

September 23rd, 2023 09:00 - 11:00

## PARALLEL SESSION 31 - BRAIN 6

### ID 104. Brain State of the Newborn (BSN), a fully automated bedside trend, predicts the clinical outcome after perinatal asphyxia

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#### Background

Long-term EEG monitoring is indicated by many guidelines, but it is hampered by the lack of resources for a continuous EEG review. We have recently developed a robust, deep learning –based algorithm (Brain State in the Newborn, BSN) that makes reliable interpretations and visualization of the EEG background activity [1]. The BSN is a continuous index that ranges from 0 (inactive) to 100 (fully continuous, age-typical). In this study, we examined the clinical utility of BSN in fully automated interpretation of early EEG background after perinatal asphyxia. Particularly, we evaluated BSN's ability to predict poor clinical outcomes, including death and infantile epilepsy.

#### Methods

The average BSN were calculated for a cohort of N = 80 full-term infants with moderate to severe HIE. Clinical outcomes included: death (N=11), epilepsy (N=6), cerebral palsy without epilepsy (N=7), and favorable (N=56) [2]. We then calculated the receiver operating characteristic (ROC) curves, area under the curve (AUC) at five

time points (6, 12, 24, 36, and 48). Moreover, we inspected temporal changes in positive and negative predictive values (PPV and NPV) when considering a fixed BSN cut-offs (35) selected as optimal operating points at 12 hours in the AUC. True positive for poor outcome (death, infantile epilepsy) was defined as a BSN value less than 35. Our cloud server (babacloud.fi) makes the entire BSN algorithm openly available.

## Results

Summary distributions at five time points reveal a significant difference in BSN levels between outcome categories (Fig 1A). From six to 24 hours of life, the two worst outcomes—death or infantile epilepsy—were predicted with an AUC value ranging from 95.5% to 99.2%, respectively (Fig 1B1). Expectedly, the PPV and NPV levels evolve over time (Fig 1B2).

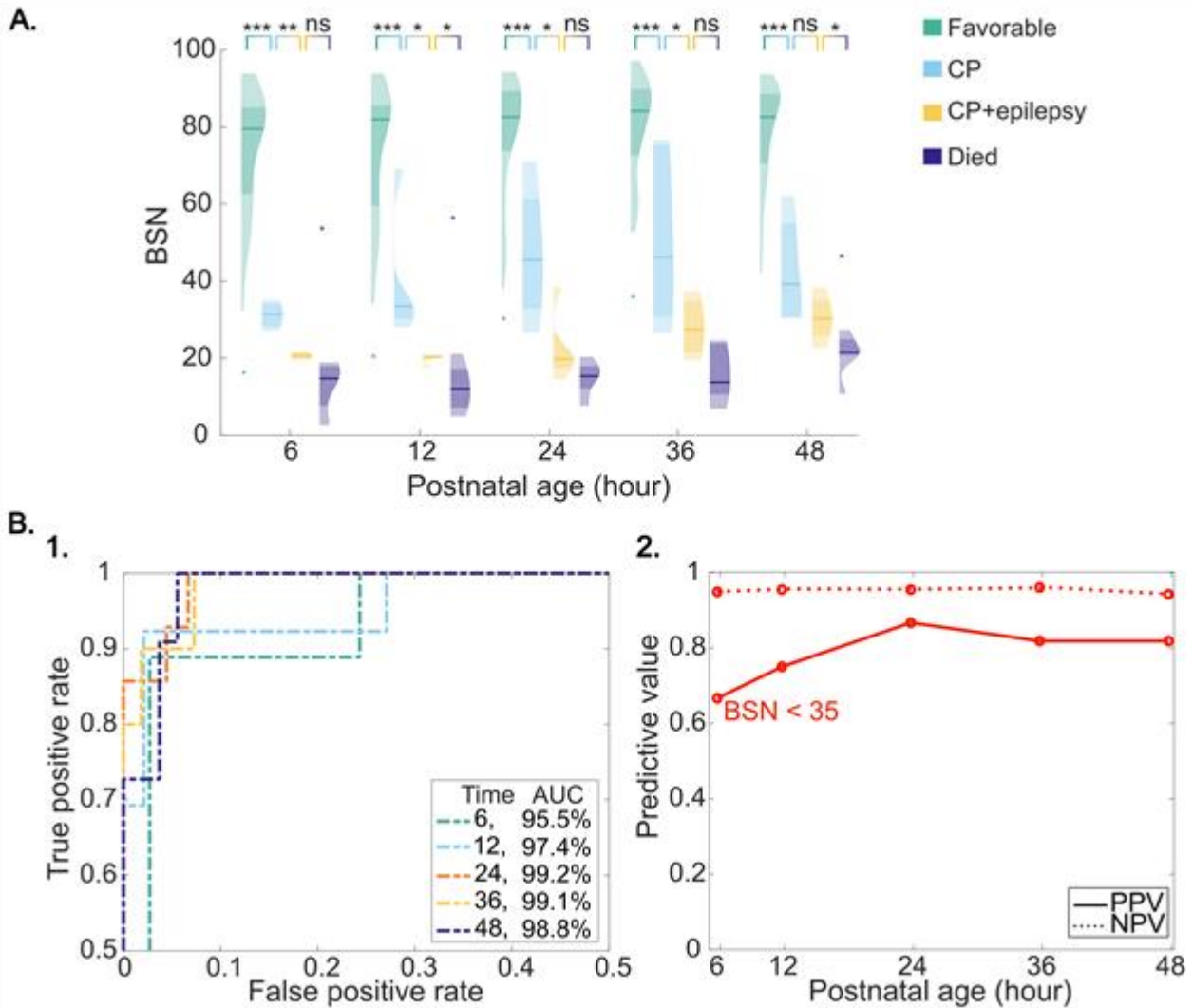
## Conclusion

The present findings show that BSN:

- provides an intuitive interpretation of the recovering cortical activity in HIE
- allows an efficient clinical outcome prediction from early hours of life

Future studies are needed to establish evidence-based, and context-sensitive limits for BSN to provide efficient clinical guidelines for using BSN in the clinical care.

- 1.Moghadam, S.M., et al., Lancet Digit Health, 2022.
- 2.Nyman, J., et al., Clin Neurophysiol, 2022.



A. Distributions of BSN levels in each outcome group. B1. ROC and AUC. The ROC plot is zoomed in to better visualize the differences. B2. PPV and NPV time courses. A. Distributions of BSN levels in each outcome group. B1. ROC and AUC. The ROC plot is zoomed in to better visualize the differences. B2. PPV and NPV time courses.

None declared

## ID 786. THE PREDICTIVE ROLE OF EARLY QUALITATIVE AND QUANTITATIVE (A)EEG ON LONG-TERM NEURODEVELOPMENTAL OUTCOMES IN EXTREMELY PRETERM INFANTS

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### Background

Extremely preterm (EP) infants (<28 weeks of gestation) are at great risk for long-term neurodevelopmental impairments. Early continuous amplitude-integrated electroencephalography (aEEG) with raw EEG traces holds a high potential for predicting later outcomes in the preterm population. This study aimed to determine whether and which qualitative and quantitative (a)EEG features obtained within the first postnatal days predict EP infants' neurodevelopmental outcomes at preschool and early school age.

### Methods

This study used a retrospective cohort of 369 EP infants who underwent routine (a)EEG monitoring during their first postnatal three days. From pre-processed (a)EEG signals, we extracted an extensive feature set, including three types of qualitative parameters (background pattern, sleep-wake cycles, and seizure activity) and four groups of quantitative metrics (amplitude, spectral content, connectivity, and discontinuity). The extracted (a)EEG features were fed into machine learning (ML)-

based regression and classification models to assess their predictive value for cognitive, motor, and behavioural problem outcomes at two and five years of age. Potential confounders were corrected in the prediction analysis.

## Results

The ML-based regression analyses showed statistically significant but relatively weak predictive performance ( $R = 0.12-0.23$ ) for most (11/13) outcomes. However, the binary classifiers showed acceptable performance in identifying EP infants with delayed full-scale and verbal intellectual quotient scores at five years from those with optimal scores, achieving 68% and 72% (both permutation  $P$ -value  $< 0.001$ ) balanced accuracy, respectively.

## Conclusion

These results highlight the potential benefits of early postnatal (a)EEG monitoring, along with using ML approaches, to automatically recognize EP infants with impaired outcomes, shedding light on developing an explainable prognostic tool that aids in decision making and therapy planning in this population.

None declared

## ID 592. Prevalence of epilepsy and pathological EEG in a Norwegian sample of children with fetal alcohol spectrum disorder (FASD): Impact on cognition and adaptive functioning.

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Background: Fetal Alcohol Spectrum Disorder (FASD) is an umbrella term describing a combination of developmental, cognitive and behavioural disabilities after prenatal alcohol exposure. Data on prevalence is limited, but it's estimated that the current prevalence of FASD in populations of younger school children as high as 2–5% in the US and other Western countries. Increased prevalence of epilepsies and pathological EEG have been reported. This study aimed to examine the prevalence of epilepsy, EEG pathologies and its implication on cognitive and adaptive functioning.

Methods: Cross-sectional study on 148 children with FASD, assessed multidisciplinary and with EEG recording. Group comparisons and regression analyses were used to test the associations between epilepsy and EEG on FASD subgroups and neurocognitive performance in children with presence or absence of ADHD as comorbidity.

Results: The incidence of epilepsy was 6% compared to 0.7–0.9 % in children in general. Pathological EEG was seen in 21% of children with FASD. ADHD was confirmed in 64% of the children, evenly distributed between children in different FASD subgroups. Children with epilepsy and/or pathological EEG findings did not have lower cognitive and adaptive scores compared to the total FASD group. However, significantly lower scores of the IQ indices processing speed and working

memory were found in children with frontal EEG-pathologies (but without epilepsy) compared to FASD children without such findings, irrespective of ADHD status, sex or preterm birth, indicating executive function deficits.

Conclusion: We found a 6.7 –8.6 fold increased prevalence of epilepsy in the FASD group. A pathological EEG was found in a many children throughout all FASD subgroups, even in absence of an epileptic disorder. Irrespective of epilepsy, ADHD and FASD subgroup, children with frontal EEG pathologies showed significantly reduced processing speed and working memory, which may justify medical treatment.

None declared



## ID 807. IMPACT OF AMPLITUDE-INTEGRATED ELECTROENCEPHALOGRAPHY FINDINGS DURING CARDIAC SURGERY ON NEURODEVELOPMENTAL OUTCOME

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### Background and aims

Perioperative brain injury is common in young infants undergoing cardiac surgery (CS). We aimed to determine the relationship between intra-surgical electrical seizures and the background pattern of amplitude-integrated electroencephalography (aEEG) with brain damage biomarkers and 2-year neurodevelopmental outcome in infants undergoing CS.

### Methods

A total of 120 infants undergoing CS underwent aEEG monitoring during surgery. Seizure activity and aEEG background pattern were recorded and analyzed. Brain damage biomarkers (protein s100b and neuronal specific enolase (NSE)) were analyzed immediately after surgery and 72 hours post. Survivors underwent neurodevelopmental outcome assessment using the Bayley Scales at 2 years.

### Results

Sixty-one per cent of the patients were operated with less than one month. Cardiopulmonary bypass was used in 58.47 %. Intraoperative electrical seizures occurred in 22.87%. Seizures were more frequent in surgeries with higher Aristoteles score ( $p=0.001$ ). Those patients with seizures presented higher levels of s100b immediately after surgery ( $p=0.0019$ ). Mean time of seizure burden was 30 min [9.6–



71.4]. Seizure burden was correlated with time of aortic clamps ( $\rho=0.60$ ;  $p<0.05$ ) and temperature ( $\rho= -0.32$ ;  $p=0.02$ ). Those surgeries that require Aortic clamp presented worse aEEG patterns. There is no correlation between seizures or aEEG pattern and Bayley scores at 2 years.

### Conclusions

Patients with seizures presented higher levels of S100B. Aortic Clamp and hypothermia are the main risks for intra-operative seizures and abnormal background patterns. Intraoperative seizures were common in this cohort of infants but did not impact on 2-year neurodevelopmental outcome. Post-surgical monitorization will be important to determine the impact of the recovery of the aEEG patterns on the long-term outcome.

None declared