Incidence of Delirium and Its Related Risk Factors Among Patients in Cardiac Intensive Care Unit

Abstract

Background: The incidence of delirium in patients who underwent open-heart surgery can cause them to face many short- and long-term complications. Having comprehensive information on the incidence and risk factors of delirium in patients who underwent open-heart surgery is essential for preventive care. Owing to the lack of studies in this regard, this study was conducted with the aim of investigating the incidence of delirium and its associated risk factors among patients undergoing cardiac surgery in a cardiac intensive care unit.

Methods: This is a cross-sectional descriptive study conducted in the cardiac surgery intensive care unit of Booali Sina Hospital in Qazvin, Iran in 2018. The study sample comprised 230 patients who underwent open-heart surgery. For data collection, a demographic checklist and the Neelon and Champagne Confusion Scale were used. Data collection started in the evening before cardiac surgery and continued every day until patients left the intensive care unit. Collected data were then analyzed using descriptive tests and a nonlinear logistic regression model by Statistical Package for the Social Sciences, version 23.

Results: Of all the patients who participated in this study, 53.5% showed some degree of delirium; 17 patients (7.4%) showed symptoms of moderate-to-severe delirium, 16 patients (7%) showed symptoms of mild delirium, and 90 patients (39.1%) developed confusion. Among the variables studied in this study, older age, history of renal diseases, history of stroke, the use of intraoperative cardiopulmonary bypass, clamp time, postoperative fibrillation, and postoperative stroke significantly predicted delirium ($P < .05$).

Conclusion: More than half of the patients reported some degree of delirium. Therefore, it is necessary to take preventive measures into consideration in this regard.

Keywords: Delirium, intensive care, critical patients, cardiac surgery, risk factors

Jalil Azimian[1]
Mohammad Ali Soleimani[1]
Seyed Saeed Farzam[1]
Zahra Rahimi Dosaldeh[2]

[1] Social Determinants of Health Research Center, Research Institute for prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran
[2] Student Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran

Introduction

Delirium is an acute change in the mental state that is characterized by disturbed consciousness, reduced attention, and cognitive changes and has a fluctuating course over its period.[1] The acute onset of symptoms and the fluctuating course, inattention, disturbed consciousness, and impaired cognition are the main keys to diagnosing delirium.[2] In recent studies, this disorder has been reported as one of the most common neurological disorders after cardiac surgery.[3,4,5] Delirium in patients with cardiac surgery can be associated with many side effects, including decreased physical ability, increased risk of stroke, increased length of hospital stay, increased cost and mortality, and readmission.[2,6] In addition, delirium also has negative impacts on the patients' quality of life after long-term cardiac surgery.[3]

Nurses have an important role in the identification and management of delirium in hospitalized patients.[7,8] They usually spend more time with patients than other healthcare workers, and early recognition of delirium by them helps in taking measures to prevent an advanced form of this problem.[8,9] Nurses usually are the first personnel among the healthcare workers to observe a change in a patient's baseline cognition.[9] So, having sufficient and comprehensive information on the risk factors of delirium in hospitalized patients is the crucial key to planning and implementing preventive interventions to prevent delirium by nurses.[8,10] Although international studies on the incidence and risk factors of delirium in patients undergoing open-heart surgery are increasing, the results of systematic reviews indicate that further studies, especially regarding the risk factors for delirium, are needed.[11] Studies in Iran are also very limited. Our searches showed that 4 studies have been

conducted on this topic. Limitation on the comprehensiveness of the studied variables is considered the main limitation in most of these studies. In addition, the application of different tools has resulted in a 23-48% incidence of delirium in these studies.[12,13,14] Previous studies on this topic in Iran have also recommended that further studies be conducted. Therefore, this study was designed and conducted with the aim of investigating the incidence of delirium and its associated risk factors among patients undergoing cardiac surgery in the intensive care unit (ICU).

Methods

This was a cross-sectional descriptive study conducted from March to late July 2018. The study setting was the cardiac surgery ICU of Booali Sina Hospital in Qazvin, Iran. This hospital has 2 cardiac surgical operating room with a 7-bedded cardiac surgery ICU. In this ICU, no specific protocol was used to assess and prevent delirium in patients.

The inclusion criteria for the study included undergoing elective open-heart surgery and being aged >18 years. The exclusion criteria for the study included the presence of delirium on admission, hearing loss, blindness, inability to fill in the questionnaire, and being intubated on the first day. According to Gannati et al.'s study[12] entitled "incidence of delirium and associated factors before open-heart surgery" in which the incidence (p) of delirium was reported as 0.28, the sample size was calculated as follows:

$d = 0.13 \times P = 036 \ P = 0.28$

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2 \times p(1-p)}{(d)^2} = \frac{2.57^2 \times 0.285(0.958)}{0.036^2} = \frac{0.260}{0.0013} = 200$$

The final sample was calculated to be 230 patients considering a drop-out percentage of 15%. The convenience sampling technique was utilized.

The information required for this study was collected in 3 stages, including before, during, and after the surgery. The demographic checklist (including age, gender, education level, income, occupation, marital status, history of diabetes, history of smoking, history of drug use, history of taking hypnotic drugs, history of hypertension, history of stroke, history of mental illness, history of renal diseases, decreased serum albumin, and left ventricular ejection fraction) was completed before the surgery. The checklist for intraoperative predictive factors of delirium included cardiac surgery using cardiopulmonary bypass, type of surgery (coronary valve or artery), pump time, clamp time, and the use of anesthetic (sufentanil or midazolam). Examination of postoperative data until admission to the ICU included postoperative fibrillation and postoperative stroke.

The Neelon and Champagne (NEECHAM) confusion scale was used to assess delirium. This scale was developed in 1996 by Neelon et al.[15] This scale contains 3 main subscales: subscale I, information processing (score range of 0-14 points), evaluates attention and alertness, verbal and motor response, and memory and orientation; subscale II, behavior (score range of 0-10 points), evaluates general appearance and posture, sensory-motor performance, and verbal responses; and subscale III, performance (score range of 0-16 points), assesses vital signs, oxygen saturation level, and urinary incontinence. The scores may range from 0 to 30. On the basis of the score obtained, the patients are divided into 4 categories: healthy persons with scores of 30-27, confused patients with scores of 26-25, patients with mild delirium with scores of 24-20, patients with moderate-to-severe delirium with scores of 19-0. The validity and reliability of the Persian version

of this scale were determined by Jannati et al. in 2014. They reported a Cronbach alpha of 0.98.[16] The Cronbach alpha value of the scale in our study is 0.91.

In the evening before the surgery, all patients in the cardiac surgery unit were assessed by 1 of the researchers to rule out primary delirium using the NEECHAM confusion scale. For each patient, the demographic checklist and the checklist for intraoperative and 1-day postoperative predictive factors of delirium (due to the lack of postoperative intubation) were completed from 4 pm to 8 pm; symptoms of delirium are more severe in the evening and early hours of the night.[12] This procedure was done while the patient was in the unit. The assessment of delirium was performed by 1 of the researchers who was skilled in the field.

Data Analysis

In this study, Statistical Package for the Social Sciences (SPSS), version 23 (IBM Corp.; Armonk, NY, USA) was used for data analysis.[17] Chi-square test and Fisher's exact test were used to investigate the relationship between the qualitative variables. Because of the qualitative and binary nature of the response variable (whether or not delirium was present), a nonlinear logistic regression model was used to determine the predictive factors of delirium after open-heart surgery. In this model, the odds of an outcome are expressed as the size of their relationship. The significance level of all tests was considered to be <0.05.

Ethical Consideration

After the approval of the study by the Ethics Committee of Qazvin University of Medical Sciences (IR.QUMS.REC.1396,444) and presenting an official letter from the Research Department of Qazvin School of Nursing and Midwifery to the authorities and obtaining their approval, eligible patients were asked to participate in the study after providing the necessary information for them, assuring them of the confidentiality of their personal information and obtaining informed written consent from them. Withdrawal from the study at any time was also guaranteed.

Results

The mean age of participants was 61.9 ± 12.3. The majority of them were male (60.4%) and illiterate (49.1%). Table 1 shows the detailed demographic information of the patients who participated in the study.

Of all the patients who participated in this study, 53.5% of them showed some degrees of delirium; 17 patients (7.4%) showed symptoms of moderate-to-severe delirium, 16 patients (7%) showed symptoms of mild delirium, and 90 patients (39.1%) developed confusion. In the investigation of independent and predictive variables of delirium incidence, older age, history of renal diseases, history of stroke, the use of intraoperative cardiopulmonary bypass, clamp time, postoperative fibrillation, and postoperative stroke were identified as the important and effective variables on the basis of the results of the univariate logistic regression model (*P*<.05). Table 2 shows the concurrent impacts of these variables on the incidence of delirium. The results showed that age, the history of perioperative stroke, the use of intraoperative cardiopulmonary bypass, and the occurrence of postoperative stroke were among the significant factors affecting the incidence of delirium (*P*<.05) (Table 2).

Discussion

The incidence of delirium in patients after cardiac surgery can be associated with many complications. The results of this study showed

Table 1. Patients Demographics Information

Item		N (%)
Age	<60	92 (40)
	>60	138 (60)
Gender	Male	139 (60.4)
	Female	91 (39.6)
History of smoking	Yes	58 (25.2)
	No	172 (74.8)
History of stroke	Yes	18 (7.8)
	No	212 (92.2)
History of renal diseases	Yes	20 (18.7)
	No	210 (91.3)
Clamp time	< 60	127 (55.2)
	>60 min	103 (44.8)
Postoperative atrial fibrillation	Yes	36 (15.7)
	No	194 (83.3)
Hypertension	Yes	147 (63.9)
	No	83 (36.1)
Diabetes	Yes	99 (43)
	No	131 (57)

min: minute

that a high percentage of patients develop delirium after open-heart surgery. In addition, age, history of stroke, history of renal disease, the use of intraoperative cardiopulmonary bypass, clamp time, postoperative fibrillation, and postoperative stroke were all associated with delirium incidence.

Previous studies on the incidence of delirium among patients who underwent cardiac surgery show different results from those obtained in this study. In 1 recent study, Noh and Park[18] investigated the incidence of delirium and its associated risk factors among patients who underwent open-heart surgery in South Korea. The results of their study showed a 15% incidence of postoperative delirium,[18] which is much lower than that found in this study. The difference between the findings of these 2 studies can be due to 2 reasons. The first reason is related to the tools used in the 2 studies. In this study, the NEECHAM confusion scale was used to assess delirium, which classifies patients into 3 categories according to the severity of their symptoms, whereas in the Noh and Park's study,[18] the Nursing Delirium Screening Scale was used to assess delirium. In this tool, patients with a score ≥2 are considered to have delirium. In fact, patients with mild cases of delirium in the Noh and Park's study appeared to be less favored than those in this study (who were classified in the mild and confused categories). In this regard, the results of the study by Van Rompaey et al.[19] showed that using different tools for the evaluation of delirium can produce different results. They evaluated the accuracy of both the NEECHAM confusion scale and Confusion Assessment Method for the ICU (CAM-ICU) in the diagnosis of delirium in nonintubated patients admitted to ICUs. The results of their study showed the NEECHAM confusion scale had a higher detection power than the CAM-ICU.[19] In addition, the second reason can be due to the difference between the methods used in the 2 studies. This study was a cross-sectional study, in which patients were followed in case of delirium incidence by the researchers, whereas the Noh and Park's study was retrospective, and they referred to the patients' files and used the information in the pa-

Table 2. Simultaneous Investigation of the Predictive Factors of Delirium Incidence Using A Multivariate Nonlinear Logistic Regression Model

Variable	β regression coefficient	e^{β} (OR)	P	Wald statistics	OR
Age (<60)	–	–	–	–	–
(>60)	0.57	1.77	.050	3.74	0.93-3.34
History of stroke (no)	–	–	–	–	–
Yes	1.87	6.5	.006*	7.67	1.73-24.4
History of renal diseases (no)	–	–	–	–	–
Yes	1.06	2.89	.100	2.5	0.77-10.7
The use of intraoperative cardiopulmonary bypass (no)	–	–	–	–	–
Yes	1.35	3.8	.001	10.12	1.68-8.95
Clamp time (<60 mins)	–	–	–	–	–
(>60 mins)	0.46	1.58	.140	2.12	0.85-2.95
Postoperative fibrillation (no)	–	–	–	–	–
Yes	-0.51	0.59	.300	0.71	0.17-1.9
Postoperative stroke (no)	–	–	–	–	–
Yes	3.6	36.5	.002*	39.03	3.86-39.3

min: minute; OR: odds ratio; * P < .01

tients' files to determine the incidence of delirium. In another study in 2014, Jannati et al.[16] investigated the incidence of delirium in patients who underwent open-heart surgery. Similar to this study, Jannetti et al.[16] used the NEECHAM confusion scale to assess delirium. The incidence of delirium in their study was 29%, which is lower than that reported in this study. The differences in the results of the 2 studies could be due to the differences in the duration of delirium assessment for each patient. Jannati et al.[16] followed their patients for up to 5 days for delirium incidence, whereas in this study, patients were assessed until discharge, which increases the chances of delirium being detected. In addition, Jannati et al.[16] only reported that 29% of their samples had delirium, but it was not clear whether they also included patients with mild symptoms.

Among the variables studied in this study, age, history of stroke, history of renal disease, the use of intraoperative cardiopulmonary bypass, clamp time, postoperative fibrillation, and postoperative stroke were all associated with delirium incidence. The function of different systems of the brain is responsible for the proper cognitive function of the individual; hence, aging and the dissolution of the elements involved in these systems increase the chance of cognitive disorders, such as delirium.[20] In this study, delirium was higher in people aged >60 years. Previous studies also showed similar results.[21] Postoperative atrial fibrillation can make patients more susceptible to delirium by reducing at least 25% of cardiac output and blood supply to organs, especially to the brain. Similar to the results of some previous studies, the results of this study showed that atrial fibrillation can lead to delirium.[22,23] There is a significant relationship between delirium incidence and clamp time and the use of intraoperative cardiopulmonary bypass in our study and almost all studies.[23] When cardiac surgery is performed using cardiopulmonary bypass, there is a risk of systemic embolism owing to systemic inflammatory reactions. In addition, owing to inflammatory responses and excess fluid intake, brain edema may occur, which together with microemboli can cause delirium.[24,25] Concerning perioperative and postoperative stroke, it can also be said that disrupted brain function and decreased consciousness in this group of patients may be a cause of more delirium incidence in them than in other patients.

Limitation

This study was conducted in a single cardiac ICU, and therefore, generalization of results to other populations is impossible. In addition, delirium determination was performed by an expert clinical nurse but not confirmed by other experts, such as a psychiatrist.

Conclusion

The results of this study showed that more than half of the patients reported some degree of delirium. Age, history of stroke, history of renal disease, the use of intraoperative cardiopulmonary bypass, clamp time, and postoperative stroke were all associated with delirium incidence. Nurses should take preventive measures into consideration in this regard for patients undergoing cardiac surgery. Concerning the risk factors of delirium, several factors have been identified in this study and in previous studies, which can be considered by planners when designing preventive programs. In addition, the results of various studies on the risk factors for delirium have revealed numerous factors. It seems that according to recent studies, a systematic review of this issue is needed.

References

1. Pérez-Ros P, Martínez-Arnau F. Delirium assessment in older people in emergency departments. A literature review. *Diseases.* 2019;7(1):14. [Crossref]

2. Brown CH. Delirium in the cardiac surgical ICU. *Curr Opin Anaesthesiol.* 2014;27(2):117-122. [Crossref]

3. Crocker E, Beggs T, Hassan A, et al. Long-term effects of postoperative delirium in patients undergoing cardiac operation: a systematic review. *Ann Thorac Surg.* 2016;102(4):1391-1399. [Crossref]

4. Szwed K, Pawliszak W, Szwed M, Tomaszewska M, Anisimowicz L, Borkowska A. Reducing delirium and cognitive dysfunction after off-pump coronary bypass: A randomized trial. *J Thorac Cardiovasc Surg.* 2021;161(4):1275-1282.e4. [Crossref]

5. Szylińska A, Rotter I, Listewnik M, et al. Postoperative delirium in patients with chronic obstructive pulmonary disease after coronary artery bypass grafting. *Medicina (Kaunas).* 2020;56(7):342. [Crossref]

6. Brown CH, Laflam A, Max L, et al. The Impact of Delirium After Cardiac Surgical Procedures on Postoperative Resource Use. *Ann Thorac Surg.* 2016;101(5):1663-1669. [Crossref]

7. Inouye SK, Foreman MD, Mion LC, Katz KH, Cooney LM Jr. Nurses' recognition of delirium and its symptoms: comparison of nurse and researcher ratings. *Arch Intern Med.* 2001;161(20):2467-2473. [Crossref]

8. Faught DD. Delirium: The nurse's role in prevention, diagnosis, and treatment. *Medsurg Nurs.* 2014;23(5):301-305.

9. Bennett C. Caring for patients with delirium. Nursing. 2019;49(9):17-20. [Crossref]

10. Simeone S, Pucciarelli G, Perrone M, et al. Delirium in ICU patients following cardiac surgery: An observational study. *J Clin Nurs.* 2018;27(9-10):1994-2002. [Crossref]

11. Gospels ANC, Slooter AJC, Boere PRQ, Zaal IJ. Risk factors for delirium after on-pump cardiac surgery: a systematic review. *Crit Care.* 2015;19(1):346. [Crossref]

12. Gannati Y, Bagheri Nesamy M, Sohrabi M, Yazdani Ch, Mazdarani S. Incidence of delirium and associated factors before open heart surgery. *J Res Dev Nurs Midw.* 2013;10(1):33-42.

13. Rad M, Mohammadi N, Seyedoshohadaee M, Haghani H, Assarzadeh S. The assessment of risk factors related to delirium after coronary by-pass graft. *MCS.* 2015;2(3):158-166 [Crossref]

14. Salari A, Hasandokht T, Dadkhah Tirani H, Nourisaeed A, Javadzadeh Moghtader A. The incidence of delirium after heart bypass surgery in patients with preoperative anxiety and depression. *Jour Guilan Uni Med Sci.* 2017;26(101):36-45

15. Neelon VJ, Champagne MT, Carlson JR, Funk SG. The NEECHAM Confusion Scale: construction, validation, and clinical testing. *Nurs Res.* 1996;45(6):324-330. [Crossref]

16. Jannati Y, Bagheri-Nesami M, Sohrabi M, Yazdani-Cherati J, Mazdarani S. Factors associated with post-surgical delirium in patients undergoing open heart surgery. *Oman Med J.* 2014;29(5):340-345. [Crossref]

17. The Statistical Package for the Social Sciences https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-23

18. Noh EY, Park YH. Prevalence of delirium and risk factors in heart surgery patients in intensive care unit: a retrospective study. *Korean J Adult Nurs.* 2019;31(2):146-155. [Crossref]

19. Van Rompaey B, Schuurmans MJ, Shortridge-Baggett LM, Truijen S, Elseviers M, Bossaert L. A comparison of the CAM-ICU and the NEECHAM Confusion Scale in intensive care delirium assessment: an observational study in non-intubated patients. *Crit Care.* 2008;12(1):R16. [Crossref]

20. Sohrabi M. Evaluation and comparison of cognitive state and depression in elderly admitted in sanitarium with elderly cited in personal home. *Knowledge & Health.* 2006;3(2):27-31.

21. Shadvar K, Baastani F, Mahmoodpoor A, Bilehjani E. Evaluation of the prevalence and risk factors of delirium in cardiac surgery ICU. *J Cardiovasc Thorac Res.* 2013;5(4):157-161.

22. Oliveira FR, Oliveira VH, Oliveira ÍM, et al. Hypertension, mitral valve disease, atrial fibrillation and low education level predict delirium and worst outcome after cardiac surgery in older adults. *BMC Anesthesiol.* 2018;18(1):15. [Crossref]

23. Sugimura Y, Sipahi NF, Mehdiani A, et al. Risk and consequences of postoperative delirium in cardiac surgery. *Thorac Cardiovasc Surg.* 2020;68(5):417-424. [Crossref]

24. Sabol F, Bily B, Artemiou P, et al. Incidence and risk factors of delirium in patients after cardiac surgery: Modifiable and non-modifiable factors. *Cor et Vasa.* 2015;57(3):168-175. [Crossref]

25. Järvelä K, Porkkala H, Karlsson S, Martikainen T, Selander T, Bendel S. Postoperative delirium in cardiac surgery patients. *J Cardiothorac Vasc Anesth.* 2018;32(4):1597-1602. [Crossref]