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ORIGINAL ARTICLE

Clinical and Cognitive Characteristics Associated with the Onset of Delirium in Postoperative Cardiovascular Surgery Patients Admitted to the ICU

Kuninori Sano, MS, OT [a] Aki Watanabe, PhD, OT [b] Takayuki Kawaguchi, PhD, OT [c] Yasunori Sakamoto, MS, OT [a] and Michinari Fukuda, MD [d]

Objectives: Occupational therapy (OT) studies of delirium have attempted to test the effectiveness of interventions to reduce the incidence and duration of delirium. Although some cognitive stimulation appears to be important, appropriate approaches to delirium characterized by cognitive dysfunction remain unclear. This study aimed to determine the incidence and duration of delirium in postoperative cardiovascular surgery patients at the initial time of OT to identify characteristics of patient demographics and cognitive function according to the presence or absence of delirium. **Methods:** This retrospective study included patients judged to have delirium by the Confusion Assessment Method at the first postoperative OT session (after extubation) in the intensive care unit (ICU). Patient data included age, sex, days until extubation, type of hospitalization, outcome at discharge, Sequential Organ Failure Assessment score and Glasgow Coma Scale (GCS) score at the first OT session, presence or absence of delirium, duration of delirium, and Mini-Mental State Examination-Japanese (MMSE-J) score. The Mann–Whitney U test was used to test differences between the delirium and the non-delirium groups, and a binomial generalized linear model (logistic regression model) with Bayesian estimation was adopted to investigate factors characterizing delirium. **Results:** A Bayesian logistic regression model with delirium as the dependent variable and "days until extubation" and "spatial orientation" as adjustment variables suggested that "spatial orientation" was a significant factor in delirium. **Conclusions:** For ICU patients with delirium, the provision of information tailored toward spatial orientation during the first day of OT may improve delirium.

Key Words: cognitive function; delirium; ICU; occupational therapy

INTRODUCTION

Prevention of delirium and appropriate treatment after its onset are crucial because, in addition to the effects of the primary disease, delirium is a factor in the worsening of a patient's life expectancy. As summarized by the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5),[1] delirium is an acutely fluctuating disturbance of consciousness and cognitive function that is induced by physical illness and intoxication. Prolonged duration of delirium in patients admitted to the intensive care unit (ICU) increases the risk of death.[2] Furthermore, as the duration of delirium increases, there are increased risks of long-term cognitive dysfunction[3] and long-term decline in activities of daily living.[4] In addition to infection, acute metabolic abnormalities, drug side effects, and cardiovascular disease, other factors known to induce delirium include environmental factors, sleep disturbance, exercise, pain, and

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[a] Department of Rehabilitation Medicine, Yokohama City University Medical Center, Yokohama, Japan
[b] Department of Rehabilitation, Kanagawa University of Human Services, Yokosuka, Japan
[c] National Institute of Mental Health, National Center of Neurology and Psychiatry, Kodaira, Japan
[d] Department of Rehabilitation Medicine, Kitasato University School of Allied Health Sciences, Sagamihara, Japan
Correspondence: Kuninori Sano, MS, OT, 4-57 Urafunechou, Minami-ku, Yokohama City, Kanagawa 232-0024, Japan, E-mail: kuni_sn8@yokohama-cu.ac.jp

psychological stress.[5] Cardiovascular surgery has also been noted as a precipitating factor for delirium.[5] In a study of the incidence of delirium in 225 patients undergoing scheduled cardiovascular surgery, 103 patients (46%) developed delirium on or after the day following surgery, 65% of whom had delirium that resolved within 1 to 2 days after surgery, and 35% had delirium that persisted for 3 days or longer.[6] It has also been reported that the cognitive function of patients with delirium was significantly lower than that of patients without delirium when investigated using the Short Form of the Informant Questionnaire on Cognitive Decline in the Elderly (Short IQCODE).[5] Furthermore, a longitudinal study[6] that investigated cognitive function using the Mini Mental State Examination (MMSE) reported that cognitive function declined for more than 1 year after surgery in patients with delirium and that it took time for cognitive function to improve. In confirming delirium as a factor that worsens the patient's prognosis, these studies highlight the significant need for interventions that prevent and treat delirium.

Various interventions have been investigated for the prevention of delirium or to shorten the period of delirium after onset. These interventions have included adjustment of the sleep environment, adjustment of sensory stimulation, cognitive training,[7] early exercise programs after surgery (getting out of bed, training in activities of daily living),[8] and controlled exposure to light. Environmental adjustments such as providing visual location information and frequently checking for disorientation using sound stimulation have been reported to be effective.[9] Simons et al.[10] also stated that high-intensity phototherapy alone does not reduce the incidence of delirium and must be combined with other interventions. Therefore, various perspectives and intervention methods are needed to prevent delirium, but no definitive conclusions have yet been reached.

In an occupational therapy (OT) intervention study for delirium, the effect of cognitive training on delirium in the ICU was unclear, but it was reported that there were no adverse events.[11] In another study,[12] cognitive tasks such as sensory stimulation, upper limb strength training, card games, memory games, and visuo-spatial construction games were administered to non-ventilated patients admitted to the ICU after surgery. In comparison with a control group, the intervention group showed lower incidence of delirium and shorter duration.[12] Furthermore, Pozzi et al.[13] suggested that early OT intervention might be beneficial in the prevention and treatment of delirium. Although some cognitive stimulation appears important and effective, the appropriate approach to delirium, a condition that is characterized by cognitive impairment, remains unclear. Therefore, it is important to characterize the cognitive features of delirium in the early stages of OT to provide effective cognitive training that will reduce the duration of delirium.

To our knowledge, few studies have investigated the characteristics of cognitive function in postoperative cardiovascular surgery patients who developed delirium after extubation. Retrospective investigation of the cognitive features of delirium in clinical settings would be meaningful to address such research gaps and provide insight into effective intervention strategies and their components for patients who develop delirium. This study aimed to determine the incidence and duration of delirium in postoperative cardiovascular surgery patients at the initial time of OT and to identify characteristics of patient demographics and cognitive function according to the presence or absence of delirium.

MATERIALS AND METHODS

Study Design and Participants

This retrospective study included medical information on participating patients older than 20 years of age who underwent open-chest cardiovascular surgery at our hospital from 16 July 2019 to 15 July 2020. We did not vary the analysis by type of hospitalization, because no difference was observed in the incidence of delirium between emergency admissions and those for elective surgery. Patients underwent their first postoperative OT session (after extubation) in the ICU and were assessed for the presence of delirium after extubation using the Confusion Assessment Method (CAM).[9,14] Patients judged to have delirium on the first day of OT were included in the delirium group, and those judged not to have delirium were included in the non-delirium group. We excluded cases in which the first OT intervention was after ICU discharge because we expected that the change in environment associated with changing to another ward would affect the results. The following exclusion criteria were also used: OT could not be performed, cerebrovascular accident had occurred by the start of the first OT session, native language other than Japanese, and refusal to participate in this study with blanket consent.

Assessment Items

The participant assessment items were age, sex, disease classification, hospitalization type, days until extubation, postoperative hospital stay (POHS), Sequential Organ Failure Assessment (SOFA) score,[15] and Glasgow Coma Scale

(GCS) score on the first day of OT, presence of delirium by CAM, duration of delirium, the Mini-Mental State Examination-Japanese (MMSE-J) total score,[16] and the MMSE-J subitem scores. For most patients, MMSE-J was administered in the afternoon (2:00–5:00 pm). In the assessment of delirium by CAM, the following four items were assessed: (1) acute onset and fluctuating course, (2) distraction, (3) incoherent thinking, and (4) change in the level of consciousness. Delirium was diagnosed when (1) and (2) and either (3) or (4) were identified. The SOFA score is an organ failure evaluation score in which the presence or absence of organ failure in the respiratory system, coagulation system, liver, cardiovascular system, central nervous system, and kidneys is rated on a 5-point scale from 0 to 4, and the sum of these scores is the degree of organ failure. The score ranges from 0 to 24, with higher scores indicating greater severity.

Analysis

Basic statistics were calculated for the surveyed data, and Spearman's rank correlation coefficient was used to examine the relationships between the survey items. A Mann–Whitney U test was performed for each variable to test the difference between the delirium group and the non-delirium group.

The level of statistical significance was set at 5%. A binomial generalized linear model with Bayesian estimation was adopted to investigate factors characterizing delirium. Bayesian estimation was used because of the small sample size and the low number of subjects in the delirium group. The independent variables were entered using the forced entry method. Variables were selected based on the items that were significantly different in the test of difference between the two groups and that met the criteria for the Hosmer–Lemeshow test, $P \geq 0.05$.[17] A Markov Chain Monte Carlo (MCMC) method was adopted for Bayesian estimation.

The following settings were used for Bayesian estimation: 10,000 simulations, a burn-in period of 5000, and four Markov chains. Convergence decisions were made with a potential scale reduction factor of less than 1.05.[18] Statistical analysis was performed using brms package 2.17.0 in R v4.1.3 (https://www.r-project.org).

Ethics Statement

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Yokohama City University (23 October 2020/ Approval No. B201000007). This retrospective study only used patient data after written consent was obtained for use of the information. The purpose and methods of the study were publicly available, and subjects were offered the opportunity to withdraw from the study.

RESULTS

Characteristics of Participants

The procedure for capturing survey data is shown in **Fig. 1**. The data of the patients who met the exclusion criteria included that of 53 participants for whom OT could not be performed due to holidays or reimbursement reasons. The characteristics of the participants are shown in **Table 1**. Attention for each results, there were significant differences between the two groups in the subscales for spatial orientation ($p = 0.001$), serial 7s ($p = 0.030$). Furthermore, we did not vary the analysis by type of hospitalization, because no differences in the incidence of delirium were found between emergency and elective surgery.

Correlations between Variables

Correlations Between Variables are shown in **Table 2**. Attention for each survey item, significant 183 correlations were found between days until extubation and POHS ($r = 0.423$, $p < 0.001$), and between POHS and GCS score ($r = -0.358$, $p < 0.001$).

Identification of Characteristics According to Presence or Absence of Delirium

In designing the logistic regression model using Bayesian estimation, the "SOFA score", "POHS", "GCS score", "MMSE-J total", and the MMSE-J items of "Verbal comprehension" and "Reading a sentence" were removed from the items for which significant differences were found in comparison of the two groups. "SOFA score" was excluded because previous research has shown that delirium is more likely to develop in patients with severe conditions.[19] "POHS" was excluded because it is not a variable that can be considered at the start of the study. "GCS score" is a factor that should be considered for the level of alertness at the start of the study because significant differences were found between the groups with and without delirium. However, given that delirium is defined in the DSM-5 as a change in the level of consciousness, the "GCS score" at the time of evaluation does not accurately reflect the characteristics of delirium. Therefore, we considered that it was inappropriate to include "GCS score" as an independent variable. "MMSE-J total" was excluded because it has been shown that patients who develop delirium have lower MMSE scores[6] and it does not

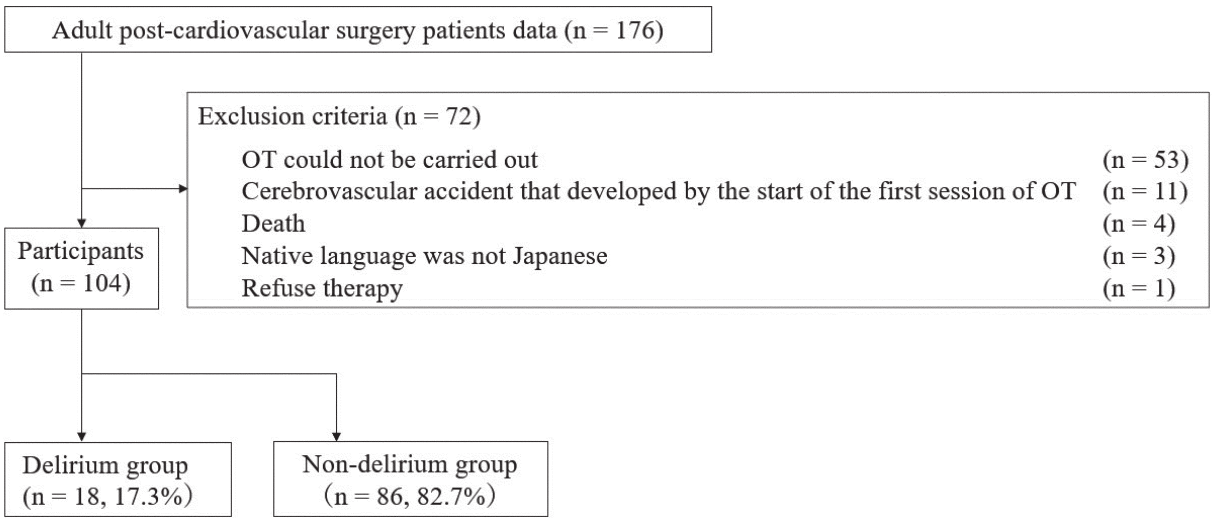

Fig. 1. Flowchart of data selection. The data of 104 post-cardiovascular surgery patients were divided into the delirium group or the non-delirium group.

reflect the characteristics of the cognitive functions that were the target of the study. "Verbal comprehension" and "Reading a sentence" were excluded because of the small volume of data. Furthermore, the Hosmer–Lemeshow test showed that the generalized linear model with "Presence of delirium" as the dependent variable and "Days until extubation" (odds ratio=1.193, P=0.234), "Spatial orientation" (odds ratio=0.353, P=0.044), and "Serial 7s" (odds ratio=0.706, P=0.245) as the independent variables did not meet the criteria (P=0.018), so "Serial 7s" was excluded from the independent variables. The chi-square test of the model for both "Days until extubation" and "Spatial orientation" was significant at P<0.001, and the Hosmer–Lemeshow test showed the model to be a good fit at P=0.915 ("Days until extubation": odds ratio=1.215 and P=0.159; "Spatial orientation": odds ratio=0.288, P=0.005).

Based on our results, we designed a logistic regression model using Bayesian estimation with MCMC with "Presence of delirium" as the dependent variable and "Days until extubation" and "Spatial orientation" as the independent variables. The results showed that "Spatial orientation" was a significant characteristic of delirium in a model with "Days until extubation" as an adjustment variable (95% confidence interval: −6.56 to −3.33) (**Table 3**).

DISCUSSION

The results of this study revealed specific cognitive characteristics of patients admitted to the ICU. In addition to the conventional findings that delirium is characterized by the patient's advanced age, blood data, and severity of illness,[20,21] the results of this study show that the MMSE-J item "Spatial orientation" may be a cognitive characteristic related to the onset of delirium in the ICU setting. Location disorientation has been confirmed previously in an inpatient with delirium in a clinical setting.[22] Although the importance of cognitive training for patients with delirium has been pointed out in previous studies,[7,9,11,12] no study has examined the detailed characteristics of cognitive function in delirium. The characteristics of cognitive function caused by the onset of delirium as revealed in this study may indicate the essential points of any rehabilitation strategy for patients with delirium.

Differences in Patient Attributes According to Presence or Absence of Delirium

In this study, we analyzed the data obtained during the study period for those who met the study criteria and found that 17.3% showed onset of delirium on the first day of OT. Saczynski et al.[6] reported that 46% of patients undergoing scheduled cardiovascular surgery developed delirium on or after the day following surgery; subsequently, delirium disappeared 1–2 days after surgery in 65% of those with delirium, and it persisted in 35% for more than 3 days. Our study indicated a lower incidence of delirium than the results of Saczynski et al.[6] because the presence of delirium was assessed at the start of OT when some patients with delirium may have already improved. Inouye[5] stated that risk factors for invariant delirium among the patient demographics data

Table 1. Characteristics of participants

Characteristic	All (n=104)	Delirium group (n=18)	Non-delirium group (n=86)	P value	95% CI
Sex (M/F)	62/42	13/5	49/37	0.231	
Age, years	68.0±10.7	70.9±11.9, 48–87	67.4±10.4, 39–86	0.135	−9.99 to 1.99
Hospitalization					
Scheduled	77	12	65	0.433	
Emergency	27	6	21		
Disease					
Ischemic heart disease	26	2	24	0.299	
Valvular heart disease	39	6	33		
Macrovascular disease	35	9	26		
Other	4	1	3		
Type of operation					
Coronary artery bypass	26	2	24	0.109	
Valve replacement/plasty	34	4	30		
ABVR	29	8	21		
Combined procedure	4	2	2		
Other	11	2	9		
Duration of operation, min	434.0±155.6	448.2±33.9	431.1±17.1	0.369	−1.99 to 41.00
Days until extubation, days	2.1±2.1	3.1±2.8, 1–10	1.8±1.9, 0–11	0.022*	−1.99 to 0.00
Days until OT started, days	2.6±2.2	3.6±0.8, 1–13	2.4±0.2, 1–12	0.052	−1.99 to 0.00
SOFA score	4.9±2.8	6.3±3.3, 1–12	4.6±2.7, 0–11	0.042*	−3.00 to 0.00
Duration of delirium, days	—	3.2±2.7, 1–9	—	—	
POHS, days	29.8±28.6	47.9±61.9, 18–290	26.1±12.0, 11–79	0.006**	−14.0 to −2.0
GCS score	14.2±1.0	13.4±1.0, 11–15	14.3±1.0, 9–15	0.001**	0.99 to 0.00
MMSE-J total	24.6± 3.8, 81	20.8±5.3, 11–28, 9	25.1±3.4, 16–30, 72	0.013*	0.99 to 7.00
1. Temporal orientation	4.1±2.0, 92	3.6±1.2, 2–5, 11	4.2±0.9, 1–5, 81	0.060	0.00 to 1.00
2. Spatial orientation	4.4±0.9, 92	3.4±1.6, 0–5, 11	4.5±0.6, 3–5, 81	0.001**	0.00 to 1.00
4. Serial 7s	2.7±1.7, 88	1.6±1.3, 0–4, 9	2.9±1.7, 0–5, 79	0.030*	0.00 to 2.99
3. Immediate memory	3, 1–3, 92	3, 1–3, 11	3, 2–3, 81	0.146	−0.00 to 0.00
5. Delayed recall	2, 0–3, 88	2, 1–3, 9	2, 0–3, 79	0.542	−0.00 to 0.99
6. Naming	2, 1–2, 86	2, 1–2, 9	2, 1–2, 77	0.070	−0.00 to 0.00
8. Verbal comprehension	3, 0–3, 83	3, 0–3, 9	3, 0–3, 74	0.009**	0.00 to 0.00
7. Verbal repetition (Y/N)	86/0	9/0	77/0	—	
9. Reading a sentence (Y/N)	83/1	8/1	75/0	0.004**	
10. Writing (Y/N)	72/15	12/3	60/12	0.255	
11. Constructional praxis (Y/N)	62/19	06/3	56/16	0.458	

Data given as number, mean ± standard deviation (SD), range, and/or median. Data for MMSE-J total and subitems 1, 2, 4 given as mean ± SD, range, number; data for MMSE-J subitems 3, 5, 6, 8 given as median, range number; data for MMSE-J subitems 7, 9, 10, 11 given as number.

CI, confidence interval; ABVR, artificial blood vessel replacement and/or graft replacement.

*P<0.05; **P<0.01.

included males aged 65 years or older, cognitive decline before surgery, and histories of alcohol consumption and vascular disease. In contrast, there was no difference in age, sex, disease category, or outcome between the participants with and without delirium in this study. However, the time to extubation and the SOFA score were significantly greater, and the GCS score was significantly lower in the group with delirium. These results support the findings of previous stud-

Table 2. Correlations between variables

	Age	Days until extubation	SOFA score	Duration of delirium	POHS	GCS score
Days until extubation (n=104)	−0.053 (0.592)	-	-	-	-	-
SOFA score (n=104)	0.008 (0.935)	0.139 (0.160)	-	-	-	-
Duration of delirium (n=18)	0.468 (0.050)*	0.057 (0.822)	0.089 (0.726)	-	-	-
POHS (n=104)	0.122 (0.218)	0.423 (0.000)**	0.145 (0.141)	0.196[b] (0.436)	-	-
GCS score (n=104)	−0.025 (0.798)	−0.305 (0.002)**	−0.412 (0.000)**	−0.218[b] (0.384)	−0.358 (0.000)**	-
MMSE-J total[a] (n=81)	−0.311 (0.005)**	−0.419 (0.000)**	−0.158 (0.159)	−0.161[c] (0.679)	−0.150 (0.182)	0.270 (0.015)*
Temporal orientation (n=92)	−0.222 (0.033)*	−0.371 (0.000)**	−0.175 (0.095)	−0.343[d] (0.302)	−0.143 (0.173)	0.454 (0.000)**
Spatial orientation (n=92)	−0.306 (0.003)**	−0.102 (0.336)	−0.040 (0.703)	−0.350[d] (0.291)	−0.116 (0.272)	0.166 (0.112)
Immediate memory (n=92)	−0.210 (0.044)*	−0.112 (0.287)	−0.051 (0.627)	0.214[d] (0.527)	−0.159 (0.131)	0.108 (0.307)
Serial 7s (n=88)	−0.183 (0.087)	−0.324 (0.002)**	−0.126 (0.242)	−0.122[c] (0.754)	−0.140 (0.195)	0.080 (0.458)
Delayed recall (n=88)	−0.236 (0.027)*	−0.202 (0.058)	−0.018 (0.866)	−0.642[c] (0.062)	0.006 (0.955)	0.061 (0.572)
Naming (n=86)	−0.109 (0.319)	−0.014 (0.902)	−0.089 (0.413)	0.302[c] (0.430)	−0.120 (0.272)	0.117 (0.283)
Verbal comprehension (n=83)	0.017 (0.877)	−0.264 (0.016)*	−0.146 (0.187)	0.098[c] (0.802)	−0.039 (0.727)	0.153 (0.168)

Data given as Spearman's correlation coefficient (P value).
[a] For those able to complete MMSE-J; [b] n=18; [c] n=9; [d] n=11.
*P<0.05; **P<0.01.

Table 3. Factors predicting delirium by Bayesian generalized linear model

	Estimate	Estimate error	95% CI	Effective sample size	Rhat
Intercept	−4.81	0.82	−6.56 to −3.33	13,701	1.00
Days until extubation	0.13	0.12	−0.13 to 0.35	11,712	1.00
Spatial orientation	−0.60	0.19	−0.95 to −0.21	11,573	1.00

CI, confidence interval; Rhat, potential scale reduction factor.

ies that the characteristics of the patient demographics data can be factors in the onset of delirium.

Cognitive Characteristics According to Presence or Absence of Delirium

Detailed investigation of characteristics of the cognitive function of patients with and without delirium is important to provide appropriate interventions following extubation, based on the presence or absence of delirium in the subject. Significant differences were found in the MMSE-J subscales for spatial orientation, Serial 7s, and verbal comprehension, depending on the presence or absence of delirium. Inouye et al.[14] also listed attentional dysfunction, incoherent thinking, and altered level of consciousness as categories of CAM to determine the presence or absence of delirium. In addition, this previous study suggested that the difference in Serial 7 scores depending on patients with and without delirium was caused by the decrease in attentional function, which is one of the typical symptoms of delirium.[14] Therefore, the results of this study are consistent with observations of the cogni-

tive characteristics of patients with delirium from previous studies.

Characteristics of Relationships between Assessed Items in Patients with Delirium

Characteristics of the patients with delirium and their association with assessment data were analyzed to identify patient information that might be related to the onset of delirium. There was a significant positive correlation between age and duration of delirium, a significant negative correlation between age and MMSE-J total, and patients with longer time to extubation had lower GCS scores and longer POHS. In addition, there was a significant negative correlation between GCS score (on the first day of OT) and postoperative hospital days. Sugishita et al.[16] reported that the mean MMSE-J score was significantly lower for the older group than for the younger group. Pandharipande et al.[19] reported that the incidence of delirium tends to increase with increasing age. Elderly patients and patients who take a long time to be extubated are considered to be at high risk of developing delirium. However, Giacino et al.[23] reported that even patients with prolonged impaired consciousness who were unable to communicate reliably responded to visual and motor stimuli. Considering that patients with low postoperative arousal have a longer POHS, the provision of early sensory stimulation in the ICU to promote arousal was suggested to be important if there are no medical contraindications.

Characteristic Factors Associated with Onset of Delirium

Modeling analysis based on variables selected from multidimensional measurements may identify characteristic factors associated with the onset of delirium. A previous study that created a risk model for delirium based on patient admission characteristics cited the factors of dementia, benzodiazepine drug use before ICU admission, creatinine level, and arterial blood pH.[20] Another previous study[21] used with and without delirium as the dependent variable and visual impairment, severity, cognitive dysfunction, and blood urea nitrogen as independent variables. However, although both studies stated that cognitive dysfunction is a risk factor for delirium, neither discussed specific items of cognitive function. A previous study describing items of cognitive function found current year, date, reverse spelling, and graphic drawing to be predictors of delirium using the MMSE in a general ward.[24]

The design of a logistic regression model by Bayesian estimation using "with and without delirium" as the dependent variable in this study showed that "spatial disorientation" was a characteristic factor according to the onset of delirium with "Days until extubation" as the moderator variable. Because disorientation is a prerequisite for the preservation of short-term memory, an item that characterizes a decrease in cognitive function, the "Spatial orientation" derived in this study is an independent variable that reflects the presence or absence of cognitive dysfunction caused by delirium. Therefore, in addition to predictors of delirium such as age, original mental illness, cerebrovascular disease, and preexisting cognitive impairment,[25] the characteristic of "Spatial orientation" identified in the present study is expected to be useful in rehabilitation for patients who showing the onset of delirium on admission to the ICU. Moreover, delirium has been reported to be characterized by visual cognitive dysfunction,[26] unlike dementia and healthy individuals. It is anticipated that this visual cognitive dysfunction makes it difficult for patients to make normal judgments about their situation. In this study, although it was difficult to clarify how spatial orientation affects the onset of delirium, spatial orientation disorders may lead to confusion in patients, promote anxiety, which is a precipitating factor in delirium, and induce delirium. The spatial orientation score may reflect the inability of a patient to accurately judge their situation because of impaired visual cognitive function. Furthermore, orientation is a complex cognitive skill, and although the neurophysiological mechanisms have not been clarified, it is reported to be mainly influenced by memory, attention, and other cognitive functions such as language function.[27] Magnetic resonance imaging has shown that activation of orientation-related cortical areas can be observed in the frontal cortex, inferior parietal lobe, and medial frontal cortex.[28] In addition, it has been reported that frequent confirmation of the ward, hospital name, and progress, as an approach to general orientation, is correlated with a lower incidence of delirium.[29] Taken together, this information suggests that providing information on spatial orientation that is tailored to the patient's cognitive function might have some impact on patients with delirium.

Limitations

This study is the first to investigate the detailed characteristics of cognitive function according to the presence or absence of delirium at the start of OT. However, the study also has some limitations. First, because this study used cross-sectional data at the time of OT initiation, we could not determine whether delirium caused location disorientation or whether location disorientation was a contributor to

the onset of delirium. Therefore, although this study revealed the cognitive characteristics associated with the onset of delirium, additional longitudinal research will be necessary to investigate the causal relationship between the onset of delirium and cognitive characteristics. Second, the characteristics of patients with delirium that developed outside of the ICU could not be analyzed. However, because some patients develop delirium after discharge from the ICU, it will be necessary to investigate the onset of delirium during hospitalization in detail in future studies. Finally, although the characteristics of the cognitive function of patients with delirium were clarified, delirium is susceptible to symptoms such as depression and anxiety,[5] and this may limit the interpretation of the results. However, in considering intervention methods for delirium, the results of this study suggest that it is important to assess the characteristics of cognitive function in detail.

CONCLUSION

This study investigated the demographic and cognitive characteristics of patients undergoing cardiovascular surgery in relation to the onset of delirium at the start of OT. Because the presence of delirium influences the number of postoperative hospital days, we believe that the provision of spatial orientation information to patients in the early stages of delirium may have an impact on improving delirium in inpatients of the ICU and may shorten hospital stay.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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