Setting up a neurological prognostication service in a cardiothoracic ICU with no on-site neurophysiology support

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Essex Cardiothoracic Centre

1.8 Million population
2500 PCI / yr
750 PPCI / yr
140 OHCA / yr

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Background and Rationale

- Brain injury is the most common cause of morbidity in OHCA patients
- Sedation, paralysis and mild therapeutic hypothermia (MTH) makes early neurological prognostication difficult
- ERC / ESICM guidelines highlight the importance of a multimodal approach to neurological prognostication
- Across the UK neurological prognostication is inadequate in many cardiothoracic centres

The problems

- Most UK heart attack centres do not have neurophysiology departments
- Access to EEG / SSEP at clinically relevant time points can be challenging
- Neuro-biomarker measurement not available in most UK centres

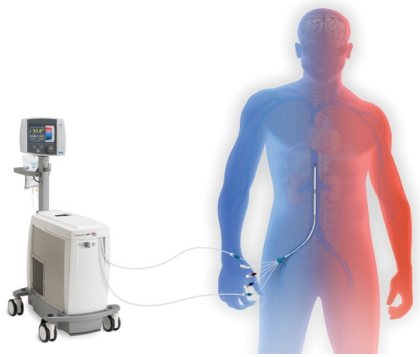
The aim

- Feasibility and safety of setting up a neurological prognostication service in a cardiothoracic centre with no on-site neurophysiological support

  - EEG / SSEP
  - Neuro-biomarkers

Inclusion Criteria

- Consecutive patients admitted to the ICU following OHCA that receive MTH (33˚C) in the catheter lab using Intravenous Temperature Management were included



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EEG / SSEP Training

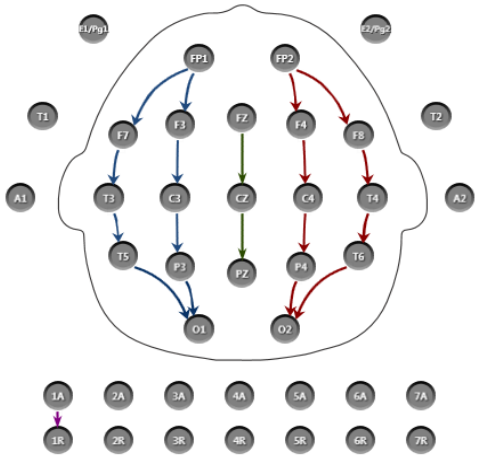
- ICU staff received training over a 4 month period from external neurophysiology experts at Barts / Royal London and Addenbrookes hospital plus CTC centre visits from an experienced healthcare scientist to record quality EEG and SSEP

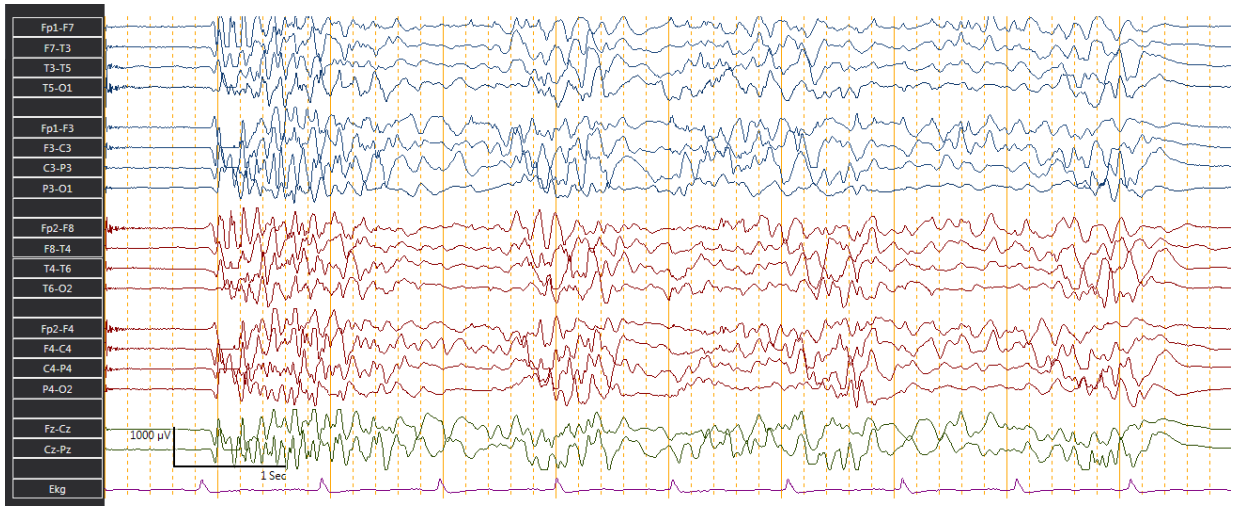
- Once competent with these methods EEG / SSEP & biomarkers were then implemented as part of a multimodal approach to neurological prognostication in 50 OHCA patients (as part of THAW trial)

Intermittent EEG

- 20 minute EEG using the full 10-20 system + polygraphic electrodes

- Double banana (bipolar) and average reference montages are most commonly used





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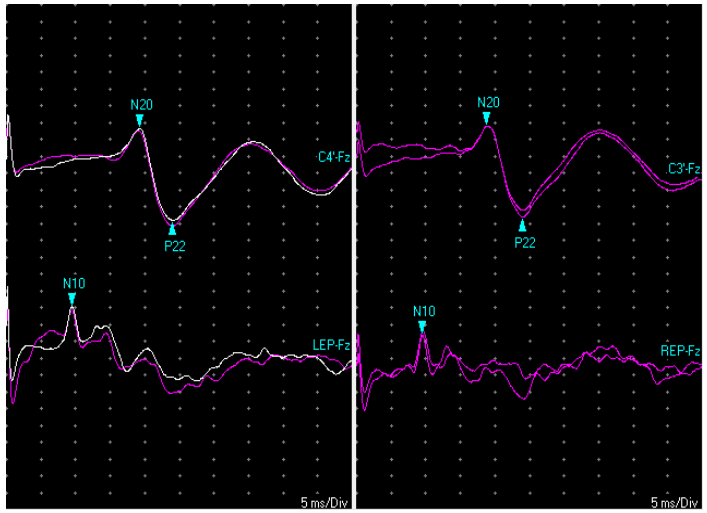
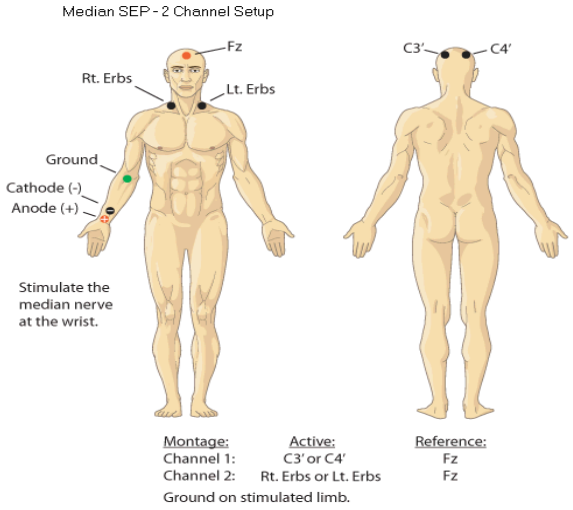
Two Channel SSEP

- Median nerve stimulation with recordings at N9 (Erb's point) and N20 (somatosensory cortex)

- The presence / absence of N20, amplitude and speed of evoked potentials is assessed <23.4ms and N9 <11ms is considered normal





Biomarkers

- NSE and S-100B
- Recorded alongside neurophysiology techniques
- Absolute concentrations and trends will be analysed
- Sent to core lab for analysis

Neurophysiology on ICU

- EEG / SSEP / Biomarkers performed on admission to ICU, 6, 12, 24, 48, 72 hours after – unless the patient wakes before this time

- EEG / SSEP sent off-site for interpretation by an expert neurologist in EEG / SSEP post cardiac arrest care (Dr Max Damian)

Feasibility Results

- 98% of EEG were recorded adhering to the protocol, 98% were good quality
- 97% of SSEP were recorded successfully with 94% being good quality
- 98% of biomarker samples were recorded with 98% not haemolysed
- All recordings were sent off-site electronically for interpretation
- 75% survival to discharge rate

The benefits

- Safe bedside tool to aid neurological prognostication
- Detection of non-convulsive seizures - benefits of earlier treatment
- A more full multi-modal approach to support clinicians
- Improve care of patients by using all the tools available
- Plan for neurorehabilitation and future care requirements
- Ease of taking biomarker Samples

The challenges

- EEG / SSEP hardware costs (50k GBP)
- Intensive training and education
- Resistance from neuro-physiology establishment
- Each recording takes clinical time
- Known technical challenges (MTH, sedation, shivering, ICU interference
- Standardization of stimulation technique
- 24/7 Neurophysiology diagnostic service
- Care / transfer of blood samples

Conclusion

- In a Cardiothoracic centre it is feasible:
  - For ICU staff to be trained to perform EEG / SSEP and biomarkers for effective and accurate multimodal neurological prognostication following ERC / ESICM (2014) guidelines, without on-site neurophysiology support
  - Recordings can be securely transferred to a core lab for rapid expert interpretation
  - Biomarker samples can be taken and transferred to reference lab for analysis

Clinical implementation & future plans

- Future research with a larger cohort of patients will study these techniques further and test the effectiveness of the service that had been set up for early neurological prognostication
- More ICU staff will be trained to perform full EEGs and SSEPs to be interpreted off-site
- Continuous 4-channel EEG is possible using the current patient monitors
- EEG electrode cap with bluetooth connectivity

Thank you for listening!

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