

Is there a better timing for frontal electroencephalogram (EEG) α -band power quantification to predict postoperative delirium (POD) in cardiac surgery with cardiopulmonary bypass (CPB)? A pre-planned secondary analysis of a prospective cohort study.

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Background-Goal of Study - POD is a frequent complication after cardiac surgery. Lower intra-operative frontal α power has been associated with the occurrence of POD^{1,2}. However, some practical questions still need to be answered regarding its usefulness in predicting POD. In this secondary analysis, we aimed to determine the most suitable perioperative timing to quantify α power to predict POD.

Material-Methods - Using a 32-channel BioSemi ActiveTwo EEG recording system (BioSemi B.V., Amsterdam, The Netherlands), five EEG recordings (lasting 2 to 5 minutes) from 220 adult patients undergoing cardiac surgery under sevoflurane anaesthesia were collected (NCT03706989): preoperatively eyes-closed (T0), 30 minutes post-induction and before surgical incision (T1), before aortic cannulation (T2), during CPB (T3) and after chest closure (T4). Patients were screened for POD using CAM-ICU, CAM and chart reviews, from their admission in ICU to hospital discharge.

Spectral analyses were performed with MATLAB® and focused on **frontal mean α power** (8-12 Hz) for this study. EEG data were converted into dB and expressed as means $\pm$ SD. Comparisons between patients with and without POD were performed by Mann-Whitney U test or Student t-test., depending on normality assumption. We evaluated the effect of mean α power at each significant time-point on the occurrence of POD by performing univariate logistic regression analyses.

References: ¹Khalifa C et al. Eur J Anaesthesiol (2023), ²Gutierrez R et al. Front Syst Neurosci (2019)

	POD(-) (n = 155)	POD(+) (n = 65)	P
Age (years)	67 (59, 74)	74 (64, 79)	<0.001
EuroSCORE II (%)	1.5 (0.9, 2.5)	2.4 (1.3, 4.0)	<0.001
Baseline MMSE, /30	29 (27, 29)	28 (26, 29)	0.047
CPB time (min)	99 $\pm$ 33	112 $\pm$ 40	0.015
ICU length of stay (days)	2 $\pm$ 1	4 $\pm$ 3	0.004

Table 1 – **Pre-, per-, and postoperative data of patients with and without POD.**
Continuous variables are expressed as mean $\pm$ SD or as median (P₂₅, P₇₅). Abbreviations: CPB: Cardiopulmonary Bypass; EuroSCORE: European System for Cardiac Operative Risk Evaluation; ICU, intensive care unit; MMSE: Mini-Mental State Examination

	POD- (n = 155)	POD+ (n = 65)	P
Mean α power, dB (T0)	-16.74 $\pm$ 4.42	-17.61 $\pm$ 4.21	0.178
Mean α power, dB (T1)	-11.59 $\pm$ 3.37	-14.03 $\pm$ 4.61	<0.001
Mean α power, dB (T2)	-12.48 $\pm$ 3.76	-14.67 $\pm$ 4.76	0.001
Mean α power, dB (T3)	-12.03 $\pm$ 3.65	-14.45 $\pm$ 4.86	0.001
Mean α power, dB(T4)	-13.08 $\pm$ 4.03	-15.74 $\pm$ 4.77	<0.001

Table 2 – **Spectral analysis of frontal mean α power among patients with and without POD.**
Data are expressed as mean ($\pm$ SD) at iterative timings : T0 = preoperative period, T1 = post-induction phase; T2 = before aortic cannulation, T3 = during CPB; T4 = after chest closure.

Results-Discussion – Patients’ characteristics are detailed in Table 1. **The incidence of** POD was 29.5%. POD(+) patients were significantly older (P<0.001), had higher EuroSCORE II scores (P<0.001), longer CPB time (P=0.015) and longer hospital length of stay (P=0.006). Spectral analysis data of frontal mean α power are detailed in Table 2. In contradiction with what was observed at T0, POD(+) patients had significantly lower intra-operative mean α power throughout surgery (T1-T4). Table 3 shows that mean α power analysed at T1 (post-induction) was already a good predictor of POD.

	β ($\pm$ SE)	OR	95% CI for OR
Mean α power, dB (T1)	-0.16 ($\pm$ 0.04)	0.85	0.78 - 0.92
Mean α power, dB (T2)	-0.13 ($\pm$ 0.04)	0.88	0.82 - 0.94
Mean α power, dB (T3)	-0.14 ($\pm$ 0.04)	0.87	0.81 - 0.93
Mean α power, dB (T4)	-0.14 ($\pm$ 0.04)	0.87	0.81 - 0.93

Table 3 – **Univariate logistic regression analyses. Dependent variable : POD**
Abbreviation: OR = Odds Ratio

Conclusion - Frontal α power under general anaesthesia was significantly lower throughout cardiac surgery in patients who experienced POD. According to our results, quantification of frontal α power can be performed early during anaesthesia and allows the initiation of prompt strategies to prevent POD whenever appropriate.

