

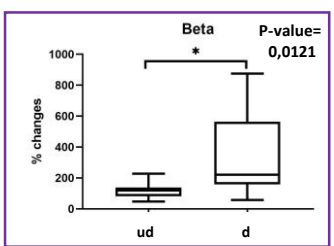
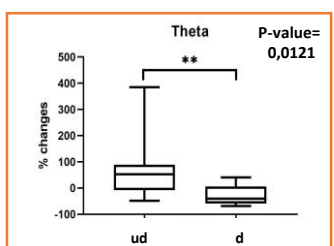
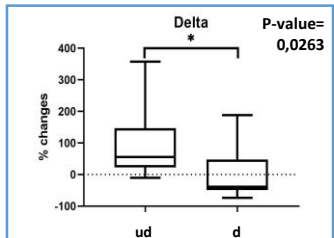
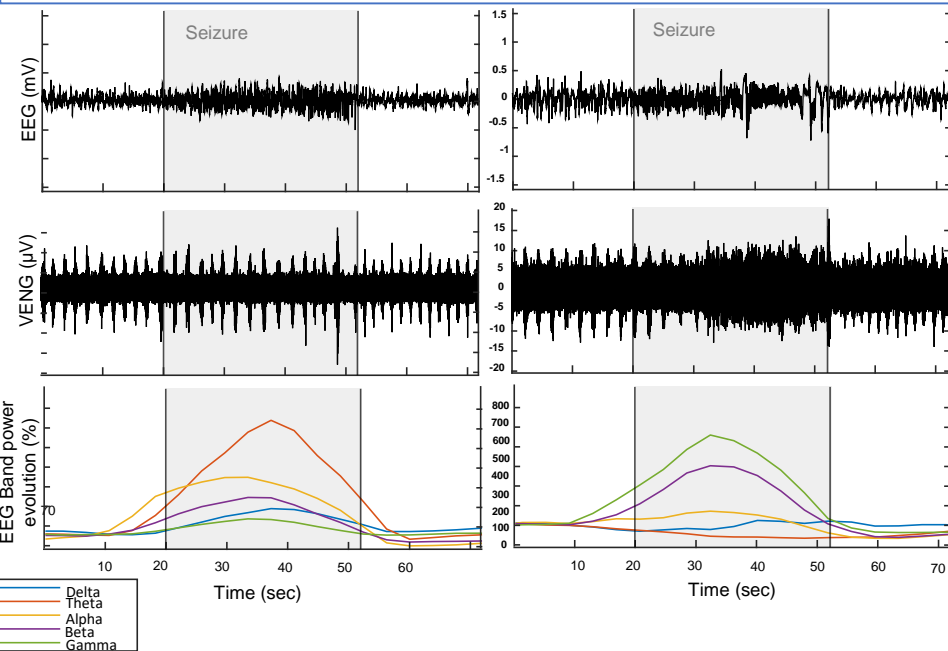
Characterization of Vagus Nerve Electroneurogram during kainic acid induced seizures for seizure detection

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Detection of acute KA induced seizures

Undetected sz (ud)	Detected sz (d)
Sample size n = 10 sz	n = 13 sz
Mean sz duration 51 ± 21 sec	52 ± 17 sec

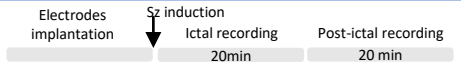


Results

- 23 sz recorded, 3-5 sz/animal
- 13 sz detected (d) by the algorithm
- Mean delay between EEG and VENG sz onset: 25 ± 15 sec
- 10 sz undetected (ud) by the algorithm
- Slower mean activity in ud group. (δ p-value: 0,0263, θ p-value: 0,0121)
- + Decreased in θ band as a predictor for sz detection (p-value: 0.017)
- Faster mean activity in detected group (β p-value: 0,0121)

Methods

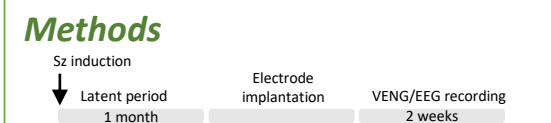
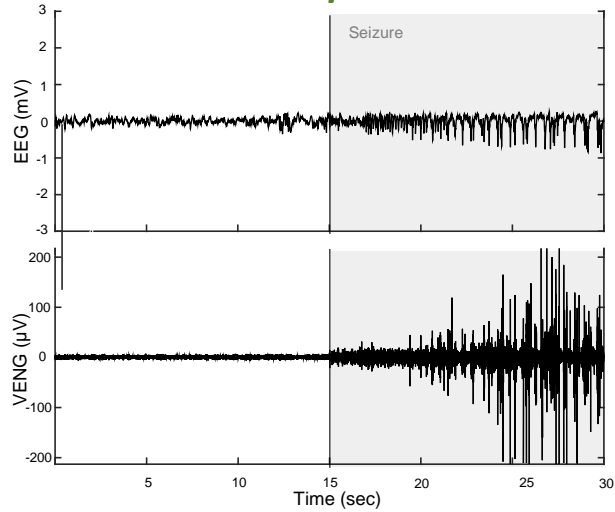
- 6 male Wistar rats anesthetized with 100mg/kg Ketamine and 7mg/kg Xylazine i.p.
- 3 epidural EEG electrodes ([+]:AP:+2mm, ML:±3mm, [-]:AP:+6mm)
- 3 ECG Lab-made Tungsten electrodes
- 1 VENG tripolar Micro-Cuff electrode around the left cervical VN
- Sz induction: Intra-hippocampal (KA) injection ((0,4µg/0,2µl)²)
- Detection based on sliding Fg/Bg windows highlighting the loss of rhythmicity in the signal
- Mann-Whitney test was used to compared mean individual EEG band power between detected sz vs undetected sz group
- EEG band power evolution was calculated by doing a ratio between pre-ictal (PI) and ictal windows for each individual band



Background

Seizures (sz) produce **autonomic symptoms**¹, mainly sympathetic but also parasympathetic in origin. Within this context, the **vagus nerve (VN)** is a **key player** as it carries information from the different organs to the brain and vice versa. For this reason, exploiting the vagal neural traffic with respect to seizures might offer a novel way to **detect seizures** and develop a **closed-loop Vagus Nerve Stimulation (VNS) system**. Therefore, this project aims to characterize Vagus Nerve Electroneurogram (VENG) in an **acute** and **chronic** kainic acid rat (KA) model and develop a detection algorithm based on these changes.

Chronic seizure: Spontaneous Recurrent Seizure (SRS)



- ### Methods
- Sz induction: 5mg/kg KA i.p. following Hellier protocol
 - 3 epidural EEG electrodes
 - 1 VENG tripolar Micro-Cuff electrode

- ### Results
- Sz duration: 40 sec
 - Stage 4 sz according to Racine scale⁴
 - Delay SE induction – recorded sz: 1,5 month
 - Mean PI signal amplitude (10sec): $1,41 \cdot 10^{-6} \mu V$
 - Mean ictal signal amplitude (10sec): $5,03 \cdot 10^{-6} \mu V$
 - 356,8% increased VENG signal amplitude

Conclusion

This study showed the different modulations of spontaneous VN activity during **acute/chronic** KA-induced sz. In **acute** sz, we showed a loss of spontaneous rhythmicity exploited for sz detection and 13/23sz were correctly detected. EEG band power evolution as an indicator of sz severity showed faster activity correlated with a better detection. **Acute** experiments are reproduced **in awake animals** to refine the detection algorithm, and preliminary results showed a VENG modulation characterized by an increased VENG signal amplitude during sz.

References:

- ¹Wannamaker, B. (1985). Epilepsia
- ² Bragin, A. et al. (1999). Epilepsia
- ³ Hellier JL et al. (1998). Epilepsy Res.
- ⁴ Racine, J.R. (1972) Electroencephalography and Clinical Neurophysiology

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