

Original article

Effect of preoperative cognitive dysfunction on postoperative outcomes in cardiac surgery

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Background: Preoperative cognitive dysfunction (PreOCD) has not been well described as a risk factor for poor outcomes in cardiac surgery. This study was aimed to demonstrate the effects of PreOCD on postoperative outcomes in cardiac surgery.

Methods: One hundred adult patients undergoing elective open cardiac surgery at King Chulalongkorn Memorial Hospital were recruited. The Montreal Cognitive Assessment (MoCA) was used to evaluate cognitive function the evening before surgery and defined a score of less than 26 as cognitive impairment. We compared postoperative outcome data between patients with PreOCD group and no PreOCD group.

Results: One patient in the PreOCD group withdrew from our study. Sixty nine out of 99 patients (68.31%) had PreOCD. In the PreOCD group, the postoperative mechanical ventilation period was significantly longer (15.9 ± 26.6 vs. 7.4 ± 8.76 hours, $P = 0.018$), ICU stay was significantly longer (39.9 ± 43.7 vs. 27.6 ± 15.0 hours, $P = 0.039$), and the cost of hospital stay was significantly higher ($13,540 \pm 6,355$ vs. $11,264 \pm 5,229$ baht, $P = 0.014$). However, the length of hospital stay was not significantly different (10.1 ± 3.8 vs. 9.3 ± 4.4 days, $P = 0.384$).

Conclusions: We demonstrated the adverse effects of PreOCD on patients outcomes after cardiac surgery. Identifying PreOCD may be useful in risk stratification during preoperative assessment to improve surgical outcomes.

Keywords: Preoperative cognitive dysfunction, cardiac surgery, postoperative outcome, cognitive assessment.

Postoperative cognitive dysfunction (POCD) is a common complication after both cardiac and non-cardiac surgery in elderly patients. The incidence of POCD persisted for 6 months after surgery occur in about 10 - 30% of cardiac surgical patients.⁽¹⁾ Several studies showed adverse postoperative outcomes in patients with POCD. A multicenter cohort study with 701 patients demonstrated the association between POCD and prolonged lengths of hospital stay, recovery times and an increased one-year mortality rate.⁽²⁾ Patients with POCD also lose their functional independence that leads to disability.

Several studies indicated an association of preoperative cognitive dysfunction and postoperative morbidity, especially in the elderly. A cohort study found that elderly patients with mild cognitive impairment were associated with pulmonary complications after coronary artery bypass grafting (CABG).⁽³⁾ Robinson's study also found that preoperative cognitive dysfunction (PreOCD) was associated with postoperative delirium, longer hospital stays, higher rates of discharge, institutionalization and six-month mortality.⁽⁴⁾ However, when compared with POCD, there is less information regarding preoperative cognitive dysfunction with varied results. This study aimed to demonstrate the effect of preoperative cognitive dysfunction on postoperative outcomes in cardiac surgery.

Methods

Study population

After the institution review board have approved our study project, we recruited 100 consecutive

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patients who presented at King Chulalongkorn Memorial Hospital for elective cardiac surgery facilitating cardiopulmonary bypass from July 2015 to October 2016. The inclusion criteria were 18 - 65 years-old patients who had a left ventricular ejection fraction of more than 30% and serum creatinine levels less than 2 mg/dL in males and 1.5 mg/dl in females. The exclusion criteria were a history of symptomatic cerebrovascular diseases, psychiatric problems or other neurological diseases. Conditions that prevented participation in the assessment such as the patient who had hearing and visual impairment as well as an inability to understand Thai language were also excluded. Written information was completed by the patients before recruitment.

Cognitive assessment

Preoperative cognitive function was assessed in all participants the evening before surgery. We used the Montreal Cognitive Assessment (MoCA) for screening of cognitive impairment. This is a one-page, 30-point test which can be completed in about 10 minutes. This test has already been translated into Thai and validated for the Thai population.⁽⁵⁾ Eight domains were assessed including visuospatial and executive function, naming, memory, attention, language, abstraction, delayed recall and orientation. The test also compensates for educational level by giving an additional point for any patients who graduated below grade 12. MoCA is independent of gender, and correlates well with age. The reported sensitivities for detecting mild cognitive impairment

were 83% - 90% and specificities were 50% - 87% varying with health, age and cognitive background.⁽⁶⁻⁹⁾ We defined PreOCD as a MoCA score below 26.

Outcome measurement

Our subjects were divided into two groups regarding the presence or absence of PreOCD. One subject in the PreOCD group refused to continue in the study due to a personal reason. As a result, 99 patients were eligible for data analysis (Figure 1).

We compared data regarding duration of postoperative mechanical ventilation, duration of ICU stays, length of hospital stays, as well as calculated cost of hospital stays between groups. The cost of a hospital stay was based on the charge rate occurred by patients in our institute. For instance, a charge of a hospital bed per day is 1,400 baht in ICU and 400 baht for general wards. Continuous vital signs monitoring in the ICU costs 1,000 baht per day. The charge for ventilator support during an ICU stay is 1,900 baht per day.

Statistical analysis

All statistical analyses were performed using SPSS software (version 23). Data are expressed as mean \pm standard deviation (SD) for continuous data and number (percentages) for categorical data. Comparisons between groups were made using non-parametric testing which were Mann-Whitney-U tests for continuous data and Chi-square tests for categorical data. A *P* - value of less than 0.05 was considered statistically significant.

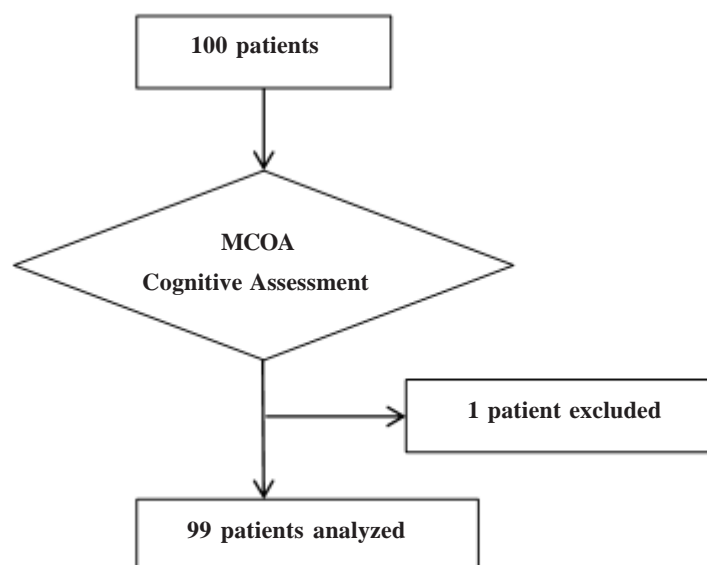


Figure 1. Study flow diagram.

Results

The number of eligible patients for data analysis was 99. Demographic data between both groups are shown in Table 1. The prevalence of preoperative cognitive dysfunction was 69%. The mean and SD of MoCA test scores for the preoperative cognitive dysfunction group was 21 ± 3.4 compared to 27.1 ± 1.1 in the other group. There was no difference between both groups in terms of age, weight, body mass index (BMI), serum creatinine levels and left ventricular ejection fraction (LVEF).

We found adverse postoperative outcomes in the PreOCD group, as shown in Table 2. The time required for mechanical ventilation was significantly longer (15.9 ± 26.6 hours vs. 7.4 ± 8.76 hours; $P = 0.018$). Also, the lengths of ICU stays were significantly longer (39.9 ± 43.7 hours vs. 27.6 ± 15.0 hours; $P = 0.039$). However, the length of hospital stays were not statistically significantly different between both groups (10.1 ± 3.8 days vs. 9.3 ± 4.4 days; $P = 0.384$). Additionally, the calculated cost of a hospital stay was significantly higher in the PreOCD group ($13,540 \pm 6,355$ baht vs. $11,264 \pm 5,229$ baht, $P = 0.014$).

Discussion

More than half of the patients in our study had PreOCD as defined by a MoCA score of less than 26. The prevalence of preoperative cognitive impairment in previous studies varied with age range and health backgrounds of study populations and the diagnostic criteria use in each research.^(6, 7, 10, 11) PreOCD is rather common in elective surgical patients. Moreover, subtle cognitive impairment can be easily missed. As a result, the prevalence among studies may be underestimated. Our study demonstrated the relationship of PreOCD on patients' postoperative outcomes following cardiac surgery. PreOCD was found to be associated with prolonged mechanical ventilation, longer ICU stays and increased costs of hospital stays when compared with those who did not have PreOCD.

Although preoperative cognitive dysfunction is not routinely screened in preoperative evaluations, it may be a useful indicator for risk stratification during preoperative screening and potentially facilitate risk reduction.⁽¹²⁾ Although formal neuropsychological tests may be effective in diagnosing mild cognitive

Table 1. Characteristics of the patients.

	PreOCD	No PreOCD	Overall
Number	69	30	99
MoCA score	21.0 ± 3.4	27.1 ± 1.1	22.9 ± 4.0
Age (year)	54.0 ± 11.0	48.0 ± 14.0	52.0 ± 12.0
Weight (kg)	61.0 ± 12.0	61.0 ± 14.0	61.0 ± 12.0
BMI (kg/m ²)	23.3 ± 3.2	23.1 ± 3.6	23.3 ± 3.3
Serum creatinine (mg/dL)	1.9 ± 7.7	1.8 ± 4.4	1.9 ± 6.9
LVEF(%)	60.0 ± 14.0	66.0 ± 9.0	62.0 ± 13.0

BMI: Body mass index; LVEF: Left ventricular ejection fraction; MoCA: Montreal Cognitive Assessment.

Table 2. Postoperative outcomes.

	PreOCD (n = 69)	No PreOCD (n = 30)	P - value
Mechanical ventilation (hour)	15.9 ± 26.6	7.4 ± 8.8	0.018
ICU stay (hour)	39.9 ± 43.7	27.6 ± 15.0	0.039
Length of hospital stay (day)	10.1 ± 3.8	9.3 ± 4.4	0.384
Calculated cost hospital stays (baht)	$13,540 \pm 6,355$	$11,264 \pm 5,229$	0.014

ICU: Intensive Care Unit.

impairment, it may not be practical in our routine preoperative anesthetic and surgical evaluation. The MoCA test, widely validated as an effective screening tool for mild cognitive impairment, may be an alternative in this situation due to its simplicity and ease of use.

This is an observational study. For more applicability of future research, study of the aged population and exploration of the long-term outcomes would be more beneficial. Controlling anesthetic regimens, targeted sedation protocols in ICU and the ICU discharge criteria should be defined. Measuring the time required to complete ICU discharge criteria rather than actual time spent in the ICU might be more clinically relevant. Additionally, assessment of postoperative cognitive dysfunction and postoperative delirium should be evaluated.

Conclusion

We demonstrated the adverse effects of PreOCD on patients' outcomes after cardiac surgery such as prolonged duration of mechanical ventilation, prolonged ICU and increased cost of hospitalization. Identifying PreOCD may be useful in risk stratification during preoperative assessment to improve surgical outcomes.

Conflict of interest

None of the authors has any potential conflict of interest to disclose.

References

1. Newman MF, Kirchner JL, Phillips-Bute B, Gaver V, Grocott H, Jones RH, et al. Longitudinal assessment of neurocognitive function after coronary-artery bypass surgery. *N Engl J Med* 2001;344:395-402.
2. Steinmetz J, Christensen KB, Lund T, Lohse N, Rasmussen LS. Long-term consequences of postoperative cognitive dysfunction. *Anesthesiology* 2009;110:548-55.
3. Aykut K, Albayrak G, Guzeloglu M, Baysak A, Hazan E. Preoperative mild cognitive dysfunction predicts pulmonary complications after coronary artery bypass graft surgery. *J Cardiothorac Vasc Anesth* 2013;27:1267-70.
4. Robinson TN, Wu DS, Pointer LF, Dunn CL, Moss M. Preoperative cognitive dysfunction is related to adverse postoperative outcomes in the elderly. *J Am Coll Surg* 2012;215:12-7.
5. Vichitvejpaisal P, Preechakoon B, Supaprom W, Sriputtaruk S, Rodpaewpaln S, Saen-Ubol R, et al. The Montreal Cognitive Assessment as a screening tool for preoperative cognitive impairment in geriatric patients. *J Med Assoc Thai* 2015;98:782-9.
6. Waite LM, Broe GA, Grayson DA, Creasey H. Preclinical syndromes predict dementia: the Sydney older persons study. *J Neurol Neurosurg Psychiatry* 2001;71:296-302.
7. McLennan SN, Mathias JL, Brennan LC, Stewart S. Validity of the Montreal Cognitive Assessment (MoCA) as a screening test for Mild Cognitive Impairment (MCI) in a cardiovascular population. *J Geriatr Psychiatry Neurol* 2011;24:33-8.
8. Smith T, Gildeh N, Holmes C. The Montreal Cognitive Assessment: validity and utility in a memory clinic setting. *Can J Psychiatry* 2007;52:329-32.
9. Bernstein IH, Lacritz L, Barlow CE, Weiner MF, DeFina LF. Psychometric evaluation of the Montreal Cognitive Assessment (MoCA) in three diverse samples. *Clin Neuropsychol* 2011;25:119-26.
10. Torisson G, Minthon L, Stavenow L, Londos E. Cognitive impairment is undetected in medical inpatients: a study of mortality and recognition amongst healthcare professionals. *BMC Geriatr* 2012;12:47.
11. Busse A, Bischof J, Riedel-Heller SG, Angermeyer MC. Mild cognitive impairment: prevalence and incidence according to different diagnostic criteria. Results of the Leipzig Longitudinal Study of the Aged (LEILA75+). *Br J Psychiatry* 2003;182:449-54.
12. Crosby G, Culley DJ, Hyman BT. Preoperative cognitive assessment of the elderly surgical patient: a call for action. *Anesthesiology* 2011;114:1265-8.