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A Retrospective Review of EEG Pattern and Outcome in Post Cardiac Arrest Patients

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Background

- Cardiac arrest causes hypoxic brain damage; the mechanism is multifaceted and complex (summarised in figure one).
- After clinical examination, EEG is the most commonly used tool to assess prognosis.
- There is a wealth of published literature regarding the association between EEG pattern and patient outcome, post cardiac arrest. The consensus is that EEGs showing burst suppression, generalised periodic complexes or isoelectricity are associated with poor outcome. EEGs with continuous slow wave activity may be associated with good outcome (but are no guarantee). Other types of EEG pattern show a variable relationship with patient outcome.
- It is notable that the published studies tend to be of whole populations of cardiac arrest patient; it is usual to see some version of the phrase 'all patients who were admitted to the centre underwent EEG recording'. However, the population we see locally is only partial; Critical Care Units (CCUs) refer patients for EEG only if clinically required. Our department does not, by any way, see all post cardiac arrest patients admitted to CCU and does not have a role in the selection of patients to be tested.
- Our population of patients is therefore subtly different from those in the published literature; including only those patients who do not recover as expected; it is absent of those patients who do particularly well and make a quick, good recovery, and also those who do particularly badly.
- We assume the relationships between EEG pattern recorded and patient outcome are the same for our population as for those detailed in literature, and we use this assumption in our reporting of EEGs, however we have not analysed this. A desire to clarify our position led to this retrospective review.

Aim of Review

To ensure that the service that we provide for our CCU colleagues - recording and interpreting EEGs in post cardiac arrest patients - is accurate and evidence based, by examining the relationship between EEG pattern recorded and patient outcome in our population of patients, and comparing this to the relationship detailed in published literature.

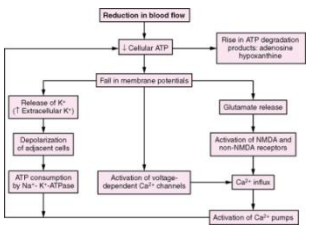

Figure One: The various mechanisms by which hypoxia causes cell damage

Summary Method

- Retrospectively review of consecutive EEGs recorded in post cardiac arrest adult patients referred from the Trust CCUs over four years. When patients had repeat tests, only their first EEG was included.
- Assign EEGs to categories according to the clinical conclusion (see table one).
- Determine the proportion of patients who survived and the number who died (at day 40 post event) in each EEG category. Look for broad trends.
- Compare the trends to those detailed in published literature.
- *NB Despite the large cohort and long collection period, after categorisation of the data, meaningful statistical analysis of the dataset was not feasible. Although this limits the surety of the trends we identify, we feel that a visual analysis of the data is appropriate for this review.*

Results

The EEGs of 64 patients were analysed. Mortality in the group was high; 47 of the patients died (73%).

PATTERN CATEGORY	INDICATIVE REPORT CONTENT	ASSOCIATION WITH PATIENT OUTCOME
Generalised periodic complexes	Spike, sharp, epileptiform, sharpened, BIPEDS, GPEDS, and which is continuous or 'almost continuous' and is generalised in all areas.	10 out of 10 patients died (100%); Poor outcome
Isoelectric	Flat or isoelectric, or no cerebral activity recorded	10 out of 10 patients died (100%); Poor outcome
Continuous slow wave activity	slow wave activity, or theta or delta activity, whether reactive or not, present throughout the recording.	11 out of 19 patients survived (57%); associated with better outcome
Discontinuous slow wave activity	slow wave activity, theta or delta frequency activity whether reactive or not, which was suppressed at times or discontinuous.	8 out of 10 patients died (80%); uncertain relationship
Intermittent / focal periodic complexes	Spike, sharp, epileptiform, sharpened, BIPEDS, GPEDS, and which is variably present; either variable over different regions or discontinuous.	6 out of 6 patients died (100%); uncertain relationship to outcome due to small group size
Burst suppression	A burst suppression or suppression burst pattern	1 out of 1 patients died (100%); group too small to comment

Table One: EEG categorisation and association with patient outcome

Summary of Results

- EEGs with generalised periodic complexes or isoelectricity are associated with poor patient outcome in the published literature. Our review mirrors this; all of the patients in whom these patterns were recorded died.
- In published literature, patients who have a good outcome are more likely to have an EEG showing continuous slow wave activity. This is reflected in our data; more patients survived than died.
- In published literature, EEGs showing discontinuous slow wave activity or intermittent / focal periodic complexes have uncertain associations with patient outcome. Our results indicate that this is transferable to our local population; intermittent / focal periodic complexes seem to be related to poor outcome, but the group is small.
- We only recorded a burst suppression EEG pattern once, so this cannot be analysed.

Conclusions

- Our data shows similar relationships between the EEG pattern recorded and patient outcome to those in published literature.
- This review therefore supports our continued use of published literature to guide us in our interpretation of EEG recordings made in post cardiac arrest patients.

Selected References
Anon. Hypoxic – Ischaemic Encephalopathy in Infants and Older Children. [Online]. Available http://clinicalgate.com/hypoxic-ischemic-encephalopathy-in-infants-and-older-children/ [Accessed 04/10/2016].
Westhall, E., Rosen, I., Rossetti, A.O., Van Rootselaar, A.F., Kjaer, T.W., Hirn, J., Ullen, S., Friberg, H., Nielsen, N., Cronberg, T. (2014) Electroencephalography (EEG) For Neurological Prognostication After Cardiac Arrest And Targeted Temperature Management; Rationale And Study Design". *BMC Neurology* 14:159.