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ABOUT COVER

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Retrospective Study

Risk factors for delirium after surgery for craniocerebral injury in the neurosurgical intensive care unit

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Abstract

BACKGROUND

Postoperative delirium is common in patients who undergo neurosurgery for craniocerebral injury. However, there is no specific medical test to predict postoperative delirium to date.

AIM

To explore risk factors for postoperative delirium in patients with craniocerebral injury in the neurosurgery intensive care unit (ICU).

METHODS

A retrospective analysis was performed in 120 patients with craniocerebral injury admitted to Hainan People's Hospital/Hainan Hospital Affiliated to Hainan Medical University, The First Affiliated Hospital of Hainan Medical University, and The Second Affiliated Hospital of Hainan Medical University between January 2018 and January 2020. The patients were categorized into groups based on whether delirium occurred. Of them, 25 patients with delirium were included in the delirium group, and 95 patients without delirium were included in the observation group. Logistic regression analysis was used to explore the association between sex, age, educational level, Glasgow coma scale (GCS), complications (with or without concussion, cerebral contusion, hypoxemia and ventricular compression) and site of injury and delirium.

RESULTS

The GCS score above 8 and concomitant disease of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression, and damage to the frontal lobe were associated with delirium in patients admitted to neurosurgical intensive care unit (ICU) (all $P < 0.05$). However, age, sex, administration more than three medicines, and educational level were not significantly associated with the onset of delirium in patients with craniocerebral injury in the neurosurgical ICU ($P < 0.05$). Multivariate logistic regression analysis showed that GCS score above 8, cerebral concussion, cerebral contusion, hypoxemia, ventricle compression, and frontal lobe disorders were independent risk factors for delirium in patients with craniocerebral injury in the neurosurgical ICU ($P < 0.05$).

CONCLUSION

GCS score, concussive concussion, cerebral contusion, hypoxemia, ventricle compression, and damage to frontal lobe are risk factors of postoperative delirium.

Key Words: Brain injury; Delirium; Neurosurgery; Intensive care unit; Risk factors

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Core Tip: Neurosurgical patients with craniocerebral injury are at high risk of developing postoperative delirium. Investigating predictive factors for postoperative delirium will aid in early implementation to greatly reduce the risk. This study analyzed the association between age, sex, use of medicines, Glasgow coma scale score (GCS), comorbid diseases, and injury sites and onset of delirium in patients with craniocerebral injury in the neurosurgical intensive care unit. The results of this study suggest that GCS score above 8, comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression, and frontal lobe injury might contribute to delirium in this population.

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INTRODUCTION

Craniocerebral injury is a common surgical disease with high morbidity and mortality. Generally, patients with craniocerebral injury can be saved if rescued in a timely manner through surgical treatment[1,2]. However, some patients may suffer from delirium after surgery due to serious damage to brain tissues[3,4]. Delirium is an acute cognitive deficit with changes in arousal level. The development of delirium may cause secondary injury, which will lead to disability and even death[5,6]. Therefore, clinicians in the neurosurgery intensive care unit (ICU) should mainly focus on whether delirium may occur in this population. Some studies[7,8] have shown that patients with brain injury probably experience more craniocerebral trauma after surgery because of head injury caused by a direct or indirect outside force. This may lead to dysregulation of psychological activity and psychological defect with manifestation of delirium. Research[9] has shown that the occurrence of delirium in patients in the ICU not only has a strong effect on treatment efficacy but also increases the incidence of complications and mortality. Moreover, delirium can hinder ongoing treatment for brain injury, resulting in extended ICU stay and increase in the health care expenditure burden[10-12].

This study discussed risk factors influencing the onset of delirium in patients with craniocerebral injury in the ICU after surgery.

MATERIALS AND METHODS

Participants

A retrospective analysis was conducted at Hainan People's Hospital/Hainan Hospital Affiliated to Hainan Medical University, The First Affiliated Hospital of Hainan Medical University, and The Second Affiliated Hospital of Hainan Medical University between January 2018 and January 2020 including 120 patients with craniocerebral injury. Based on whether delirium occurred, these patients were categorized into different groups. Of them, 25 patients with delirium were included in a delirium group

and 95 patients without delirium were included in the observation group. Patients included in the study were admitted to the neurosurgical ICU for craniocerebral injury. All patients and their family members provided written informed consent. Eligibility criteria were: patients admitted to the ICU for at least 24 h, patients aged 18 years to 78 years, and patients with a Glasgow coma scale (GCS) score of 5 to 13. Exclusion criteria were: patients with comorbidity of psychological disorders, patients with comorbidity of severe cardiovascular disease, and patients with poor basic physical performance. In the delirium group, 19 patients were male and 6 patients were female, aged 36 years to 72 years with an average age of 54.34 ± 11.09 years. In the observation group, 72 patients were male and 23 patients were female, aged 35 years to 73 years with an average age of 55.40 ± 10.93 years. The sex composition and age structure were comparable between the two groups ($P > 0.05$).

Methods

General information of the selected 120 participants were collected including sex, age, and education level. Meanwhile, clinical data were collected including GCS score; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression; and site of injury. The confusion assessment method for the intensive care unit (CAM-ICU) was used to evaluate whether a patient had delirium. Logistic regression analysis was conducted to explore the association between sex, age, education level, GCS score, comorbid diseases and site of injury and delirium[13].

For the measure, CAM-ICU was used to assess acute change and fluctuations in cognitive state consciousness; attention deficit with either a Letters (auditory) test or a Pictures (visual) test; thought disorder; and clarity of consciousness. A positive CAM-ICU test result was defined as the conditions of both (1) and (2) as well as either (3) or (4) were fulfilled. Moreover, the judgement whether a patient had delirium was subject to the consistency of assessment by two researchers at the same time.

SPSS 22.0 was used as the statistical software for data analysis. Measurement data was expressed using mean $\pm$ SD and inter-group difference was compared using Student's *t* test. Enumeration data was expressed using *n* (%) and inter-group difference was compared using χ^2 . $P < 0.05$ represented there was a significant difference.

RESULTS

Potential risk factors for delirium

GCS score above 8; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression; and frontal lobe injury were associated with delirium in patients admitted to the neurosurgical ICU (all $P < 0.05$). However, patient sex, age, education level and use more than three medicines were not associated with the occurrence of delirium in this population ($P > 0.05$). Table 1 showed the risk factors that might have an influence on the onset of delirium in patients with brain injury admitted to neurosurgical ICU (all $P < 0.05$).

Multivariate logistic regression analysis

Logistic analysis demonstrated that GCS score above 8; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression and frontal lobe injury were independent risk factors for the onset of delirium in patients with brain injury admitted to neurosurgical ICU (all $P < 0.05$, Table 2 and Table 3).

DISCUSSION

The specific mechanism for delirium caused by brain injury is unknown. It may be due to the involvement of the brainstem reticular formation and diffuse inhibition in the cerebral cortex[14,15]. The patients who underwent a surgery for brain injury are prone to displaying behaviors like quarrel and scold and self-harm. This may be associated with quick changes in patients' conditions and tranquility after brain injury. One fourth patients with delirium die in the hospital compared with mortality of 1% in patients brain injury but without delirium[16-18]. Moreover, the length of ICU stay is long in patients with delirium. Duration of mechanical ventilation and the length of ICU stay is prolonged in patients with delirium compared with those without delirium[19,20]. Furthermore, delirium is associated with the onset of tube related adverse events such as unexpected extubation and tracheal intubation[21]. The present study discussed the risk factors for the onset of delirium in patients who underwent surgery for brain injury in neurosurgical ICU.

The results of the study showed that GCS score above 8; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia or ventricular compression; and frontal lobe injury were independent risk factors for the onset of delirium in patients with brain injury in the neurosurgical ICU. It can be interpreted as a low GCS score indicates a serious brain injury. If cerebral concussion, cerebral contusion, hypoxemia, and ventricular compression coincide with a low GCS score, it means the brain

Table 1 Analysis of potential factors influencing delirium in patients admitted to neurosurgical intensive care unit

Relative factors	Delirium group, <i>n</i> = 25	Observation group, <i>n</i> = 95	<i>t</i> / χ^2 value	<i>P</i> value
Sex			0.135	0.804
Male	19	72		
Female	6	23		
Age in yr, mean $\pm$ SD	54.34 $\pm$ 11.09	55.40 $\pm$ 10.93	0.101	0.845
GCS score			13.033	0.001
≥ 8	12	70		
5-8	13	25		
Administration more than 3 medicines	18	65	3.024	0.052
Comorbid cerebral concussion	17	34	10.098	0.001
Comorbid cerebral contusion	15	28	9.075	0.001
Comorbid hypoxemia	17	35	7.865	0.001
Comorbid ventricular compression	16	27	12.096	0.001
Frontal lobe injury	18	30	9.763	0.001

GCS: Glasgow coma scale; SD: Standard deviation.

Table 2 Variate score setting for the logistic analysis

Variates	Score setting
GCS	1 indicated GCS score ≥ 8 ; 0 indicated GCS score between 5 and 8
Comorbid cerebral concussion	1 indicated presence of the comorbidity; 0 indicated absence of the comorbidity
Comorbid cerebral contusion	1 indicated presence of the comorbidity; 0 indicated absence of the comorbidity
Comorbid hypoxemia	1 indicated presence of the comorbidity; 0 indicated absence of the comorbidity
Comorbid ventricular compression	1 indicated presence of the comorbidity; 0 indicated absence of the comorbidity
Frontal lobe injury	1 indicated frontal lobe injury; 0 indicated injury of other sites of the brain

GCS: Glasgow coma scale.

Table 3 Multivariate logistic regression analysis of risk factors for the onset of delirium in patients with brain injury admitted to the neurosurgical intensive care unit

Variates	B value	SE value	Wald χ^2 value	<i>P</i> value	OR value	95%CI
GCS score	0.221	0.126	7.531	0.001	1.201	1.085-1.452
Comorbid cerebral concussion	0.189	0.223	6.542	0.001	1.154	1.058-1.503
Comorbid cerebral contusion	0.287	0.103	8.032	0.001	1.302	1.123-1.651
Comorbid hypoxemia	0.212	0.139	7.093	0.001	1.189	1.072-1.440
Comorbid ventricular compression	0.190	0.189	6.734	0.001	1.172	1.065-1.542
Frontal lobe injury	0.271	0.098	7.689	0.001	1.233	1.110-1.722

CI: Confidence interval; GCS: Glasgow coma scale; OR: Odds ratio.

had more severe injuries that may lead to acute stress-related disorders[22-23]. The key to controlling delirium is to discriminate the factors influencing the development of delirium and take preventive measures to reduce its occurrence. It was previously believed that medicines, metabolism, and brain parenchyma influence the occurrence of delirium[24]. This study demonstrated that using more than

three medicines was not significantly associated with the development of delirium, which may be attributed to the good basic physical performance of the participants in the study.

Lack of timely and effective health care may cause serious adverse outcomes such as disability and even death when patients with brain injury have delirium in the neurosurgical ICU. Therefore, the prevention of delirium and effective management should be highlighted in this population. Early preventive measures, diagnosis, and treatment can effectively prevent and reduce the incidence and duration of delirium in patients with a high risk of developing delirium to improve treatment outcomes and promote rehabilitation. A study[25] showed that due to the high incidence of delirium and relevant adverse effects it caused, risk factors influencing the occurrence of delirium should be highly concerned and active quality health care should be provided to prevent and reduce the impact of delirium and promote beneficial outcomes in this population.

CONCLUSION

As discussed above, GCS score; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression; and frontal lobe injury are risk factors for the onset of delirium in patients with brain injury and should be highly considered. Especially for patients with comorbid risks, appropriate nursing interventions should be implemented in the clinical treatment to reduce the incidence of delirium and improve clinical outcomes.

ARTICLE HIGHLIGHTS

Research background

Postoperative delirium is common in patients with brain injuries. Patients with delirium are more likely to experience increased complications such as cognitive dysfunction, disabilities, and morbidity. Predictors of postoperative delirium vary across inpatient settings. This study discussed the predictors of postoperative delirium in neurosurgical patients.

Research motivation

Exploring which factors play a part in the development of delirium helps to provide insights for clinicians and nurses to provide interventions at an early date to reduce the damage of disease in neurosurgery intensive care unit (ICU).

Research objectives

The study examined the predictors of postoperative delirium in patients who were hospitalized for brain injuries in neurosurgery ICU.

Research methods

This was a retrospective analysis. Data were collected including age, sex, years of education, the score of Glasgow coma scale (GCS), comorbid diseases, and injury sites in inpatients of the neurosurgery ICU who had brain injuries and underwent surgery. Logistic regression analysis was used to examine the association between the above factors and delirium in this population.

Research results

GCS score above 8; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression; and frontal lobe injury were independent risk factors for the onset of delirium in patients with brain injury admitted to the neurosurgical ICU.

Research conclusions

Patients with GCS above 8; comorbid diseases of cerebral concussion, cerebral contusion, hypoxemia and ventricular compression; and frontal lobe injury are much more likely to develop delirium after surgery for brain injuries.

Research perspectives

Future studies in a larger sample size are warranted to understand the epidemiology of postoperative delirium in neurosurgical patients admitted to ICU.

FOOTNOTES

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