

Intraoperative frontal α power and its correlation with the occurrence of postoperative delirium (POD) in cardiac surgery with cardiopulmonary bypass (CPB) : preliminary results of a prospective observational cohort study

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Background - Postoperative delirium (POD) is an important complication after cardiac surgery. Although preexisting cognitive impairment is a well-known predisposing factor, objective tools assessing perioperative brain vulnerability to anaesthesia and surgery are still missing.

Electroencephalogram (EEG) under general anaesthesia (GA) is characterised by simultaneous slow (<1Hz) and a (8-12Hz) oscillations, predominantly in the frontal region of the brain.¹ This phenomenon is called « anteriorisation » of the α band from parieto-occipital to frontal regions. It has been demonstrated that a lower intraoperative frontal α band power is associated with lower preoperative cognitive index scores.² Moreover, the α power tends to decrease with age and this decrease is more pronounced in the presence of underlying cognitive disorders.

Objectives - The main objective of this preliminary analysis is to evaluate whether intraoperative frontal α band oscillations derived from the raw EEG signal after weaning from CPB, is associated with the occurrence of POD. This approach does not rely on automated EEG processing commonly obtained using EEG monitoring device.

Materials & Methods – This preliminary overview is part of an ongoing research project (NCT03706989). EEG data of 100 adult patients who underwent an elective cardiac surgery with CPB under sevoflurane anaesthesia were analysed. In total, 220 patients will be included.

An intraoperative 32-channel EEG recording of 5 minutes was collected, at least 30 minutes after weaning from CPB. EEG preprocessing and spectral analysis were performed using Letswave, a comprehensive EEG analysis toolbox for MATLAB®, developed in our institution (IoNs, UCLouvain, Belgium)

For spectral analysis, a Fast Fourier Transform (FFT) was computed in order to measure the power spectrum (μV) with a specific attention to the α band in the frontal region. Average α power, α peak frequency and its related top10% power were extracted from each frontal electrode. Then, average results were calculated and results were finally log-transformed to obtain normally distributed data.

All patients were screened for POD using the Confusion Assessment Method for Intensive Care Unit (CAM-ICU), CAM (at the ward) and a chart review, until discharge from the hospital.

Statistical analysis - Continuous variables are expressed as median (P_{25} - P_{75}) or mean $\pm$ SD.. Student t-test, Mann-Whitney U and Chi square tests were used to compare data between patients with or without POD. A multivariate regression analysis was used to predict POD including age and EEG data that showed significant difference in the univariate analysis.

A p value < 0.05 was considered statistically significant.

	POD – (n = 72)	POD + (n = 28)	p
Age, y	68 (56-76)	74 (65-81)	0.009
Euroscore II, %	1.58 (0.94-2.6)	2.49 (1.47-3.99)	0.013
Open heart surgery, %	61.1	60.7	0.971
CPB time, min	97 (76-119)	114 (86-133)	0.062
α average power ($\log_{10}$)	-0.439 +/- 0.217	-0.57 +/- 0.202	0.007
α peak power ($\log_{10}$)	-0.211 +/- 0.238	-0.345 +/- 0.227	0.013
α peak frequency ($\log_{10}$)	0.952 +/- 0.054	0.946 +/- 0.05	0.632

Table 1 – Characteristics of the population

Results – 28% of the included patients had a positive screening for POD. They were significantly older and had a higher Euroscore II score than those who did not.

In addition, they presented significantly lower average α power and lower peak α power than patients who did not experience POD (Table1).



In multivariate analysis, when taking account for age > 74 years old (median age of patients presenting POD), this difference between both groups remained not statistically significant, although the difference in average α power had a p value of 0.05 (Table 2).

	OR (95% CI)	p
α average power ($\log_{10}$)	0.91 (0.01-1.03)	0.05
Age > 74 y	1.49 (0.53-4.14)	0.45
α peak power ($\log_{10}$)	0.15 (0.02-1.26)	0.08
Age > 74 y	1.61 (0.59-4.41)	0.36

Table 2 – Multivariate regression analysis for age > 74 years old

Conclusions – Preliminary results of this currently underpowered study suggest that cardiac surgery patients with lower intraoperative average α power might have a higher risk of developing POD.