1. Background

• Healthcare differs if patient is unresponsive (UWS) or minimally conscious (MCS).

• 35% clinical diagnosis error which can impact life and death decisions.

• Neuroimaging helps, but is expensive and difficult in daily clinical setting.

• Heart and brain’s Central Autonomic Network (CAN) are connected in a two-way dynamic interaction through the Autonomic Nervous System (ANS).

→ Can we better diagnose by monitoring the heart?

2. Methods

From heart rate to multi-scale entropy to COMPLEXITY INDEX in the short term (CIₜ) and long term (CIₗ):

• Conducted on 16 UWS and 17 MCS sedated patients as assessed by the Coma Recovery Scale – Revised (CRS-R) acquired since 2008 up to 2017.

• Patients were matched for age, gender, ethology and onset.

• Electrocardiographic activity (ECG) and photoplethysmographic sensor (PPG) were acquired for 10 minutes, simultaneously with MRI (3T Siemens Magnetom TrioTm).

• PPG and ECG were cleaned with a Fourier Transform (SigView software) and multi-scale entropy was calculated (HRV Advanced Analysis software v2.2). CI was calculated as the area under the sample entropy timescale curve.

• MRI T1 and EPI BOLD were preprocessed with SPM12 and 2nd-level correlation analyses were calculated with CONN 17f with CI, & CI, as covariates of interest in a parametric regression.

3. Results

3.1. MCS have higher CI than UWS on average

Group-wise, MCS show higher CIₜ (z=2.846, p=0.002) and CIₗ (z=3.386, p=0.001) compared to UWS using a Mann-Whitney’s test.

S1 represent all patients (n=33), S2 the subset who underwent fMRI analysis (n=24).

3.2. CI correlates with CAN fMRI connectivity recovery

• CIₜ correlates with MPFC <-> Lateral Occipital Cortex/Occipital Fusiform Gyrus (red connectivity).

• CIₗ correlates with Thalamus <-> Sensorimotor (green), Cerebellum <-> AC/PC Gyri(blue), Auditory STG <-> SPL (magenta) connectivities

3.3. CI reliably discriminates MCS from UWS

One-R classifier with 10-fold cross-validation:

→ CIₗ selected as the best predictor

→ 85% accuracy, 19% false positive and 12% false negative rates

→ In comparison, Zero-R (always predicting MCS) has 52% accuracy

→ Lower error than clinical consensus

4. Conclusion

→ Complexity Index has high discriminative power and low false negative rate

→ Might provide an inexpensive way to diagnose MCS & UWS and screen/monitor CAN connectivity changes

→ Future: should investigate in a bigger cohort and in acute patients

5. Bibliography & Acknowledgements


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