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Research Article

Incidence and Risk Factors of Sub-Syndromal Delirium in Patients after Cardiac Surgery

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ABSTRACT

Introduction: Sub-Syndromal Delirium (SSD) is characterised by a milder state of delirium involving one or more symptoms of delirium, without the complete syndrome. Both delirium and SSD in the ICU are recognised as determinants of long-term functional impairment and cognitive impairment, but few studies on SSD results have been reported. The incidence rates of delirium and SSD have been based on earlier studies involving various patient groups in different hospital units. Few studies on incidence of SSD in patients after cardiac surgery have been reported. Here, we investigated the incidence and risk factors of SSD in patients after cardiac surgery.

Methods: 378 patients who underwent cardiac surgery in our institution were recruited and screened. In order to diagnose delirium, the evaluation method was used to evaluate the symptoms of delirium and DSM-5 criteria. SSD is defined as one or more core features of delirium without satisfying diagnostic criteria. Independent samples t test was used for comparison between two groups; binary logistic regression analysis was performed on variables with statistically significant differences in uni variate analysis to find independent risk factors for SSD after cardiac surgery.

Results: Among 378 subjects, 112 (29.63%) had Sub-Syndromal Delirium (SSD) and 28 (7.41%) had delirium and the remaining 238 patients (62.96%) were without delirium. Univariate analysis showed that: Age, APACHE II score, duration of aortic clamping, length of ICU stays, duration of sedation use and daily sleep time were the risk factors for the occurrence of SSD ($P<0.05$). Logistic regression analysis showed that age >70 years old, APACHE II score >20 points, length of ICU stay>5 d and duration of sedation use >24 h were independent risk factors for SSD after cardiac surgery ($P<0.05$). Fit a functional model for predicting SSD after cardiac surgery according to the analysis results of the binary logistic regression model, namely logit P=1.472X1+2.213X2 +3.028X3 +1.306X4, in the function, X1 is the age (>70 years old), X2 is the APACHE II score (>20 points), X3 is the length of ICU stay (>5 d), X4 is the duration of sedation use (>24 h).

Conclusion: Patients undergoing cardiac surgery should be clinically comprehensively assessed and appropriate precautions for patients with these risk factors. Preventive treatment should be carried out for the treatment of such a patient and the consciousness state is closely observed after the operation and moderate intervention should be carried out.

Keywords: Sub-syndromal; Lirium; Cardiac surgery; Patient; Confusion Assessment Method for Intensive Care Units version (CAM-ICU)

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INTRODUCTION

Delirium is an acute onset of consciousness disorders that affect all higher cerebral cortical function. It exists along the continuum between normal awakening and stupor or coma with an incidence of up to 73% during the postoperative period and 14%-24% during hospital admission. Delirium is an important burden for Intensive Care Units (ICU) associated with ICU mortality, longer durations of mechanical ventilation and lengths of stay both of ICU and hospital [1]. It is difficult to determine the resulting mortality of delirium, there is no evidence exists that shortening the duration may reduce short-term mortality.

Sub-Syndromal Delirium (SSD) is a milder form of delirium rather than a different disease in a partial delirium syndrome or "previous delirious" aspect. Certainly, patients with SSD display only a few delirium symptoms (e.g., inattention, thought disturbances, irritability, anxiety, restlessness and/or sleep disturbances) without satisfying the full criteria of delirium. SSD is clinically interested from the beginning of the 21st century. Same as delirium, SSD is associated with negative patient outcomes, such as lengthened hospital stays, worse cognitive and functional outcomes and higher mortality rates [2].

Despite its clinical significance, detecting SSD is difficult for its variable course and mild symptoms. The incidence of SSD is highly variable, extending from 0.9% to 36.5%. More, risk factors for delirium were identified including old age, extensive surgical procedure, long term operation, higher number of comorbidities, blood transfusion, longer management in intensive care unit and decreased serum albumin concentration several studies have examined the factors associated with SSD, although Cole MG have suggested that the risk factors of SSD are similar to those associated with delirium. Nonetheless, SSD may be considered to be their endogenous factors in delirium because SSD may be a marker of basic disease that is not severe enough to cause complete delirium. Systematic reviews and meta-analysis about SSD highlight the need for further research to deepen the understanding of risk factors and outcomes associated with SSD and differentiate patients who present risk factors and results in SSD and delirium [3]. Therefore, the purpose of this study was to evaluate and describe the differences in risk factors and outcomes associated with the different trajectories related to the presence or absence of SSD, delirium and non-delirium among patients hospitalized in a cardiac surgery intensive care unit.

MATERIALS AND METHODS

Selection

The study was approved and the need for patients informed consent was abandoned by the local ethics committee of Taihe hospital, Shiyan city, Hubei province. Between January 2020 and December 2021, all 395 patients who underwent cardiac surgery in our institution were screened after postoperative admission to the ICU. Exclusion criteria: (1) Concurrently with other types of cardiovascular diseases, such as aortic dissection; (2) Previous severe mental system diseases, such as schizophrenia; (3) Intraoperative or postoperative complications of intracranial hemorrhage, cerebral patients with infarction or any disease that can cause disturbance of consciousness; (4) Patients with cardiac arrest during or after surgery; (5) Patients with tumors, blood diseases or autoimmune diseases. Drop-out criteria: (1) In-hospital death due to any cause after surgery; (2) Drop-off of investigators midway. As the result, 17 patients on the first 5 postoperative days were excluded. The relationship between their risk factors and harmful outcomes have already been analyzed [4].

Screening for sub-syndromal delirium

We screened patients for symptoms of delirium on a daily basis during the first seven days of hospitalization. To assess core delirium features, A dedicated postoperative SSD assessment team was established, consisting of 1 doctor and 2 nurses and all members received the ICU Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) combined with Intensive Care Delirium Screening Checklist (ICDSC) related training to the level of proficient use. The study showed that the sensitivity and specificity of CAM-ICU and ICDSC for the diagnosis of SSD were 84%, 95% and 83%, 87%, respectively. Among them, CAM-ICU includes four contents: Sudden change of mental state, distraction, disorder of thinking and change in degree of consciousness. ICDSC includes changes in level of consciousness, inattention, disorientation, hallucination-fantasic psychotic state and psychomotor type. Agitation or block, inappropriate speech and emotions, sleep-wake cycle disturbances and fluctuating symptoms. Assessments were performed every 8 hours postoperatively. In the evaluation method, CAM-ICU was used to evaluate patients in the first step and ICDSC was used to evaluate CAM-ICU-negative patients in the second step, with 0 being negative and 1-3 being subdelirium. Two nurses made the assessment respectively and the corresponding results were taken when the two judgments were consistent and a doctor made the final judgment when the two were inconsistent. We excluded from SSD group patients in whom delirious symptoms could be better explained by neurological deficit due to stroke. Patients without core features of delirium were defined as ND/NSSD [5].

Patient characteristics and outcome

The following parameters were extracted from the existing database: Age, gender, education level, alcoholism, smoking, hypertension, diabetes disease. In addition, patients who reached ICU using acute physiology and chronic health evaluation II (APACHE II) score were evaluated. The primary outcomes of interest included the length of ICU stay, the duration of mechanical ventilation (by standardized criteria of extubation), duration of sedation use and daily sleep time.

Statistical analysis

SPSS 25.0 statistical software was used for data analysis and continuous variables are presented as means (SDs) and categorical variables are presented as frequencies and percentages. The α significance level was set at 0.05 for all tests. Independent samples t test was used for comparison between

two groups; count data were expressed by frequency or percentage (%) was expressed and the *chi-square* test was used for comparison between groups. Binary logistic regression analysis was performed on variables with statistically significant differences in univariate analysis to find independent risk factors for SSD after cardiac surgery [4].

RESULTS

Characteristics of the patient sample

As shown in Table 1, 112 (29.63%) of 378 patients had Sub-Syndromal Delirium (SSD) and 28 (7.41%) had delirium and the remaining 238 patients (62.96%) were without delirium. Univariate analysis showed that: Age, APACHE II score, duration of aortic clamping, length of ICU stay, duration of sedation use and daily sleep time were the risk factors for the occurrence of SSD.

Table 1: Univariate analysis between the non-delirium, sub syndromal delirium and delirium groups.

Variable	Non-delirium (n=238)	SSD (n=112)	Delirium (n=28)	Omnibus test (P)	Non-delirium *vs.* SSD (P)	Non-delirium *vs.* delirium (P)	SSD *vs.* delirium (P)
Gender, n (%)							
Male	139 (58.40)	68 (60.71)	17 (60.71)	0.106	0.682	0.814	1
Female	99 (41.60)	44 (39.29)	11 (39.29)				
Age (years)							
<70	189 (79.41)	73 (65.18)	11 (39.29)	<0.001	0.004	<0.001	0.012
≥ 70	49 (20.59)	39 (34.82)	17 (60.71)				
Education level, n (%)							
≤ 9 years	134 (56.30)	62 (55.36)	15 (53.57)	0.956	0.868	0.783	0.865
>9 years	104 (43.70)	50 (44.64)	13 (46.43)				
Alcoholism, n (%)							
Yes	142 (59.66)	73 (65.18)	18 (64.29)	0.586	0.323	0.637	0.929
No	96 (40.34)	39 (34.82)	10 (35.71)				
Smoking, n (%)							
Yes	115 (48.322)	56 (50.00)	12 (42.86)	0.795	0.769	0.584	0.499
No	123 (51.68)	56 (50.00)	16 (57.14)				
Hypertension, n (%)							
Yes	46 (19.33)	28 (25.00)	8 (28.57)	0.319	0.225	0.25	0.699
No	192 (80.67)	84 (75.00)	20 (71.43)				
Diabetes disease, n (%)							
Yes	44 (18.49)	31 (27.68)	9 (32.14)	0.066	0.051	0.087	0.64
No	194 (81.51)	81 (72.32)	19 (67.86)				

APACHE II score	19.71 ± 5.12	22.09 ± 4.87	23.07 ± 5.08	0.038	0.034	0.032	0.046
Duration of aortic clamping (h)	2.82 ± 1.37	3.37 ± 1.12	4.46 ± 1.53	0.036	0.041	0.028	0.043
Length of ICU stay (d)	3.21 ± 1.02	5.02 ± 2.42	6.16 ± 1.81	0.026	0.029	0.016	0.032
Duration of ventilation (h)	10.86 ± 6.82	12.62 ± 8.41	13.15 ± 7.29	0.168	0.148	0.245	0.181
Duration of sedation use (h)	18.63 ± 8.92	24.77 ± 9.25	28.96 ± 7.78	0.008	0.006	0.004	0.018
Daily sleep time (h)	9.72 ± 3.29	7.87 ± 1.27	5.26 ± 2.08	0.037	0.037	0.045	0.041

Note: APACHE II: Acute Physiology and Chronic Health Evaluation II; ICU: Intensive Care Unit; SSD: Sub-syndromal Delirium; h: hour; d: day

Binary logistic regression analysis of the influencing factors of SSD after cardiac surgery

As shown in Tables 2 and 3. The variables with statistically significant differences in univariate analysis were assigned and binary logistic regression analysis was performed. By the logistic regression analysis, age >70 years old, APACHE II score >20 points, length of ICU stay >5 d and duration of sedation use >24 h were independent risk factors for SSD after cardiac surgery (P<0.05) [5].

Table 2: Assignment of independent variables in binary logistic regression analysis of factors affecting the occurrence of SSD after cardiac surgery.

Independent variable	Assignment method	
Age (years)	0=<70	1= ≥ 70
APACHE II score	0=<20	1= ≥ 20
Duration of aortic clamping (h)	0=<3	1= ≥ 3
Length of ICU stay (d)	0=<5	1= ≥ 5
Duration of sedation use (h)	0=<24	1= ≥ 24
Daily sleep time (h)	0=>5	1= ≤ 24

Table 3: Binary logistic regression analysis of influencing factors of SSD after cardiac surgery.

Variable	B	SE	Wald	P value	OR value	95% CI
Constant term	1.682	0.448	5.682	-	-	-
Age (years)	1.472	0.387	8.489	0.017	4.328	2.113~8.982
APACHE II score	2.213	0.341	6.352	0.026	3.271	1.114~5.672
Length of ICU stay (d)	3.028	0.285	5.182	0.034	3.876	1.037~5.247
Duration of sedation use (h)	1.306	0.368	7.269	0.021	3.118	1.282~4.736

Construct a functional model for predicting SSD after cardiac surgery

In accordance with the analysis results of the binary logistic regression model, it was fitted to a functional model to predict SSD after cardiac surgery. Namely logit P=1.472X1+2.213X2+3.028X3+1.306X4, in the function, X1 is the age (>70 years old), X2 is the APACHE II score (>20 points), X3 is the length of ICU stay (>5 d), X4 is the duration of sedation use (>24 h).

DISCUSSION

Cardiac surgery often requires the help of extracorporeal circulation technology, which has the characteristics of long operation time, heavy intraoperative bleeding and large trauma, which will cause greater stress to the body. This stress effect will even persist for a period of time after surgery, increasing postoperative complications. As patients undergoing cardiac surgery get older, it is found that more and more patients are prone to postoperative SSD, which increases the length of hospital stay and costs for patient and imposes a heavy mental burden on patients and their families [6].

SSD is a type of postoperative delirium, which is different from postoperative delirium and has a higher incidence in the ICU. This study found that the incidence of SSD after cardiac surgery was 29.63% (112/378), which was consistent with most reports in the literature. Through univariate and logistic regression analysis, this study found that age >70 years, APACHE II score >20 points, length of ICU stay >5 d and duration of sedation use >24 h were independent risk factors for SSD after cardiac surgery (P<0.05). It is suggested that preventive work should be done in the treatment of such patients, the state of consciousness should be closely observed after surgery and timely intervention should be carried out.

With the development of cardiac surgery techniques, age is no longer a contraindication to major cardiac surgery. In recent years, more and more people over the age of 70 have undergone heart surgery, which makes medical personnel must pay attention to the influence of age. With the increase of age, the function of various organs gradually declines, especially many elderly patients have a variety of underlying diseases and the probability of accidents during and after surgery for these patients is greatly increased. Studies have found that advanced age is very likely to cause postoperative delirium, which is mainly related to factors such as neuronal apoptosis, imbalance of white matter and substantia nigra, decreased cerebral blood flow and changes in neurotransmitters. Therefore, we need to pay more attention to the psychological status of elderly patients before surgery, and take relevant measures to alleviate the changes in cognitive function caused by environmental changes, surgery and other factors after surgery [7].

The APACHE II score is a reliable indicator for judging the severity of the disease in patients, and is closely related to the severity and prognosis of the disease. Patients with APACHE II score >20 are critically ill, often accompanied by unstable vital signs and organ function, which greatly increases the risk of surgery. In addition, the APACHE II score, which includes two factors, age and emergency surgery, has been shown to be closely related to the occurrence of postoperative SSD, suggesting that the APACHE II score can be used as a reliable means to predict the occurrence of postoperative SSD18. Periodically assess the severity of the patient's disease, aggressively treat the primary disease, and reduce the severity of the patient's disease, thereby reducing the risk of delirium.

The results of this study suggest that the use of sedatives for more than 24 hours is an independent risk factor for the development of SSD. Sedative drug therapy is a common treatment measure for ICU patients, which can relieve the pain of the patient, relieve the pain of the patient and help the patient to fall asleep. However, after the patient uses more sedative drugs, it will affect the transmission of the body's pain signals, affect the body's sensitivity to internal and external environmental stimuli, cause the patient to respond slowly, fatigue and impaired cognitive function, which may easily induce the occurrence of delirium syndrome. Therefore, healthcare providers should assess the patient's sedation status from time to time and minimize the dose and duration of sedatives to reduce the risk of sedative-induced subdelirium [8].

The results of this study showed that the longer the ICU stay, the higher the degree of delirium, which is consistent with the findings of before [9]. The reason for this may be related to the fact that the ICU treats patients at different times and provides continuous and uninterrupted treatment. Light and noise severely affect the patient's rest and sleep, leading to disturbances in the sleep-wake cycle. The patient suffers both physically and mentally, which exacerbates the anxiety. Affect the function of the cerebral cortex, leading to the occurrence of psychiatric symptoms. In addition, due to physical discomfort caused by intubation during treatment, uncertain treatment prognosis, heavy economic burden, social isolation and other reasons, it is easy to cause psychological tension and discomfort. in patients after cardiac surgery. Depression, burnout, inattention, emotional instability and other symptoms appear in SSD. Therefore, it is necessary to actively identify the causes, improve the ICU environment, reduce noise and light stimulation, promote patients' sleep and shorten the ICU stay time, thereby reducing the risk of delirium [10].

CONCLUSION

In conclusion, the incidence of subdelirium was 29.63%, age >70 years, APACHE II score>20, ICU stay >5 days and sedative drug use >24 hours were independent risk factors for SSD after cardiac surgery in adults. Patients undergoing cardiac surgery should be comprehensively evaluated in clinical work and appropriate preventive measures should be taken for patients with these risk factors to reduce the incidence of SSD. However, there are still shortcomings in this study, only a prediction model was constructed and no further model validation was carried out. Subsequent research will focus on the validation of the model and further optimize the model.

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AUTHORS' CONTRIBUTIONS

X Chen wrote the manuscript. LT Li, MH Wang gave conceptual advice. All authors read and approved the final manuscript.

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AVAILABILITY OF DATA AND MATERIALS

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved and the need for patients informed consent was abandoned by the local ethics committee of Taihe hospital, Shiyan city, Hubei province. Reference Number: 2022XM001.

COMPETING INTERESTS

All co-authors declare that they have no competing interests.

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