Science Letter

Screening of patients at risk of postoperative delirium using specific neuropsychological testing

Postoperative delirium (POD) remains one of the most prevalent neurological complications after surgery [1] and pre-existing cognitive impairment is a leading risk factor [1, 2]. Consequently, early identification of high-risk patients through pre-operative cognitive assessment is essential. Usually, the evaluation of cognitive status is performed by trained neuropsychologists, using a standardised battery of neuropsychological tests. However, integrating this type of evaluation in a busy surgical context is challenging as it requires expertise, availability and time. The objective of this secondary analysis was to evaluate whether focusing on one instead of a battery of neuropsychological tests would predict POD and ease pre-operative screening by targeting specific cognitive domains.

This study is part of a prospective observational project in which the primary objective was to evaluate intra-operative frontal electroencephalogram α band power as a predictor of POD in patients having cardiac surgery [3]. From May 2019 to December 2021, we included 220 adult patients who underwent an elective cardiac surgery using cardiopulmonary bypass. The day before surgery, enrolled patients were submitted to a battery of pre-operative neuropsychological tests (Fig. 1): 16-item free and cued selective reminding test (FCSRT); modified visual reproduction test from the Wechsler memory scale; digit span test from the revised version of the Wechsler adult intelligence scale (WAIS-R); trail making test; and digit symbol test from the WAIS-R. Sample-specific z-scores ([individual result − mean of the cohort]/standard deviation of the cohort) were computed from each test result. For the FCSRT z-score, only the sum of the results of the three free recalls was considered. For the trail making test, only the difference (time part B minus time part A) was considered. After surgery, patients were screened for POD until discharge from the hospital using the confusion assessment method for intensive care unit (CAM-ICU) and confusion assessment method (CAM) on the ICU and ward, respectively, and a chart review. Comparisons between patients with and without POD were performed using Mann–Whitney U-test or Student's t-test, depending on normality assumption. Categorical variables were compared using a χ^2 test. Univariable and multivariable logistic regressions were performed to determine the predictive ability of the neuropsychological tests.

Patient characteristics and peri-operative clinical data of patients with and without POD are shown in Table 1. Sixty-five (29.5%) patients had at least one episode of POD. Patients with delirium were older (mean (SD) 71 (10) y vs. 65 (11) y, $p < 0.001$). There was no difference regarding educational level between groups. Patients who experienced POD had lower pre-operative cognitive score results, except for the digit span test (Table 1). Univariable regression analyses confirmed that the 16-item FCSRT (odds ratio (OR) (95%CI) 0.49 (0.35–0.68), $p < 0.001$); modified visual reproduction test (OR (95%CI) 0.45 (0.32–0.62), $p < 0.001$); trail making test (OR (95%CI) 0.63 (0.47–0.84), $p = 0.002$); and digit symbol test (OR (95%CI) 0.54 (0.39–0.75), $p < 0.001$) predicted POD. In multivariable logistic regression analysis, only the modified visual reproduction test predicted POD (adjusted OR (95%CI) 0.60 (0.38–0.95), $p = 0.030$) (online Supporting Information Table S1).

Although recent guidelines on peri-operative brain health recommend the systematic assessment of pre-operative cognitive status, there is currently no consensus on which screening test should be implemented [4–6]. Among the standardised neuropsychological tests performed in this study, our results showed that the modified visual reproduction test might be the most promising instrument to predict POD [7]. The efficient completion of this test requires the integrity of several brain regions and draws on not only visual memory but also perception and constructional skills. Practically, the patient observes for 10 s, then draws five geometric elements of increasing complexity from immediate recall. Twenty minutes later, the patient is asked to remember and draw the same pictures without prior visual reminder. A significant advantage of this test is that it does not depend on literacy or language proficiency, contrary to the 16-item FCSRT or the trail making test. Additionally, most participants found it enjoyable and less stressful than other tools in the battery, making it suitable for pre-operative assessment. However, results should be interpreted cautiously, especially regarding the patient's educational

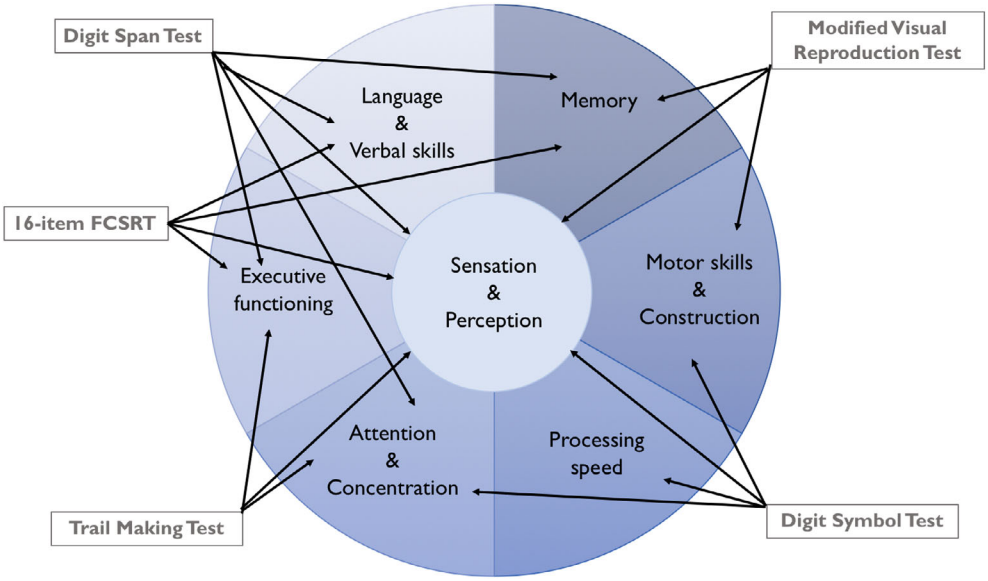

Figure 1 Cognitive domains and related neuropsychological testing. 16-item FCSRT, 16-item free and cued selective reminding test.

Table 1 Peri-operative clinical data and characteristics of patients with and without postoperative delirium. Values are mean (SD), number (proportion) or median (IQR [range]). Number of patients with available data are mentioned between brackets.

	With postoperative delirium n = 65	**Without postoperative delirium n = 155**	**p value**
Pre-operative data			
Age; y	71 (10)	65 (11)	< 0.001
Sex; male	52 (80%)	128 (83%)	0.651
EuroSCORE 2;%	2.4 (1.3–4.0 [0.6–8.8])	1.5 (0.9–2.5 [0.5–9.7])	< 0.001
Lower educational level (< 9 y)	20 (37%) (n = 54)	39 (26%) (n = 148)	0.163
z-score 16-item FCSRT	-0.47 (1.04)	0.20 (0.91)	< 0.001
z-score modified visual reproduction test	-0.54 (1.09)	0.23 (0.86)	< 0.001
z-score digit span test	-0.18 (0.96)	0.08 (1.01)	0.065
z-score trail making test	-0.37 (1.30) (n = 59)	0.14 (0.82) (n = 152)	0.003
z-score digit symbol test	-0.40 (1.07) (n = 64)	0.16 (0.92)	< 0.001
Intra-operative data			
Type of surgery			0.180
Isolated coronary artery bypass grafting	26 (40%)	74 (48%)	
Single non-coronary artery bypass grafting	10 (15%)	35 (23%)	
2 interventions	20 (31%)	30 (19%)	
≥ 3 interventions	9 (14%)	16 (10%)	
Surgical time, min	238 (60)	226 (57)	0.170
Cardiopulmonary bypass, min	112 (40)	99 (33)	0.015
Postoperative data			
Mechanical ventilation time; h	9.8 (6.6)	7.3 (3.4) (n = 152)	0.005
ICU duration of stay; d	4 (2–4 [1–21])	2 (2–2 [1–9])	0.004
Hospital duration of stay; days	8 (7–11 [6–29])	8 (7–9 [5–26])	0.006

EuroSCORE, European System for Cardiac Operative Risk Evaluation; FCSRT, Free and Cued Selective Reminding Test.

level. Indeed, it has been shown that older patients with < 8 y of scholarship had less ability to reproduce geometric elements with high complexity [8].

This study confirms that pre-operative cognitive impairment is associated with the occurrence of POD. The modified visual reproduction test stands out as a promising screening tool, provided the patient's level of education is considered.

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Supporting Information

Additional supporting information may be found online via the journal website.

Table S1. Multivariable logistic regression analysis – dependent variable: postoperative delirium.