizure medication in patients treated with the RNS System

Josiah Ambrose, MD; Kenneth Ndyabawe, PhD; Emily Mirro, MS

Introduction: In addition to being an effective treatment for focal epilepsy, the RNS System stores chronic electrocorticography (cEEG) data in the form of detected abnormal activity and electrographic seizures (long episodes). The cEEG data may be beneficial in assessing the efficacy of anti-seizure medication (ASM). We hypothesized that seizure control is no longer dependent on medication effect when a patient is responding to RNS treatment (≥ 50% seizure reduction), and therefore may be inconsequential to clinical seizure reduction and cEEG data recorded by the RNS.

Methods: A retrospective chart review was performed on all RNS System patients that had ASM reductions at Kaiser Redwood City. Epilepsy history, dosage and dates of ASM changes, and clinical seizure frequencies were obtained from the patient charts. Periods of time with stable RNS settings were identified, during which there was a concurrent ASM reduction, and Wilcoxon Signed Rank test for paired comparisons was used to assess differences in daily detections and long episodes 60 days before and after ASM reductions.

Results: 4 patients implanted with the RNS System had undergone reductions of at least 1 ASM. 3 of the 4 patients had 60 days of stable RNS settings for analysis. Results can be found in Table 1. In P3 and P4, there was no worsening of clinical seizures or increase in daily RNS detections with ASM reductions. We assessed hourly detection trends 28 days before and after ASM reduction in these 2 patients. Reduction of ASMs did not appear to modify these patients' hourly detection trends.

Conclusion: In selected RNS System patients, ASM reductions without worsening of clinical seizure frequency, increase in detected cEEG activity, or change in 24-hour cEEG patterns is possible. Data recorded by the RNS may be used to assess the effect of ASM reductions, although further studies are needed.

Seizure freedom in a child with Early Infantile developmental and epileptic encephalopathy (Ohtahara syndrome) with DEPDC5 mutation and focal epilepsy.

Matthew MacDonald, MD; Caitlin Hoffman, MD; Srishti Nangia, MD

Introduction: Early infantile developmental and epileptic encephalopathy (EIEE; Ohtahara syndrome) often has a poor prognosis and is associated with treatment resistant epilepsy and intellectual disability. We describe a 4 year old female who presented at 3 months of age with intractable epilepsy that was found to have a cortical malformation and DEPDC5 mutation.

Case Report/Case History: S.L. was the product of a term uncomplicated pregnancy and without a family history of epilepsy. She presented at 3 months of age with focal seizures. EEG demonstrated a burst-suppression pattern and focal seizures from the right posterior quadrant followed by a cluster of infantile spasms. The patient was on Phenobarbital and Levetiracetam when she was referred to our center. In response to the ongoing seizures and infantile spasms, S.L. was initiated on Vigabatrin. MRI revealed a right parietal focal cortical dysplasia. PET did not identify a corresponding abnormality. Genetic testing was done which found a pathogenic variant of DEPDC5. The patient was reviewed in multi-disciplinary epilepsy surgery conference and the group consensus was to proceed with intraoperative electrocorticography and lesion resection given the concordance of the data. The procedure was uncomplicated. Histopathological analysis of the lesion was compatible with cortical dysplasia 1a. The patient was weaned off all anti-seizure medications and continues to be seizure free over 3 years later. S.L. has thrived developmentally and at 4 years of age has met all milestones. Formal neuropsychological testing is pending.

Conclusion: This case report is significant in that patients diagnosed with EIEE are associated with a grave prognosis and are not thought to be good surgical candidates, yet this patient achieved seizure freedom and normal development. This finding indicates the need to pursue a full surgical workup for patients with this diagnosis, and potentially additional genetic epilepsy syndromes, to ensure the best possible functional outcome.

EPILEPSY: PATHOPHYSIOLOGY

Wearable device recordings inform cycles of seizure risk

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Introduction: Daily (circadian) and multiday (infradian) cycles of seizure risk are common features of epilepsy. Multiscale cycles in noninvasively measured physiology may inform seizure risk via brain state, behavior, endocrine, and autonomic interactions.

Methods: Ten individuals had concurrent monitoring with an implanted responsive neurostimulator (NeuroPace RNS) and a wrist-worn device (Empatica E4). Physician defined RNS detectors quantified interictal epileptiform activity (IEA) and electrographic seizures (epileptologist visual confirmation). The wearable device measured heart rate (HR), HR variability (HRV), accelerometry (ACC), tonic and phasic electrodermal activity (EDAt, EDAp), and temperature (TEMP). Time-frequency and phase analyses used the continuous wavelet transform (Morlet) and filter-Hilbert method (non-causal filters). Significant cycles had amplitude greater than the 95% of normally distributed white noise. Circular statistics assessed seizure phase locking to circadian and infradian (weekly – monthly) cycles per signal. Statistics used a 0.05 significance level; seizure phase locking was Bonferroni corrected.

Results: The average recording duration was 237 days. Eight subjects had reliable seizure detections (range 20 – 239 seizures). Circadian cycles were observed in 9 (IEA), 9 (ACC), 10 (HR), 10 (HRV), 10 (TEMP), 9 (EDAt), and 7 (EDAp) subjects. Seizure phase locking to circadian cycles occurred in 7 (IEA), 6 (ACC), 7 (HR), 6 (HRV), 5 (EDAt), 4 (EDAp), and 6 (TEMP) subjects. Infradian cycles were observed in all subjects for all signals. Seizure phase locking to infradian cycles occurred in 7 (IEA), 4 (ACC), 4 (HR), 3 (HRV), 3 (EDAt), 4 (EDAp), and 7 (TEMP) subjects.

Conclusion: We provide evidence of seizure phase locking to noninvasively measured circadian and infradian physiological cycles. This work has implications for noninvasive seizure risk forecasting and chronotherapy.

Uncommon Presentation of Pediatric Epilepsy in Non Lesional Brain MRI Tuberous Sclerosis Patient

JoyceE. Villarreal-Bohsain, MD; Yash Shah, MD, MPH; Muhammad Zafar, MD

Introduction: We present a case of 5-year-old boy with diagnosis of Tuberous sclerosis complex (TSC) due to TSC1 gene mutation. Focal epilepsy in his case was localized by EEG in left temporal region but with non-lesional brain MRI. This leads to consideration that in these patients there may be an important connectomic dysfunction or microtubular mechanisms in addition to an already known structural lesions.

Case Report/Case History: Patient started seizures at the age of 2 year, with focal unaware to secondary tonic-clonic seizures. The latest Brain 3 Tesla MRI with and without contrast with epilepsy protocol showed in a single area of enhancing subependymal nodule (5mm) in posterior aspect of the left lateral ventricular body with calcification on SWI/ phase sequences. This was unchanged in comparison to the prior examination. There is no evidence of subcortical tubers or radiological bands. During his EMU admission, there were 4 events, consisting of seizure originating from left temporal region. Typical events were out of sleep, with arousal, eyes opening with vocalization, this followed by behavioral arrest. Electrographic onset was better evolved on left temporal leads with spike and wave discharges over left F7-T3 electrodes. Also, with an asymmetric photic driving that better seen over the right hemisphere, indicates that it is a possible area of left focal cerebral dysfunction. He has failed multiple seizure medications.

Conclusion: Recent evidence has linked perituberal, or network connectomics as a possible source of seizures in TSC in non-lesional MRI cases. We present this uncommon case presentation as one such case where it could be possible that microtubers (Perituberal giant cells and astrocytes) and cytomegalic neurons in peritubular parenchyma may serve as the source of seizure in TSC. Also, this could explain possible surgical failure in these cases.

Epilepsy Surgery in Fraternal Twins: Stereo-EEG, Genetics, Pathology and Outcomes

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Introduction: Two twin brothers were among 233 stereo-EEG (SEEG) implantations at our center. We aim to demonstrate the SEEG and genetic findings in fraternal twins.

Case Report/Case History: Both brothers had autism, pharmacoresistant focal epilepsy, normal brain MRI and PET, symmetric Ictal SPECT. Their seizures were characterized by unresponsiveness followed by left face side clonic jerks, and rare generalized convulsions. Onset of seizures for Twin A was at 13 years, and 4 years with Landau-Kleffner syndrome for Twin B. On scalp EEG, Twin A had right temporal seizures while Twin B had independent bitemporal seizures. During SEEG evaluation, both twins had focal right temporal neocortical ictal onset (right superior temporal sulcus for Twin A, and right middle temporal gyrus/temporal pole for Twin B). Epilepsy multigene panel of Twin A showed one pathogenic variant in WWOX gene and independent variant of uncertain significance (VUS) in WWOX, PIGG, MOCS1, KCNC1, CNTNAP2 genes. Twin B demonstrated VUS in WWOX, CNTNAP2 and CACNA1 genes. Twin A underwent right temporal neocortex resection (normal pathology) and is seizure free during 3 years. Twin B underwent right anterior temporal lobectomy (pathology: heterotopic neurons) and right frontal topectomy (normal pathology) but continued to have seizures. On repeat SEEG, the ictal onset was localized to the right temporal lobe resection edge, therefore his right temporal lobectomy was extended, and his seizure frequency decreased.

Conclusion: This is the first descriptive report of the SEEG evaluation results in fraternal twin brothers. This case demonstrates epilepsy phenotype (including SEEG findings) and details the similarities and differences in particular as it relates to genetic epilepsy. Larger studies are needed to create guidelines for the role of genetics in epilepsy surgery candidates and to determine the role of SEEG evaluation in patients with presumable genetic epilepsy.

REM Sleep Patterns in Epilepsy

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Introduction: Sleep dysfunction in people with epilepsy (PWE) may relate to co-morbid sleep disorders or seizure control. PWE have less efficient sleep and notably shorter rapid eye movement (REM) sleep. Interictal discharges are hyper-synchronized in non-REM sleep (NREM) but limited in field and less frequent in REM. Seizures tend to arise from sleep transitions and NREM instead of REM. The direction of interaction between REM sleep and seizure incidence is unknown. In this study, we explored this relationship in a small cohort at an academic medical center.

Methods: We reviewed sleep EEG records in patients with multi-day admissions at the NIH from 3/2021 – 7/2021. Data on primary sleep period, REM latency, REM quantity, NREM quantity, total sleep time, wakefulness after sleep onset, and arousal frequency was collected. Time and duration of all electro-clinical seizures, and demographic and epilepsy details were recorded. Sleep efficiency was calculated. REM characteristics were compared descriptively across nights based on seizure occurrence. Statistical significance was deemphasized for these exploratory investigations.

Results: Cohort included 7 patients (average age 44 years [range 22 – 70]; 5 males) with primary diagnosis of focal refractory epilepsy (average age of onset 31 years [range 7 – 66]). REM quantity was reduced among those with seizures occurring in same night compared to those that did not (median 37 minutes [Inter Quartile Range, IQR 34-65] vs 59 minutes [IQR 46-79]). Reduced sleep efficiency was observed in those who experienced nocturnal seizures (median 69 [IQR 63-90] vs 89 [IQR 83-95]). No significant trend was identified for REM when seizures occurred 24 hours before or after evaluation.

Conclusion: Our preliminary analysis indicates a notable change in REM incurred by nocturnal seizures. However, further investigation in a larger group of PWE is necessary to identify whether REM can serve as a biomarker for seizure occurrence.

EVOKED POTENTIALS

Fraction of theta power correlates with temperature and SSEP amplitude in Aorta Surgeries

Sung-Min Park, MD, PhD; Inna Keselman, MD, PhD; Marc R. Nuwer, MD, PhD

Introduction: EEG and SSEP are frequently combined for neuro-monitoring and prognostication. Despite their widespread use, no clear quantitative relationships have been established between the two. Here, we use data from aortic surgeries, which employ cooling—a known modulator of both EEG and SEP—to determine quantitative relationships.

Methods: Observational data from 30 patients, comprising of 1235 SSEPs, were analyzed. Normalized SSEP cortical amplitudes were compared against time-matched, normalized, spectrally analyzed EEG.

Results: SSEP cortical amplitudes correlated well with the fraction of theta content of the time matched EEG. Using multivariable regression on a subset of data, the fraction of theta appeared to provide an independent contribution to the cortical amplitudes than reported temperature alone.

Conclusion: There may be shared neural generators between fronto-central theta rhythms and cortical evoked potentials. In conjunction or alternatively, the fraction of theta power may better reflect the CNS temperature than the recorded core temperature.

Measuring Neuronal Loss in Multiple Sclerosis: Role of Evoked Potentials

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Introduction: Multiple sclerosis (MS) is an inflammatory disease of the central nervous system (CNS) characterized by demyelination and axonal loss. The ongoing process of neurodegeneration in MS can be detected from the beginning of the disease and seems to be responsible of the progression in MS. By now, we just have clinical scales like the Expanded Disability Status Scale (EDSS) for measuring progression. It is of crucial importance to find markers of progression that should be quantitative, objective and easy to implement. The aim of this study was to investigate correlations between clinical measures of disability progression and objective functional measures such as evoked potentials (EP) and optic coherence tomography (OCT) measures a; and determine which objective measure correlates better with clinical progression, at one point and after 10 years of evolution.

Methods: This is a prospective transversal study of the basal multimodal EP and OCT measures of 95 MS patients with a longitudinal clinical follow-up of 10 years.

Results: In our study, EPAS scale correlated very significantly and strongly (r=0,8) with basal EDSS and after 10 years of evolution, being the strongest variable associated with progression of EDSS >4. If one EP modality should be chosen to improve our prognostic ability in the investigation of patients with established multiple sclerosis, this seemed to be the MEP, either the CCT or amplitude ratio for upper or lower limbs that has also a very good AUC (AUC=0,8 for EDSS >4 and 0,6 for worsening of EDSS after 10 years), while OCT measures didn´t showed neither a similar correlation nor an AUC for clinical progression of the disease.

Conclusion: EP measures, and particularly MEP measures, including MEP amplitudes, have a very accurate potential role in measuring neurodegeneration and as a biomarker of progression in MS

FUNCTIONAL IMAGING

FNIRS Assisted Study of Cortical Hemodynamic Alteration in Cerebrovascular Accident: A Case Report

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Introduction: One of the major concerns for people suffering from cerebrovascular disease is their quality of life. Apart from the physical difficulties, stroke also impacts higher functions such as memory, language, attention etc. These cognitive abilities are important for the person to have a healthy quality of life. We studied brain blood flow changes in a subject suffering from stroke using functional near infrared spectroscopy (fNIRS).

Case Report/Case History: A 67-year-old male presented with complaints of sudden loss of balance, slurring of speech, deviation of face and loss of voluntary movements on left side. An fNIRS study was performed with 8 pair source-detector prefrontal montages. Oxygenated (HbO) and deoxygenated haemoglobin (HHb) level was assessed in two conditions, one an awake and alert condition and other an altered sensorium condition. The subject was awake and talking and in between passed into a state of altered sensorium, only to again become alert. The changes in (HHb), (HbO) and total haemoglobin concentration was studied for 15 seconds in two phases. Data was analysed by Wilcoxon signed rank test. The result shows Statistically significant change in HbO concentration in both the conditions in phase I ($p= 0.042$) and phase II ($p=0.017$). In phase II there was inconsistent change in HbO in awake condition (0.68 ± 5.24) but there was an increase (12.5 ± 7.54) in the altered sensorium condition.

Conclusion: The results demonstrate that increased cognitive load in stroke leads to fall in HbO concentration. This may be due to changes in haemodynamics of patient suffering from cerebrovascular disease.

Functional Parcellation of the Cingulate Gyrus in Epilepsy Surgical Planning: Electrical Stimulation, Electrocorticography, and fMRI.

Rawan Mahgoub, MBBS; Ayse Bayram, MD; Rafeed Alkawadri, MD

Introduction: The CG is n intriguing brain structure located above the corpus collosum. It's recognized as a part of the limbic system and it plays many important roles. In recent years, emerging evidence from imaging modalities, supported by findings from ECS helped us understand it better. Our aim is to conduct a systemic review of electrical cortical stimulation (ECS) studies to functionally parcellate the cingulate gyrus (CG).

Methods: We conducted a systematic search using PubMed for studies which investigated the CG by using ECS. We identified 29 studies that met our inclusion criteria. We then evaluated the ECS responses across the cingulate subregions and summarized the reported findings. Statistical analysis was performed by using SPSS version 26.0.

Results: We included 29 studies (total 887 patients, mean age was 31.8 ± 9.8 years). The responses elicited from the CG were as follows: simple motor (7 studies, 24.1%), complex motor (10 studies, %34.4), gelastic without mirth (4 studies, 13.7%), gelastic with mirth (1 study, 3.4%), somatosensory (9 studies, 31%), autonomic (6 studies, 20.7%), psychic (8 studies, 27.6%), and vestibular (2 studies, 6.9%). The former two studies also reported visual and speech responses. Despite some overlapping, the ECS results show that the anterior cingulate cortex (ACC) is responsible for the majority of emotional, motor and autonomic responses, while the majority of complex motor behaviors are controlled by the middle cingulate cortex (MCC), and the posterior cingulate cortex (PCC) is the principle regulator of visual responses in addition to being involved in a variety of other responses.

Conclusion: our results will provide a segmental mapping of the functional properties of the CG and can improve the precision of epilepsy surgical resections.

NEUROPHYSIOLOGIC INTRAOPERATIVE MONITORING

Intraoperative Neurophysiological Monitoring In Latin America: A Bibliometric Analysis

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Introduction: Intraoperative Neurophysiological Monitoring (IONM) has been used worldwide to prevent postsurgical neurological deficits, however, most of the publications are from developed countries. Bibliometric analysis recognizes patterns of publications and productivity in scientific research. There is a global bibliometric analysis of IOMN in spinal surgery, however, the contribution of Latin America (LA) is not mentioned. The aim of this study is to describe scientific productivity, patterns of publications, and thematic trends of IONM in LA.

Methods: Data was collected using Scopus database, by searching scientific articles with LA affiliation, using 18 keywords. We excluded duplicates, not original articles, reviews, surveys, and articles not related to humans. Articles were analyzed and classified as follows: year of publication, language of the original document, journals metrics, country, IONM modality, etiology, location of surgery, medical specialties, and prevention of neural damage. Descriptive statistics were used.

Results: We obtained 8,699 scientific articles of which 46 scientific articles from 7 LA countries were selected. Mexico has the highest number of publications. In most countries, supratentorial location showed the highest frequency. Somatosensory evoked potentials and electrocorticography were the most performed modalities. Neurosurgery was the most involved specialty of our 46 scientific articles, and 95.6% of these publications concluded that IONM prevented neural damage during surgery.

Conclusion: Mexico and Brazil have led IONM publications in LA. The lower reference in publications of visual evoked potentials and brainstem auditory evoked potentials IONM modalities, could be considered in the future to boost tailored research in LA.

Clinical outcomes associated with electrophysiologic isolation of ulnar nerve fascicles innervating flexor carpi ulnaris in Oberlin nerve transfer surgery

Felix Chang, MD; Thomas Hirschauer, MD, PhD; Viet Nguyen, MD; Scheherazade Le, MD; Leslie Lee, MD; S. Charles Cho, MD; Thomas J. Wilson, MD; Jaime R. López, MD, FACNS

Introduction: Oberlin nerve transfer is a surgery in which a donor ulnar nerve fascicle is transferred to the biceps branch of the musculocutaneous nerve in order to restore elbow flexion. Transferring a fascicle which predominantly or solely innervates the flexor carpi ulnaris (FCU) may be beneficial for risk reduction, as the FCU is functionally less important compared to the loss of ulnar-innervated intrinsic hand muscles. We previously described an intraoperative technique to help identify fascicles innervating the FCU. We now describe the clinical outcomes of that cohort of patients.

Methods: Between 2018 and 2021, 14 cases of Oberlin nerve transfer were reviewed. FCU fascicle isolation status was noted. Clinical notes were reviewed for the strength on exam by the Medical Research Council (MRC) grading scale at baseline and follow-up. Cases where it was not possible to perform a detailed strength exam, such as in infants or in telemedicine visits, were fully excluded (n=5). Some patients (n=3) were partially excluded from analysis, as they were lost to follow up or have not yet had 12 months elapse from their surgery.

Results: The overall median biceps strength pre-operatively was 0/5 (range 0-1). The overall median biceps strength was 4/5 (range 2-4) at approximately 12 months. The median biceps strength at 12 months between the FCU-isolated (n=3) and non-isolated group (n=3) was 4 vs 4. The low number of patients prevented statistical analysis. Strength in the FCU, flexor digitorum profundus (4th and 5th digits) and ulnar-innervated hand intrinsic muscles was unchanged in all patients from pre- and post-operative exams.

Conclusion: The transfer of ulnar nerve fascicles innervating FCU versus other ulnar nerve fascicles did not result in a difference in long-term biceps strength and had no effect on FCU or intrinsic hand strength.

Frequency and characteristics of bite injuries associated with transcranial motor evoked potentials (tcMEPs) over ten years at a single institution

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Introduction: Bite injuries are rare, with a reported incidence of 0.19-0.63% but represent one of the most common complications of tcMEP monitoring. These injuries can lengthen hospital stay and sometimes require repair. Here we report the frequency and characteristics of bite injuries at our institution.

Methods: A retrospective review of 13,741 consecutive cases with intraoperative neuromonitoring from 01/2011 to 05/2021 in a single institution's database was performed. Diagnosis codes and text search for oral, tongue, or teeth injuries were used to screen for potential cases of bite injury. Clinical notes were then reviewed to determine if the injuries were related to tcMEPs. Patient demographic data, positioning, bite block characteristics, case duration, clinical notes, and stimulus intensity were reviewed.

Results: Of 11,782 cases where tcMEPs were utilized, a total of 7 bite injuries related to tcMEPs were identified. Three patients required repair of tongue lacerations with sutures. All patients with bite injuries had surgery performed in a prone or lateral position. All patients had bite blocks placed. The type of bite block was not recorded consistently, but both hard and soft bite blocks were used during this time period. The bite block was documented as having remained in place in 3 cases. The average maximal stimulation intensity in cases with bite injuries was 452 volts (SD 138) and 864 milliamps (SD 337), with 1 case utilizing maximal stimulation.

Conclusion: The rate of bite injuries in this series was 0.06%, less frequent than in previous publications, though the search strategy was biased towards finding only more serious injuries, where a diagnosis code was entered. These injuries mostly occurred at submaximal stimulation, in non-supine positions, and none appeared to result in any long-term complications.

Cerebral Hypoperfusion Detected during Awake Balloon Test Occlusion (BTO) by Intra-operative Neurophysiologic Monitoring (IONM)

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Introduction: It is not uncommon that endovascular BTO is performed to assess collateral blood flow and risk of injury of permanent occlusion of the internal carotid artery (ICA).

Case Report/Case History: 56-year old Cantonese-speaking woman with nasopharyngeal carcinoma underwent awake endovascular BTO of the right ICA. MRI showed a 2.4cm right nasopharyngeal mass extending to the hypoglossal canal, abutting the proximal right carotid structures without vascular abnormalities. Baseline exam was intact. Baseline 8-channel EEG and upper SSEPs were well-formed and symmetric. Serial neurologic exams were conducted through a phone interpreter. Mean arterial pressure (MAP) before BTO was 95 and was dropped to 60-70 during the BTO to stress collateral perfusion. Immediately after the balloon was inflated in the right ICA, the EEG showed diffuse, high amplitude, rhythmic 1.5-2Hz delta slowing. Four minutes after inflation, the patient had dizziness and difficulty following commands. The balloon was deflated 5 minutes after occlusion, EEG slowing resolved 7 minutes after deflation, and the patient returned to baseline neurologic status. It was deemed that she would not tolerate an ICA sacrifice during resective surgery because of the failed BTO.

Conclusion: This case reinforces the need for vigilant IONM throughout the procedure, and the benefit of multi-modality monitoring. Awake monitoring with serial exams is the gold standard to detect neurologic deficits. However, the patient's deficits of mild altered mental status were more difficult to discern due to the language barrier. The IONM team was able to confidently report changes because EEG showed an abrupt onset of diffuse slowing even though she only exhibited mild encephalopathy. There were no intracranial vascular abnormalities, therefore, it is likely that the diffuse EEG slowing was provoked by cerebral hypoperfusion with lower MAPs.

Usefulness of the Lateral Spread Response During Facial Nerve Microsurgical Decompression In Hemifacial Spasm.

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Introduction: Hemifacial spasm (HFS) is a disorder characterized by paroxysmal and involuntary twitching of facial muscles of one side of the face innervated by the ipsilateral facial nerve. It commonly produces a high psychological impact in the patient. The most frequent etiology is the nerve compression by a blood vessel around the root exit zone. Currently microsurgical decompression is the most accepted technique. Lateral spread response (LSR) recording allows us to prove the nerve hyperexcitability before surgery and to monitor the correct decompression of the nerve during surgery.

Methods: We present 2 patients with HFS confirmed by a preoperative neurophysiological study, who underwent microsurgical decompression. In both patients, multimodal intraoperative neurophysiologic monitoring (IONM) was performed, including LSR study.

Results: The first patient is a 51 year-old man with a 2-year-evolution left HFS. Magnetic resonance imaging (MRI) showed a left vertebral artery dolichoectasia. The second patient is a 69 year-old woman with a 9-year-evolution right HFS. MRI did not clearly show a facial nerve compression. In both cases, effective decompression was confirmed with the disappearance of the pathological response, and the postoperative evolution was favorable.

Conclusion: HFS can be extremely disabling for the patient, being the surgical treatment the only permanent solution. RLS recording allows not only to diagnose this condition before surgery, but also to confirm the complete resolution of the compression during the procedure, helping to predict a good outcome.

Multimodal Intraoperative Neurophysiologic Monitoring for the Detection of Cerebral Ischemia During Carotid Endarterectomy

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Introduction: Carotid endarterectomy (CEA) reduces the risk of stroke in patients with symptomatic carotid artery stenosis. Studies show that a selective use of carotid shunting based on intraoperative neurophysiologic monitoring (IONM) can lead to better clinical outcomes. Continuous EEG has been the mainstay of CEA monitoring, while the addition of somatosensory evoked potentials (SSEPs) results in higher detection rates of post-clamp cerebral ischemia. The degree to which monitoring of additional modalities, such as transcranial motor evoked potentials (MEPs), further improves detection of ischemia has not been systematically studied.

Methods: We retrospectively reviewed data from patients who underwent CEA from 2010-2020 under general anesthesia with multimodal IONM that included EEG, SSEPs, and MEPs. Study endpoints included IONM changes (in one or more modality) following carotid cross-clamping, IONM changes at other times of the procedure, and the need for shunt placement.

Results: During the 11-year study period, a total of 254 patients underwent 274 CEAs with multimodal IONM that included EEG, SSEPs, and MEPs. Of these CEA cases, 36 (13.1%) were reported to have IONM changes following cross-clamping and 29 (10.6%) required shunt placement. Four cases (1.4%) had IONM changes at other times of the procedure. Of the cases with post-clamp IONM changes, 9 (25.0%) had changes in EEG, 33 (91.7%) in SSEPs, and 13 (36.1%) in MEPs. Most (52.8%) had changes in only one modality: 16 cases (44.4%) exhibited isolated SSEP changes, 2 (5.6%) had isolated MEP changes, and only 1 (5.3%) had isolated EEG changes.

Conclusion: Multimodal IONM with the inclusion of MEP monitoring identified 2 additional cases with post-clamp IONM changes, which otherwise would not have been detected. This resulted in a 5.9% increased detection rate and corresponded to a number-needed-to-monitor of 137.

In Search of Motor Sulcus: An Interesting Epilepsy Surgery Case

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Introduction: In this case report, we discuss the case of 8-year-old girl with refractory epilepsy who underwent extensive medical and surgical work up including stereotactic epilepsy surgery (SEEG) and Grid, strip and depth electrodes placement. Functional MRI, cortical stimulation for language, somatosensory evoked potential, intraoperative cortical sensory evoked potentials, and direct cortical motor stimulation were carried out to determine motor and language functions. However, motor cortex was not localized to anatomical motor sulcus.

Case Report/Case History: Patient started having seizures since the age of 6.5months, which included multiple seizure types. Her current most bothersome seizures which started 2 years back includes arousal from sleep with repetitive hand movements with posturing and occurs multiple times per night. She has failed multiple anti-seizure medication. Phase 1 EMU monitoring showed seizure onset zone in left frontal region with rapid spread. This was confirmed during SEEG monitoring. No language or motor deficit was noticed during bedside cortical stimulation. To confirm this, she underwent repeat invasive monitoring with subdural grids along with additional depth electrode to cover frontal and part of temporal cortex and insula. Seizure onset zone was localized to anterior frontal region with broad spread. No motor deficit was noticed during bedside mapping. During intraoperative cortical stimulation of all the frontal lobe grid electrodes, no EMG response was noted in contralateral muscles in face, arm and leg. The decision was made to preserve posterior margin during surgery that corresponds to anatomical motor cortex, even though no response was noticed. She did well postoperatively and seizure free for 3 months without any deficit.

Conclusion: Epilepsy starting in earlier age, can affect eloquent cortex reorganization. This case also illustrate need for more standardized and novel noninvasive mapping tool in children.

Non-convulsive Status Epilepticus: Electro-clinical Features, and Prognosis in a Developing Country, Mexico.

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Introduction: There is a lack of clinical and epidemiological knowledge about the non-convulsive status epilepticus (NCSE) in developing countries. Mexico had the highest prevalence of epilepsy in Latin America and is urgent to know this information. The aim of the study is to describe the electro-clinical findings and outcomes of NCSE in a third-level center in Mexico.

Methods: We conducted a retrospective case-series study (2010-2020) that included 134 patients (≥ 15 years old) with NCSE according to the modified Salzburg NCSE criteria 2015 with at least 6 months of follow-up. We extracted clinical data (age, sex, history of epilepsy, antiseizures medications, clinical manifestations, triggers, and etiology), EEG patterns of NCSE and outcome. Descriptive statistics and multinomial logistic regression were used.

Results: 134 patients were analyzed; 55% females, mean total age was 39.5 years and 70% had a history of epilepsy. Altered state of consciousness was found in 82% (including 27.7% in coma) followed by neuropsychiatric manifestations in 5.2%. The generalized NCSE pattern was the most common (32.1%). The NCSE etiology was mainly idiopathic (56%), followed by neuro-infection in 22.4%; and previous uncontrolled epilepsy was the trigger in 58% of patients. The clinical outcome was remission with clinical improvement in 54.5%. Multinomial logistic regression showed that the patient's age ($p=0.04$), absence of comorbidities ($p=0.04$), history of perinatal hypoxia ($p=0.04$), absence of clinical manifestations ($p=0.01$), coma ($p=0.03$), and absence of generalized slowing in the EEG ($p=0.001$) have a significant effect on the prognosis ($p < 0,001$).

Conclusion: Age, history of perinatal hypoxia, coma, and focal EEG pattern influence the prognosis of the NCSE.

PERIPHERAL NEUROPHYSIOLOGY

Serial electrodiagnostic studies in three patients with Brentuximab vedotin-induced peripheral neuropathy with features of demyelination

Ashley Weng, MD; Xi Chen, MD

Introduction: Brentuximab vedotin is CD30-directed antibody-drug conjugate currently FDA-approved for the treatment of relapsed Hodgkin's lymphoma and systemic anaplastic large cell lymphoma. One of the most common adverse effects associated with brentuximab vedotin is the development of peripheral neuropathy, which is commonly described as a sensory-predominant axonal neuropathy.

Case Report/Case History: We describe three patients who were diagnosed with Hodgkin's lymphoma and were treated with Brentuximab vedotin. All three patients developed significant motor-predominant sensorimotor peripheral neuropathy after initiation of Brentuximab vedotin and was not able to complete treatment. Serial electrodiagnostic studies were done to characterize and assess the degree of neuropathy. Nerve conduction studies showed reduced amplitudes consistent with an axonopathy as well as decreased conduction velocities typically a feature of demyelination. The three patients showed varying degrees of recovery.

Conclusion: Brentuximab vedotin-induced peripheral neuropathy may present as a motor predominant sensorimotor polyneuropathy with features of both axonopathy as well as demyelination on electrodiagnostic studies.

SLEEP

Infrequent "Parasomnias and parasomnias-like" events.

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Introduction: Parasomnias are sleep disorders characterized by experiences, behaviors or automatic responses that arise from sleep. We present 4 cases that highlight the need to consider parasomnias when evaluating patients with unusual sleep related complaints.

Case Report/Case History: 1. A 51-year-old female presents for follow up with diagnosis of insomnia that didn't respond to melatonin. Zolpidem was started at 5 mg at bedtime and later increased to 10 mg due to lack of respond. 2 months after she complaint of a 5 kg weight gain. She also reported waking up to find misplaced dishes in the kitchen, the fire on the stove turned on. A zolpidem related sleep eating disorder was diagnosed. Zolpidem was discontinued and symptoms resolved. 2. A 46-year-old man was seen in the clinic as part of a judicial investigation for sexual harassment. He works as a security officer. He works 12 hours night shifts. He sleeps 8 hours during the day when he is doing night shifts. He feels sleep is non-restorative. Polysomnogram (PSG) showed an Apnea-Hypopnea Index of 26.6 episodes per hour. He was diagnosed with obstructive sleep apnea and sexsomnia. 3. A 74-year-old man was seen due to episodes of abrupt awakening at night with an intense sensation of fear and tachycardia. These episodes happened about 3-5 times a week, for the last 30 years following a traumatic event. Clinical diagnostic of nocturnal panic attacks was made. 4. A 63-year-old woman was seen with complaints of nocturnal episodes of uncomfortable sensations on her clitoris. She described the feeling as an electric or pinching sensation that starts around her clitoris and radiates to the thigs. The sensation diminishes when standing up and walking. Clinical diagnoses of possible persistent genital arousal disorder was made.

Conclusion: Parasomnias can present with unusual complex complaints and behaviors. These presentations are rare. A high level or suspicion is required to make the appropriate diagnosis.

'Nap' As A Power Booster for Problem Solving Skill: A Polysomnographic Study Among Young Adults

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Introduction: Sleep is vital to ensure normal human cognitive performance and cognitive enhancement. It has been found that not only sleep but even a short-term nap can have some enhancing effect upon different aspects of human cognitive performance. Present study is an attempt to assess whether sleep has any role in problem solving skills or not and if yes, which sleep stage is more involved in logical problem-solving capabilities.

Methods: Sixty-eight healthy volunteers of the age group 18 to 24 years of age have been recruited for the study after due ethical clearance from the Institutional Ethical committee. As a test protocol, all the participants including both case and control group were given a standard set of SUDOKU with graded difficulty levels. Each group participants were given 10 min. to 12 min. for each level. All the sleep study parameters were recorded, and comparison was made between control and test group whether they are able to solve the given task and whether any of sleep stages that is slow wave sleep and REM sleep have any role to play in problem solving abilities.

Results: Results showed that the test group volunteers have shown better performance in the problem solving and completing the task in comparison to the control group individuals. Both slow wave sleep group individual's chi square value of 14.41 and P= 0.0001) and REM sleep group individuals (chi square value of 8.988 and P= 0.002) have shown significant difference when compared to the control group individuals for completion of task in time.

Conclusion: The daytime nap has shown significant improvement in the problem-solving skill in comparison to wakeful rest. Both slow wave sleep as well as REM sleep during the daytime nap has shown significant impact upon the uncompleted numerical logical tasks suggesting nap being a useful behavior for cognitive enhancement.

Local Sequential NREM/REM Sleep Cycle Arousability

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Introduction: Sleep is increasingly recognised as a local process. The interaction with epilepsy and sequential sleep cycling is unknown. Therefore, we used a novel measure of sleep depth known as the odds ratio product (ORP) over high density recording in EMU patients.

Methods: Modified ORP was calculated for 10-10 EEG using average of TP9/TP10 from 15 patients over 1-3 nights. We used mORP from NREM (N1-3) vs. REM segments in each person's night(s) with varying number of data points per sleep segment(s) in each night(s). For variable numbers of nights/segments per patient, GEEQBOX yielded a Generalized Estimating Equation (GEE) with beta (β) values representing change in nightly sleep depth over sequential NREM/REM segments per patient. Significance was $p \leq 0.000833$ (Bonferroni correction, 60 electrodes). β was assessed hemispherically and antero-posteriorly to calculate indices where values above 1 denoted left/frontal predominance respectively.

Results: 12/15 adults have epilepsy [2 generalized, 5 left, 3 right, 2 bilateral foci]. For REM in epilepsy, average β index was left (1.9264, 87% of homologous electrode pairs) and frontal (1.4533, 82.4%). For REM non-epileptic, average β index was slightly right (0.9059, 71.4%) and frontal (1.7134, 91.3%). For NREM in epilepsy, average β index was slightly right (0.9618, 63.3%) and frontal (1.4102, 95.8%). For NREM non-epileptic, average β index was right (0.6164, 88.9%) and slightly posterior (0.928, 73.3%).

Conclusion: Using mORP, we show that spatially the brain can wake up differently over sequential sleep cycles. During REM in epileptic persons, arousability over the left hemisphere selectively increased over sequential sleep cycles despite a variety of generalized and focal epileptogenic localizations. However, comparing front-back instead of side-side, arousability is more prominent anteriorly. These findings add an additional level of complexity of the bidirectional relationship between sleep and epilepsy.

VIDEO-EEG MONITORING FOR EPILEPSY

Most outpatient EEG's are inadequate to detect new onset epileptic spasms

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Introduction: Epileptic spasms (ES), are typically seen in children between 2 months and 2 years of age. Due to poor inter-rater reliability in diagnosing hypsarrhythmia on EEG, diagnosing ES is the main objective to start appropriate treatment. Hence, ILAE has proposed using the terminology of Infantile Spasms Syndrome, instead of West Syndrome. Overnight video EEG monitoring is recommended for diagnosis of ES, in order to capture ictal events and all stages of sleep. However, many centers are unable to offer overnight video EEG monitoring and rely on routine EEGs for initial diagnosis of ES.

Methods: We consolidated the ES program at our institution in early 2020 and required inpatient overnight video EEG monitoring for all patients who were suspected of having ES. A total of 44 patients were identified from January 2020–May 2021 who were diagnosed with new onset ES and underwent inpatient work-up and treatment. EEGs were retrospectively analyzed and the time to the detection of first ES was reviewed. Etiology, age of onset of symptoms, time from onset of ES to the EEG monitoring and prior routine EEG within 48 hours of admission were noted.

Results: The mean time from the start of the video EEG monitoring and the first ES detection was 188.36 minutes, with a standard deviation of 236.11. 95% confidence interval was between 117 and 260 minutes. There was no correlation between the duration of symptoms and etiology and the time needed to detect the first spasm on EEG. Routine EEG's were obtained in 10 out of 44 patients (22%) in 48 hours prior to VEEG monitoring. Of these 10 patients, only 2 (20%) EEG's captured ES.

Conclusion: Routine EEGs are not sufficient to diagnose ES in most patients. If inpatient overnight VEEG monitoring is not possible, then 4-5 hours of outpatient EEG with video should be done in patients suspected of having ES, instead of routine EEG's.

Television-induced Electronegative Photoparoxysmal Response: An extratemporal seizure mimic?

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Introduction: Photic-induced responses are of increasing relevance given the ubiquity of screens and other light-emitting electronics in our daily life. One of these, the photoparoxysmal response (PPR), is a frequent finding in photosensitive patients with genetic generalized epilepsies. We report a unique electronegative PPR during video-EEG monitoring (VEM) induced by fluctuating illumination caused by a distant television screen.

Case Report/Case History: A 27-year-old right-handed female drug-resistant focal epilepsy was admitted for VEM as part of a comprehensive presurgical evaluation. During VEM, interictal EEG demonstrated occasional low amplitude left frontal polyspikes in N2 and N3 sleep supporting her clinical diagnosis. Upon admission for VEM, lamotrigine 500 mg daily was reduced by 50% on day 1 and then further reduced and discontinued by day 3. Overnight on day 3 of VEM, "possible subclinical" seizures were identified by the technologist. Her head was turned to the right after falling asleep while watching the news on television, a 42-inch liquid crystal display, positioned 15 feet in front of her bed. Upon review of the video-EEG, fluctuating light intensification was seen to be emanating from the television in the darkened room, reflecting off the patient's face. During light sleep, brief generalized attenuations with persistent low voltage fast activity were found to be time-synched with fluctuating intensity of higher luminance generated by the television screen to correlate with the EEG findings mimicking subclinical seizures.

Conclusion: We describe a pseudo-ictal EEG pattern observed during VEM in a patient with frontal lobe epilepsy. An atypical electronegative PPR due to fluctuating levels of illumination was generated by television and mimicked brief nocturnal extratemporal focal seizures. Video review during VEM may disclose unexpected findings when EEG changes are seen during sleep.

Utility of scalp-recorded direct current shifts in frontal lobe seizures

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Introduction: We investigated characteristics of direct current (DC) shifts in frontal lobe seizures.

Methods: A 33-year-old female patient with focal epilepsy was investigated. She developed generalized convulsion 16 years ago, and was suffering from daily seizures recently. Brain MRI showed focal cortical dysplasia in the right frontal lobe. Video-EEG for 17 hours was reviewed offline under condition of TC 0.3 sec, 30 mm/sec, and HF 60, in various montages. All clinical seizures with typical motor symptom were marked and awake/sleep stages were determined. Duration of each seizure was measured by visual inspection of video record. Then the reviewing condition was changed into the average reference montage, TC 2.0 sec, 30 sec/screen, and HF15. DC shifts were defined as negative slow deflection, better delineated with TC 2.0 sec than 0.3 sec, and reproducible in location. The amplitude was measured from onset to movement artifact.

Results: Her seizure semiology comprised of abnormal sensation in the proximal part of the left arm, dystonic posture of the left side, hypermotor movement of the right side, and clonic convulsion of the left arm with preserved consciousness. 14 eligible seizures were analyzed (duration 13.5 ± 5.1 sec, mean ± SD). Ictal EEG showed only ambiguous diffuse attenuation and low-voltage fast activities in frontocentral areas. DC shifts were present on 4 occasions (28.6%). DC shifts were and mainly observed in the right fontal area (amplitude Fp2: 200.7 ± 20.4 μV, F8: 107.9 ± 23.9 μV, and F4: 52.7 ± 4.2 μV). Seizures with DC shifts showed significantly longer duration than those without (17.7 ± 4.0 sec vs. 11.4 ± 4.2 sec, p=0.046, t-test). Seizures with DC shifts significantly associated with occurrence in sleep stage N2 (p=0.018, Fisher's exact test).

Conclusion: Scalp-recorded DC shifts during hypermotor seizures are useful in diagnosis of focal aware seizures, especially in patients without EEG seizure patterns.

Not your regular old Valsalva

Aris Hadjinicolaou, MD; Jeffrey Bolton, MD; Chellamani Harini, MD

Introduction: An 8-year-old girl with autism, left frontal grey matter heterotopia and drug-resistant generalized epilepsy, with prior EEGs demonstrating abundant sleep-activated multifocal spikes and polyspike and wave discharges, presented for evaluation of new spells.

Case Report/Case History: In the ED events were characterized by head turning to side and subsequent falling backwards with eye fluttering for 2 seconds before self-resolving. The events continued at a rate of up to 30 per hour despite valproic acid increase and lorazepam initiation. Video-EEG monitoring captured multiple episodes that began with disordered breathing with grunting and bearing down, after which she became limp, fell and became unresponsive, occasionally followed by jerks of the extremities. There were no time-locked EEG changes. EEG demonstrated initial loss of waveform in the chest leads. EKG showed a sudden reduction in amplitude at the time of the initial Valsalva and returned to baseline following the episode. A few seconds into the episode, EEG showed onset of generalized low amplitude theta slowing which later became high amplitude delta slowing. Valsalva with forced expirations against a closed glottis may resemble simple apneas on the respiratory belt. The sequence of events is as follows: (a) sudden rise in intrathoracic pressure result in EKG amplitude reduction due to cardiac axis deviation; (b) reduced cardiac output with a reflex acceleration of heart rate (c) fall in arterial pressure. When maintained over several seconds, cerebral hypoxia ensues, causing diffuse EEG slowing and loss of consciousness with marked pallor.

Conclusion: The episodes may be volitional and compulsive, and were consistent with compulsive respiratory stereotypies, which occur often during idle periods, on arousal, or with strong emotions. This case highlights the importance of concomitant use of cardiac and respiratory channels when evaluating atypical events, especially in at risk patient populations.