PN:2191

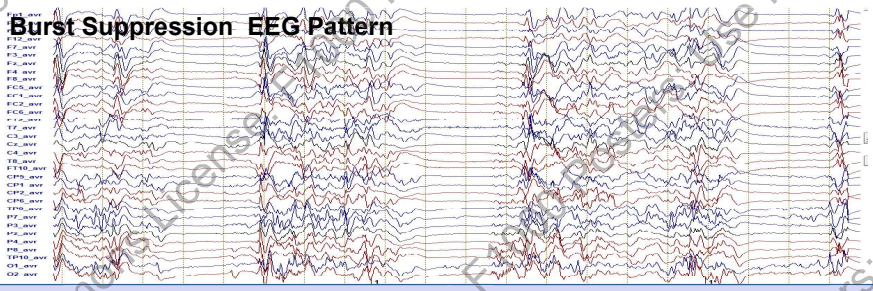
Neuronal networks in Burst Suppression EEG patterns in Newborns as revealed by source analysis

Klinik für Neuropädiatrie & Klinik für Neurologie, Institut für Medizinische Psychologie und Soziologie UKSH, Campus Kiel

Reinicke C, Muthuraman M, Möller F, Mideksa K, Rauf Anwar A, Pressler R, Deuschl G, Siniatchkin M, Stephani U, Japaridze N

Introduction: Burst suppression (B-S): an electroencephalogram (EEG) pattern characterized by the quasiperiodic alternant phases of a high voltage activity (burst) and electrical silence (suppression) and Is considered as a global state of profound brain inactivation. Burs suppression can occur during different conditions such as Early-Onset Epileptic Encephalopathies, hypothermia, general anaesthesia and coma.
Biophysical mechanisms underlying this broad range of inactivated brain states are poorly understood.

Burst Suppression EEG Pattern



13 Neonates and infants with B-S EEG pattern were included in the study

Age range: 1 day – 13 Month

Diagnoses:

1 Early Myoclonic Encephalopathy
2 Otahara syndrome
3 early onset West syndrome
4 severe hypoxic ischemic encephalopathy
3 Neurometabolic disease

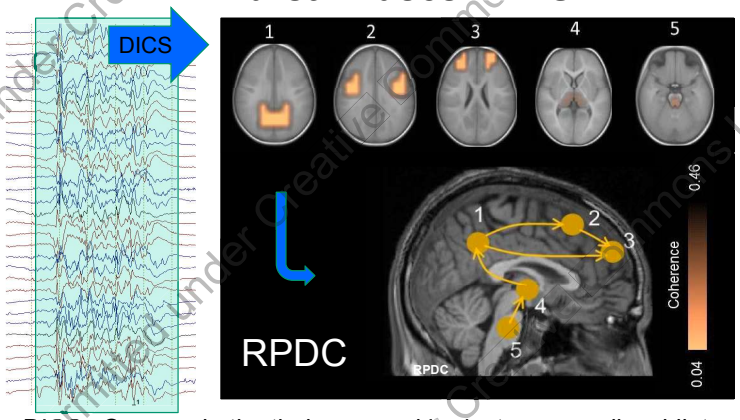
Aim: reveal the neuronal network underlying both burst and suppression phases using a source analysis method and to describe the effective connectivity between the identified sources.

Methods:

- Dynamic imaging of coherent sources (DICS) (Gross et all 2001)
- Renormalized partial directed coherence (RPDC) (Schelter et al 2008)
- DICS was applied separately to the EEG segments with bust and suppression phases
- Power spectrum analyses were performed to identify the predominant frequencies.
- The brain area with the strongest power in the analyzed frequency (1-4 Hz) range was defined as the reference region.
- DICS was used to compute the coherence between this reference region and the entire brain.
- RPDC was used to describe the informational flow between the described sources.

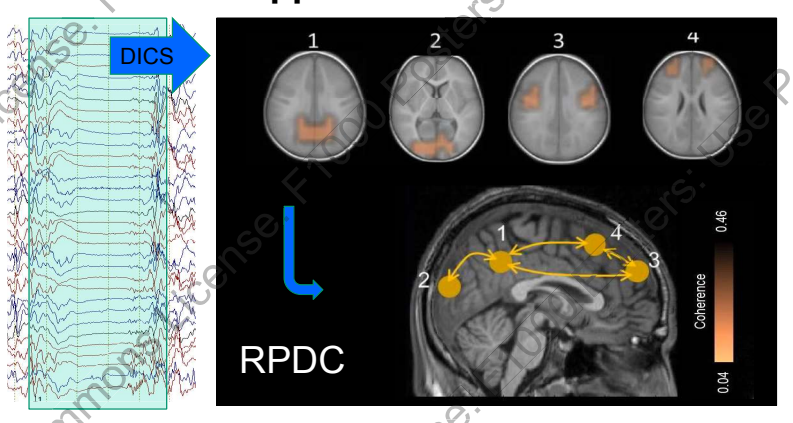
Results:

Burst Phases: DICS

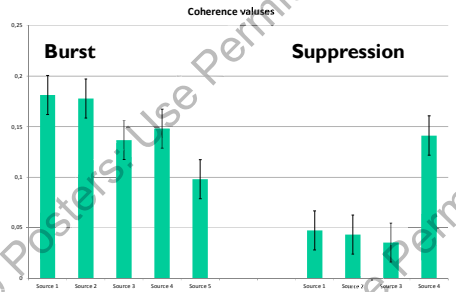


- DICS: Sources in the thalamus and brainstem as well as bilateral sources in the cortical regions mainly frontal and parietal
- RPDC: Ascending informational flow from the brainstem towards the thalamus and from the thalamus to cortical regions

Suppression Phases: DICS



- DICS: Coherent sources throughout the cortical regions
- RPDC: Intercortical connections



- Graph is showing that Coherence values of burst phases are significantly stronger during the burst phases then during the suppression phases

Conclusion: Delta activity during the burst phases was associated with sources in the thalamus and brainstem as well as bilateral sources in the cortical regions mainly frontal and parietal, whereas suppression phases were associated with coherent sources only in the cortical regions. Results of the RPDC analyses showed an ascending informational flow from the brainstem towards the thalamus and from the thalamus to cortical regions, which was absent during the suppression phases.

Our findings support the notion that "cortical deafferentation" between the cortex and subcortical structures and desynchronizations exists especially in suppression phases of burst suppression EEG.

References

GROSS, J., KUJALA, J., HAMALAINEN, M., TIMMERMANN, L., SCHNITZLER, A. & SALMELIN, R. 2001. Dynamic imaging of coherent sources: Studying neural interactions in the human brain. *Proc Natl Acad Sci U S A*, 98:, 694-699.
SCHELTER, B., TIMMER, J. & EICHLER, M. 2009. Assessing the strength of directed influences among neural signals using renormalized partial directed coherence. J Neurosci Methods, 179, 121-30.