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Incidence and Predisposing Factors of Cognitive Disorders Following off-Pump Coronary Artery Bypasses Graft Surgery

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Background: Cognitive disorder, which is a common problem for the hospitalized patients, is a fluctuating cognitive destruction that leads to the loss of consciousness. It is usually accompanied by increased mortality, prolonged hospital stay, and decreased rehabilitation.
Objectives: The purpose of this study was to determine the risk factors associated with cognitive disorder after coronary artery bypasses graft surgery (CABG).
Patients and Methods: A total of 171 patients who had undergone off-pump CABG without any history of psychiatric disorders were enrolled. Samples were selected according to a purposive sampling method. The Mini-Mental State Examination (MMSE) questionnaire was given to each patients to assess the incidence of cognitive disorder during the first 24 hours of surgery in ICU. To compare creatinine, erythrocytes sedimentation rate, extubation time, and patients' age between those with and those without postoperative cognitive disorder, independent-samplest test was employed. To compare two groups in terms of any history of diseases such as diabetes, hypertension, and hyperlipidemia, and qualitative C-reactive protein (CRP), Chi square test was used.
Results: Results showed that 75% of patients had postoperative cognitive disorder. There was a significant association between the history of hypertension, CRP, and preoperative creatinine levels in both cognitive disorder and control groups.
Conclusions: Given the significant prevalence of postoperative cognitive disorder and significant association between the history of hypertension, CRP, and preoperative creatinine and cognitive disorder, the detection of patient's clinical symptoms may improve diagnosis, treatment, and even prevention of cognitive disorder.

Keywords: Off-Pump Coronary Artery Bypass; Cognitive Disorder; Delirium; Risk Factors

1. Background

Cognitive disorder is a fluctuating cognitive damage as well as a consciousness disorder, which is a common acute problem among hospitalized patients. In another definition, cognitive disorder is a type of cognitive and consciousness dysfunction that is spread in a short time and is characterized by features such as changed level of consciousness, reduced concentration and memory, impaired orientation, rapid incidence for several hours to several days, short period, and notable fluctuations (mostly at night) (1). The incidence of cognitive disorder in hospitalized patients is associated with increased mortality (2-4), prolonged hospital stay (5, 6), increased hospitalization (7), impaired rehabilitation of patient, increased nursing measures (8), prolonged intubation (9), higher risk of falls (2), impaired cognitive function (5), increased risk of dementia (6), inability to return to work (3), poor quality of life (10), and long-term care (11).

The incidence of cognitive disorder is an indicator of poor prognosis; the rate of mortality in patients with an attack of cognitive disorder is 23% to 33% and their annual mortality rate is 50%. The mortality rate of patients who develop cognitive disorder during hospitalization is 20% to 75% and 15% and 25% of them would pass away within one and six months, respectively (12). The incidence of cognitive disorder varies in different wards. The highest rate of cognitive disorder is seen following thoracotomy and cardiac surgeries, which may even reach 90% (4).

The hypotheses about causes of cognitive disorder include metabolic encephalopathy, drug toxicity, hypoglycemia, preoperative hypoxemia, visual and hearing impairment, and the type and duration of anesthesia (6, 9). The main postoperative causes include surgical stress, postoperative pain, insomnia, pain control medications, electrolyte disturbances, fever, and bleeding (13).

The risk of cognitive disorder might increase in major operations such as heart surgery due to the complex surgical procedure, the use of anesthetics and relaxants during and after surgery, and postoperative complications (14). The postoperative pain may also lead to sleep disturbance, increased metabolism, myocardial ischemia, anxiety, and cognitive disorder (5). Thus, it is clear that the prevalence and risk factors associated with cognitive disorder in patients undergoing cardiac surgery, who are held in ICU, is necessary. Identifying the cognitive disorder risk factors may help early diagnose and reduce complications.

2. Objectives

This study aimed to assess the incidence and risk factors of cognitive disorder in patients after open-heart surgery, ie, off-pump coronary artery bypass graft surgery (CABG).

3. Materials and Methods

This descriptive study was performed on 171 patients undergoing elective CABG in Heart Center of Imam Reza Hospital, Mashhad, during eight months. The samples size was calculated using 329 North 1000 East, Kaysville, Utah 84037, USA NCSS and PASS statistical software with minimum 80% (the 1-β for the multiple logistic regression test) for the multiple logistic regression test, the significance level of 5% (the α for multiple logistic regression test), The coefficient of determination of 80%, odds ratio of 2.91 and 0.28 and 0.531 probability of cognitive disorder incidence (15). The sample size estimated 170 patients Then the samples were selected according to a purposive sampling method. For all patients, echocardiography and Doppler sonography of carotid arteries was performed before surgery.

The night before the surgery, a psychologist visited the patients and conducted a clinical interview with Millon test to evaluate the patients in terms of the history of cognitive disorder as well as mood and psychiatric disorders. Furthermore, the selected patients were examined for any sign of psychological disorder.

Patients' ASA class was at least III and even IV. Exclusion criteria were emergency operations, repeated operations, carotid stenosis > 40%, preoperative creatinine > 2 mg/dL, history of cognitive disorders, and late extubation (> 8 hours).

Anesthesia was induced by 0.1 -mg/kg midazolam, 10 -µg/kg fentanyl, 1 -mg/kg propofol, and 0.5 -mg/kg atracurium. During the operation, anesthesia was maintained by 5 -mg/h midazolam, 20 -mg/h atracurium, and 50 -µg/kg/min propofol. After transferring patients to ICU and acquiring wining and extubation condition (4 to 8 hours after operation), they were extubated and the cognitive disorder score of patient during the first 24 hours of stay in ICU (calculated after extubation) was assessed and recorded according to Mini-Mental State Examination (MMSE).

The data on the history of patients as well as other collected data were entered into SPSS version 21 (SPSS Inc., Chicago, IL. USA). To compare creatinine, erythrocyte sedimentation rate (ESR), extubation time, and patients' age between two groups of patients with and without postoperative cognitive disorder, independent-samples t test was used and to compare two groups in terms of any history of diseases such as diabetes, hypertension (HTN), and hyperlipidemia, Chi square test was used.

4. Results

Among 171 patients with mean age of 64.04 ± 9.84 years, 75% had postoperative cognitive disorder with mean age of 64.26 ± 9.04 years. As shown in Table 1, only the preoperative creatinine was significantly different between patients with and without cognitive disorder symptoms (P = 0.02) while other factors such as ejection fraction (EF), ESR, age, and even extubation duration were not significantly different.

As shown in Table 2, the patients with and without postoperative cognitive disorder were significantly different regarding the history of HTN and C-reactive protein while two groups were not significantly different regarding the history of stroke, diabetes, and hyperlipidemia.

Table 1. Comparing Age, Extubation Duration, Ejection Fraction, and Erythrocyte Sedimentation Rate Between Participants [a,b,c]

	Group Without Cognitive Disorder (n = 42)	Group With Cognitive Disorder (n = 129)	Total (n = 171)	P value
Age, y	63.97± 10.14	64.26± 9.04	64.04 ± 9.84	0.868
Cr, mg/dL	1.11± 0.33	1.22± 0.35	1.13 ± 0.34	0.029
ExtubationDuration, h	4.95± 2.48	5.42± 2.39	5.16 ± 2.43	0.236
Preoperative EF, %	48.01± 11.33	47.43± 8.91	47.87 ± 10.76	0.468
ESR, h	-	-	44.69 ± 11.95	0.354

[a] Abbreviations: EF, ejection fraction; and ESR, erythrocyte sedimentation rate.
[b] Data are presented as mean ± SD.
[c] Results of independent-samples t test.

Table 2. Comparing the History of Stroke, Hypertension, Diabetes, Dyslipidemia, and Positive Results for CRP Between Participants [a,b]

	Without Cognitive Disorder (n = 42)	With Postoperative Cognitive Disorder (n = 129)	P Value
CVA	2.3	7.1	0.171
DM	29.5	35.7	0.44
HTN	83.7	61.9	0.003
HLP	49.6	40.5	0.3
CRP+	32	80	0.045

[a] Abbreviations: CVA, cerebrovascular accident; DM, diabetes mellitus; HTN, hypertension; HLP, hyperlipidemia; and CRP, C-reactive protein.
[b] Chi square was used to compare groups. Data are presented as frequencies.

5. Discussion

The results of this study revealed that 75% of the patients had cognitive disorder after off-pump CABG whereas the incidence of this syndrome after open-heart surgery had been reported to be 20% to 45%in other studies (16-18). In the study of Ganavati et al. in Iran, this rate was reported to be 47% (19).

This difference could be due to a variety of reasons such as the sample size of the study, or the use of various diagnostic criteria to identify cognitive disorder. Moreover, this study was conducted on an aging population and since most studies introduce age as a risk factor that is associated with postoperative cognitive complications, older age may increase cognitive disorders (20-22). In the study undertaken by Miyazaki et al. high level of serum creatinine was found to be a predisposing factor for cognitive disorder (23); a finding that was confirmed by the present study.

In numerous studies including Miyazaki et al. (23) and Koster et al. (15), it was suggested that a history of stroke and HTN can be a predisposing factor for severe disorders such as cognitive disorder, whereas the present study suggested that two groups were not significantly different in terms of the history of stroke. In addition, HTN in those without cognitive disorder was more frequent than in those with postoperative cognitive disorder, which could be due to the small sample size.

A study in China showed that diabetes could be considered as a risk factor for cognitive disorder (18). Consistent with this finding, a history of diabetes in our patients with postoperative cognitive disorder was more common than in patients without this complication.

Overall, given the results of this study and the high incidence of cognitive disorder after open-heart surgery, especially among the elderly, the preoperative assessment of cognitive function of the patients is of utmost importance. Furthermore, the complications of cognitive disorder can be controlled in nonemergency surgeries by psychiatric consulting and identifying associated risk factors. Obviously, it requires studies to investigate the effect of these interventions on postoperative cognitive state of patients.

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Authors' Contributions

Mehdi Fathi and Ghasem Soltani, designing the project and performing the study; Mehdi Fathi and Azra Izanloo, analysis and interpretation of data and writing the manuscript; and Marjan Joudi, acquisition of data and supervision of the study.

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