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Dear Doctor,

Greetings from Micro Labs. We are happy to bring you "EPILEPSY Newsletter" which contains latest and interesting news in the field of Neuropsychiatry.

This issue contains:

1. A study on investigation of interictal epileptiform discharges by extended scalp EEG array and high-density EEG.
2. Children with epilepsy and focal cortical dysplasia type II were studied retrospectively for brain network analysis of interictal epileptiform discharges from ECoG to identify epileptogenic zone.
3. Adults with MRI-Negative Temporal Lobe Epilepsy: A Study of Spontaneous Brain Activity on Resting-State Functional Magnetic Resonance Imaging
4. A case report and literature review on two instances of anaesthetics that caused epileptic seizures

A study on investigation of interictal epileptiform discharges by extended scalp EEG array and high-density EEG

The goal of epilepsy surgery is to remove the epileptogenic zone, a specific region of the cerebral cortex required for the onset of seizures. Electric source imaging is a useful, non-invasive neurophysiological technique to approach the epileptogenic zone (ESI). A 3D model of the patient's brain is used by ESI to plot the epileptic activity's sources. Both ictal and interictal epileptic discharges can be treated with ESI (IEDs).[1] In addition to electrode coverage, new detection algorithms allow for semi-automated (SA) detection of high IED counts categorised into several IED kinds from numerous days of EEG records from long-term monitoring (LTM). Thus, employing an extended scalp EEG array and short-term high-density EEG (hdEEG) with visual IED type and seizure-onset zone identification(SOZ), this study evaluated semi-automatic and automated detection of IED kinds in long-term video-EEG monitoring (LTM).[2]

From four epilepsy centres, the study prospectively enrolled consecutive patients who received both LTM with a 40-electrode scalp EEG and short-term hdEEG with 256 electrodes. This study only included patients with a single circumscribed SOZ in LTM. IED types were recognised visually, semiautomatically, and automatically in LTM and hdEEG. Comparisons were made between visually detected IED types and the SOZ in LTM and visually detected semi-automatic and automated detections in LTM and hdEEG.

Fifty-two individuals had LTM and hdEEG, making 52 total. The most common IED kinds per patient that were visually observed in hdEEG and semi-automatically and automatically detected in LTM were significantly in agreement with each other (Table 1). Only when IED types with more than 50 detected single IEDs were selected did semiautomated and automated IED detections in hdEEG show a significant correlation with visually identified IED types in LTM. In half of the patients, the threshold of 50 identified IED in hdEEG was attained. The level of agreement between visual and semiautomated detections in LTM was high for all IED types per patient. (Fig 1)

Table 1: Results from the comparison of concordances between all visually detected IED types per patient in LTM against the semiautomated detection (SA) left side and all automated detection (ALL) right side		
	LTM-Vis vs LTM-SA (N 52):	**LTM-Vis vs LTM-ALL (N 32):**
Accuracy:	0.98 (±0.02)	0.95 (±0.03)
Sensitivity:	0.87 (±0.29)	0.94 (±0.21)
Specificity:	0.99 (±0.02)	0.95 (±0.03)
PPV:	0.86 (±0.21)	0.56 (±0.31)
NPV:	0.99 (±0.02)	1.00 (±0.01)
F1-score:	0.88 (±0.15)	0.72 (±0.2)

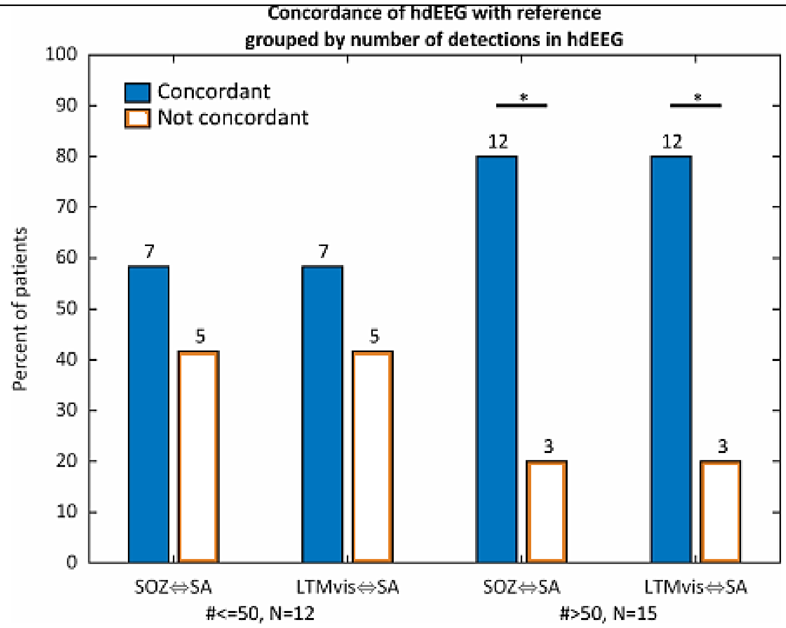

Figure 1: Concordance hdEEG SA and A detection against LTM visual detection grouped by IED counts

The majority of patients had SOZ identified based on visual, SA, and A detection of the most common IED type per patient. Again, for the most common IED type per patient, a detection worked virtually as well as SA detection. The results are consistent with research using intracranial EEG, which demonstrate that the most common IED type per patient is very important for identifying the SOZ. Even when precise criteria for the definition of the SOZ are used, the current data show that scalp EEG electrodes, which record the negative amplitude maxima of the most common IED type, are frequently primarily implicated in the seizure-onset pattern.[2,3]

There is a sizable agreement between visually detected IED kinds and the SOZ and automated and semi-automated IED type detections in LTM. Semiautomated IED type detections in short-term hdEEG are consistent with visually observed IED type detections and the SOZ in LTM if high IED counts were detected.

References:

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Children with epilepsy and focal cortical dysplasia type II were studied retrospectively for brain network analysis of interictal epileptiform discharges from ECoG to identify epileptogenic zone.

One of the most prevalent severe chronic neurological illnesses, epilepsy is regarded as a serious public health concern. Focal cortical dysplasia is the most well-known developmental cortical abnormality that causes uncontrollable epilepsy (FCD). The third most common cause among adult patients having epilepsy resection is FCD, which is the most frequent histopathological diagnosis in children.[1] Surgery still uses intracranial monitoring as the gold standard. In order to obtain long-term seizure freedom and favourable developmental and cognitive outcomes to enhance quality of life, the epileptogenic zone (EZ) must be removed as soon as possible. In order to identify prospective biomarkers for the identification of EZ that will facilitate resection for children with FCD type II, this study used brain network analysis.[2]

Retrospective inclusion involved ten young patients with Engel classes I and II of focal epilepsy who were diagnosed as FCD type II and had a follow-up following resection surgery. Graph theory analysis, power spectrum correction, and time-frequency phase transfer entropy analysis were coupled to determine the parameters of the brain network based on interictal epileptiform discharges from the ECoG.

The evaluation of five patients with frontal and extra-frontal FCD. In this investigation, 100 rigorously chosen epochs (IEDs) for each patient were employed for analysis. The most accurate biomarkers for the delineation of EZ include clustering coefficient, local efficiency, node out-degree, and node out-strength with higher values. Differences between EZ and margin zone (MZ) and EZ and normal zone (NZ) were significant ($p< 0.05$; Mann-Whitney U-test, two-tailed). Those with frontal FCD in particular had a significant difference between MZ and NZ (MZ > NZ; $p< 0.05$), however patients with extra-frontal FC did not.(Figure 1 & 2)

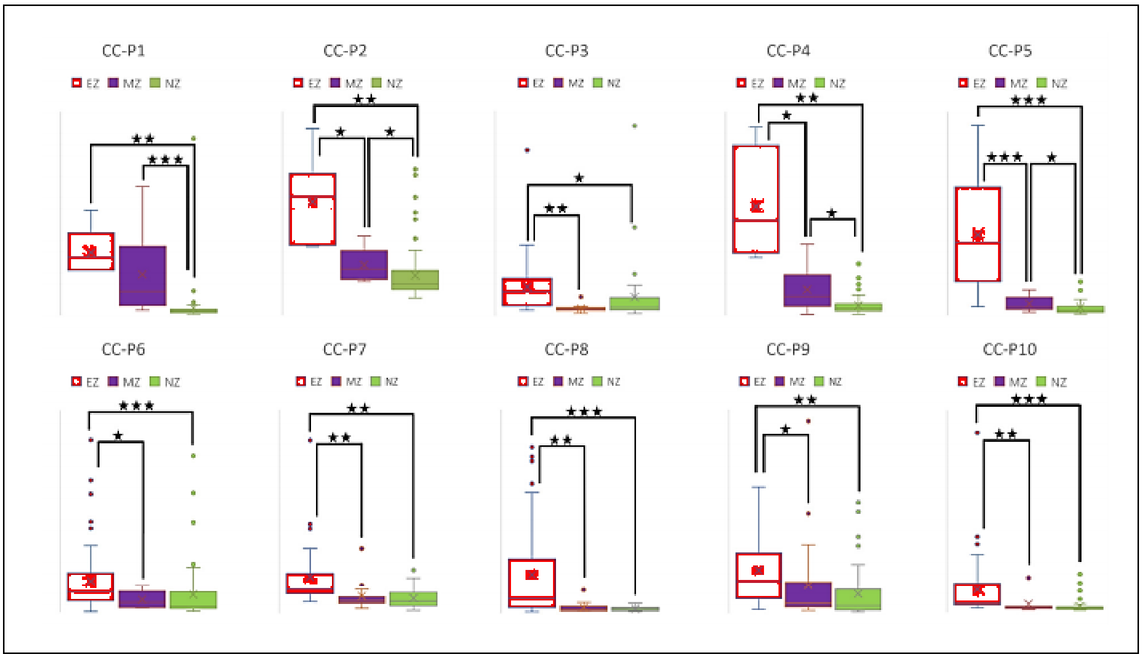

Figure 1: Box plot of CC of all ten patients for EZ, MZ, and NZ (P1 represents patient 1; ⋆ represents p < 0.05 with EZ > MZ, EZ > NZ, or MZ > NZ; ⋆⋆ represents p < 0.001 with EZ > MZ, EZ > NZ, or MZ > NZ; ⋆⋆⋆ represents p < 0.00001 with EZ > MZ, EZ > NZ, or MZ > NZ; Mann–Whitney U-test [two–tailed]).
CC, clustering coefficient; EZ, epileptogenic zone; MZ, margin zone; NZ, normal zone.

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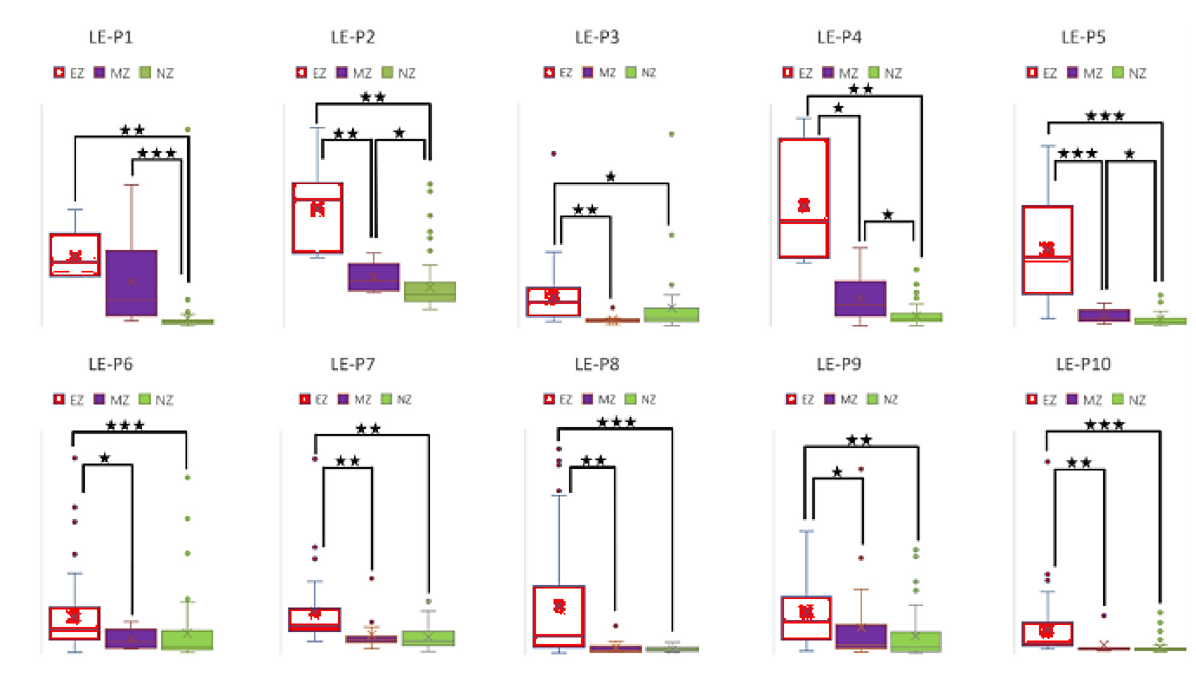

Figure 2: Box plot of LE of all ten patients for EZ, MZ, and NZ (P1 represents patient 1; ⋆ represents $p < 0.05$ with EZ > MZ, EZ > NZ, or MZ > NZ; ⋆⋆ represents $p < 0.001$ with EZ > MZ, EZ > NZ, or MZ > NZ; ⋆⋆⋆ represents $p < 0.00001$ with EZ > MZ, EZ > NZ, or MZ > NZ; Mann–Whitney U-test [two–tailed]).
LE, local efficiency; EZ, epileptogenic zone; MZ, margin zone; NZ, normal zone.

This study showed that brain network analysis, which is based on a triangulation of time-frequency analysis of phase transfer entropy, graph theory analysis, and power spectrum correction, can help to detect EZ. The research also shown that the four neural network metrics CC, LE, OD, and OS could serve as possible biomarkers to distinguish EZ from MZ and NZ (EZ > MZ and EZ > NZ) (Figure 2).[2] According to a study by An N et al., individuals with refractory focal epilepsy can locate the EZ using single-channel signal characteristics from their brain networks and SEEG recordings. These findings imply that this approach aids in EZ localisation, causing doctors to concentrate on the recognised EZ-blocks and their surrounding contacts. The model might be used to categorise patient contacts to help doctors locate the EZ before to surgery after being trained using the data of seizure-free patients in accordance with the proposed method.[3]

Pediatric focal epilepsy patients with FCD type II may benefit from brain network analysis, which is based on the combination of time-frequency analysis of phase transfer entropy, graph theory analysis, and power spectrum compensation.

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Adults with MRI-Negative Temporal Lobe Epilepsy: A Study of Spontaneous Brain Activity on Resting-State Functional Magnetic Resonance Imaging

One in 25 epileptic sufferers may go on to develop drug-resistant epilepsy in the future (DRE). Most of these patients suffer focal unaware seizures, which are restricted to the temporal lobe area (TLE). It is the most typical cause of TLE within the range of lesions in the temporal lobe. 1 While conventional MRI sequences are not sensitive to the identification of certain TLE, and about one-third of patients with TLE have negative MRI findings, a condition known as MRI-negative temporal lobe epilepsy, advances in magnetic resonance imaging (MRI) technology have significantly improved the diagnostic value for TLE (TLE-N). In order to assess the resting brain function of TLE-N patients based on neural synchronisation and intensity of local brain areas, the study used three voxel-based local brain area analysis methods of resting-state functional MRI (rs-fMRI).

The study comprised 30 individuals in the healthy control (HC) group and 47 patients with TLE, including 28 cases of drug-controlled TLE (cTLE-N) and 19 cases of drug-resistant TLE-N (rTLE-N). The study examined three data-driven rs-fMRI algorithms for amplitude of low-frequency fluctuations (ALFF), fractional ALFF (fALFF), and regional homogeneity in order to thoroughly investigate the altered brain function associated with TLE-N patients (ReHo).

Occipital lobe activation, as determined by increased fALFF values in the superior occipital gyrus (SOG) and increased ReHo values in the lingual gyrus (Lin), fusiform gyrus, and middle occipital gyrus, predominated the distribution of abnormal functional brain areas in cTLE-N patients compared to the HC group. (Figure 1 & 2)

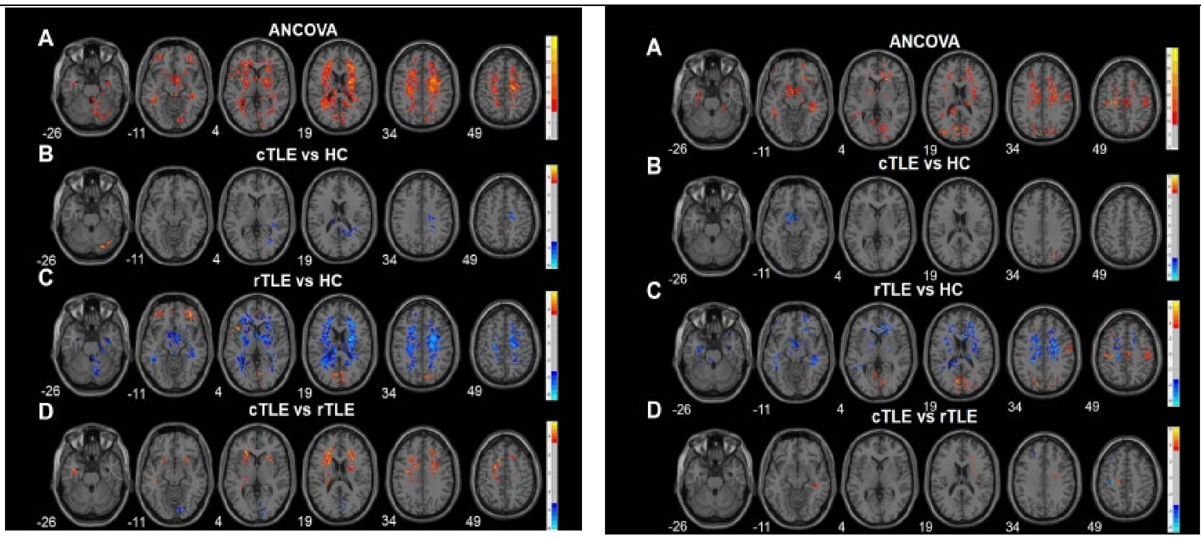

Figure 1: Brain regions exhibiting significant differences in ALFF values according ANCOVA and post-hoc analysis & Brain regions exhibiting significant differences in fALFF values according to ANCOVA and post-hoc analysis

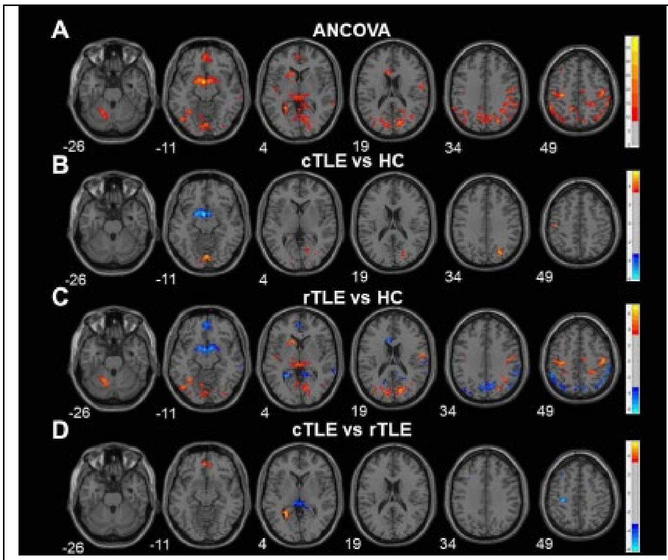

Figure 2: Brain regions exhibiting significant differences in ReHo values according to ANCOVA and post-hoc analysis.

Increased fALFF values were seen in the SOG, Lin, superior temporal gyrus, and postcentral gyrus in rTLE-N patients, while decreased fALFF values were seen in the inferior frontal gyrus orbital, parahippocampal gyrus, and superior frontal gyrus orbital. ReHo values were decreased in the precuneus, parietal inferior angular gyrus, and the orbital region of the middle frontal gyrus, whereas they were increased in a number of frontal, temporal, occipital, and subcortical brain regions. In order to examine the resting brain function in patients with TLEN from the perspective of regional neural synchronisation and intensity, as well as to investigate the neural mechanisms of brain functional impairment in patients with TLE-N, this study combined three voxel-based localregional brain analysis methods, ALFF, fALFF, and ReHo. These functional markers are analysed in accordance with various notions and show various neural actions in the brain. The results demonstrate that the cTLE-N, rTLE-N, and HC groups exhibit different spatial patterns of brain activity.[2] In this study, we found that the distribution of aberrant functional brain regions in patients with cTLE-N was dominated by occipital lobe activation; these included elevated fALFF values in the SOG and increased ReHo values in the Lin, FG, and MOG. The CG, Lin, and FG, three anatomical regions that are all involved in the processing of visual information, are related with visual processing. Hallucinations are brought on by an increase in activity in the FG's visual processing function.[3]

Patients with rTLE-N have localised abnormalities in the prefrontal limbic system and malfunction in the default model network, whereas patients with cTLE-N have localised changes in the visual functional areas of the brain. There are many epileptic networks between rTLE-N and cTLE-N.

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A case report and literature review on two instances of anaesthetics that caused epileptic seizures

A condition known as epilepsy, which has effects on the brain's neurobiology, cognition, psychology, and society, is the persistent propensity for seizures. Epilepsy affects more than 50 million people globally, and because its causes are still largely unknown, neither doctors nor patients have a clear understanding of the disease's genesis or the most effective course of action.[1] Two-thirds of epileptic patients can effectively control their seizures with regular antiepileptic medicines (AEDs), however even though their prognosis is generally favourable, only 57% of them continue to be seizure-free five years after stopping their AEDs. Status epilepticus has reportedly been under control by anaesthetics. The daily clinical work, however, revealed that several anaesthetics can cause epileptic seizures. Therefore, the purpose of this research is to investigate the connections between anaesthetics and epilepsy.[2]

To draw attention to this important issue, the researchers collected and published two examples of anesthetics-induced epileptic seizures. The paper also summarises the state of the field's research at the moment, examines links between anaesthetics and epilepsy, and discusses the mechanisms that underlie those links. Two girls who had been seizure-free for over 3 years presented with anesthetic-induced epileptic seizures that were managed with the help of Midazolam and Diazepam (Table 1). In their analysis of the literature, researchers cited six studies that showed there is no connection between the frequency of epileptic seizures and the patients' age or sex, the nature of the surgery, or the type of anaesthesia. It is closely related to both insufficient preoperative planning and the drop in antiepileptic medication (AED) blood concentration.

Table 1: Two cases of anesthetics-induced epileptic seizures who had a history of epilepsy

Sex/ age	History of epilepsy	AEDs before surgery	Seizure-free duration	Surgery	Anesthesia	EEG	One year t
Case 1 Female/16	GTCS 13years ago, lasting 1-2min and repeated more than 10 times intermittently	Sodium valproate and oxcarbazepine	3 years	Rhinoplasty and double- eyelid surgery	Propofol (100mg) General anes-thesia	Normal	No seizure
Case 2 Female/34	Limb clonic seizures 5 years ago, lasting 2-4min. This attack	Sodium val-proate, oxcar-bazepine, and lamotrigine	5 Syears	Bilateral tonsil-lectomy	Lidocaine (160mg) Local anesthesia	Increase of slow waves in both	No seizure

	occurred 1-2 times day, more frequently in the afternoon					hemispheres	

Following the administration of anaesthetic medications, all of the patients experience a tonic-clonic seizure (TCS). Patients receiving local anaesthetic experience epileptic seizures right away, while those receiving general anaesthesia experience them at any point during their anaesthesia. The age or sexual orientation of the patients has no bearing on this phenomenon. The type of operation, anaesthetic, or procedure has no bearing on whether an epileptic seizure may occur. The two instances in this study were seizure-free for more than 3 years while using standard AEDs, indicating that the anaesthetics are to blame for the return of epileptic seizures. They were instructed to keep taking AEDs in the event of a relapse.[2]

Patients with epilepsy should avoid unnecessary surgery, and anaesthetists should choose anaesthetics carefully and get enough rest before surgery.

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