Incidence and risk factors of postoperative delirium in patients after elective intracranial surgery and admitted to the intensive care unit: A prospective cohort study

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Supplemental Digital Content 1: Study protocol

**Postoperative Delirium in Adult Patients
after Elective Intracranial Operation under General Anesthesia:
a Prospective Cohort Study**

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Contents

1. Background
2. Objective of the study
3. Study design
4. Recruitment of subjects
5. Method of delirium evaluation and training
6. Delirium assessments
7. Light, noise, pain, and sleep evaluations
8. Exclusion after the enrolment and withdrawn
9. Follow-up
10. Data collection
11. Statistical analysis
12. Sample size
13. Quality control
14. Ethics and written informed consent
15. Conflicts of interests
16. Case Report Form
17. References
18. Description of the study and written informed consent

1. Background

Delirium is a non-specific cerebral syndrome characterized by an acute change in or a fluctuating mental status, inattention, disorganized thinking and sleep-wake cycle disorders [1]. It has been reported that delirium occurs in 10 to 50% of postoperative patients and in up to 80% of those who require intensive care [2-4]. In addition, delirium is associated with worse outcomes [5-9].

The causes of delirium are multifactorial. Several independent risk factors for postoperative delirium have been identified, mainly including advanced age, comorbidities, cognitive impairments, the type and duration of surgery, intraoperative hemorrhage, postoperative pain, and delayed extubation [10]. These factors are also present in neurosurgical patients. Additionally, a large proportion of patients who have undergone intracranial surgery are admitted to the intensive care unit (ICU) for postoperative care. Therefore, risk factors for ICU delirium, such as mechanical ventilation, sedation, analgesia, and ICU environment [10], may further increase the risk of postoperative delirium in neurosurgical patients admitted to the ICU. Moreover, brain lesions and intracranial manipulations are assumed to influence postoperative cognition [11]. However, neurosurgical patients have been excluded in the majority of postoperative delirium studies [2-9]. Given the potential adverse consequences that result from delirium, further study is needed to explore the incidence, risk factors and clinical outcomes of postoperative delirium in this population.

To date, several assessment tools have been developed for use by non-psychiatric personnel, such as ICU physicians and nurses, to evaluate delirium in patients admitted to the ICU [12]. The most well-known and frequently employed tool is the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU), which has been validated against the gold standard in the diagnosis of delirium, the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) [13]. A meta-analysis demonstrated that the pooled sensitivity and specificity for the CAM-ICU for the diagnosis of ICU delirium were 80% and 96%, respectively [14]. Recently, the CAM-ICU has been validated in patients with neurological illness, including traumatic brain injury [15], ischemic stroke [16], and intracranial hemorrhage [17]. Therefore, we assume that the CAM-ICU can be applied to patients after intracranial surgery.

In this prospective cohort study, we will enroll adult patients who have undergone elective intracranial surgery under general anesthesia. Delirium will be assessed using the CAM-ICU. The incidence and risk factors of postoperative delirium will be investigated. The patients will be followed, and clinical outcome variables will be collected. We hypothesize that postoperative delirium is prevalent in this population. Given that approximately 30% to 40% of delirium cases are thought to be the result of modifiable risk factors and are therefore preventable [18], identifying risk factors will help to facilitate improvements in clinical practice and prevent postoperative delirium.

2. Objective of the study

We aim to investigate the incidence and identify the risk factors of postoperative delirium in adult patients after elective intracranial surgery under general anesthesia.

3. Study design

This study is a STROBE-compliant prospective cohort study.

4. Recruitment of subjects

Consecutive patients will be screened at ICU admission by the investigators, who will evaluate the patients' hospital records to recruit subjects.

The inclusion criterion is adult patients after elective intracranial surgery under general anesthesia and admitted to the ICU. The exclusion criteria include:

- (1) Refuse to participate;
- (2) Age younger than 18 years;
- (3) Non-Chinese speaker;
- (4) Undergoing transsphenoidal surgery, cerebrospinal fluid (CSF) shunt and CSF drainage surgery, and deep brain stimulation (DBS) surgery for epilepsy and nocturnalmyoclonus;
- (5) Documented preoperative coma (Glasgow Coma Scale, GCS ≤ 8);
- (6) Documented preoperative mental retardation due to Parkinson's disease and dementia;
- (7) Documented history of psychosis;
- (8) Pregnant or lactating;
- (9) Moribund condition with a low likelihood of survival for more than 24 hours;
- (10) Admitted to the ICU after 20:00.

5. Method of delirium evaluation and training

Delirium will be evaluated by the CAM-ICU [13]. The Chinese version of CAM-ICU has been validated in an ICU setting in mainland China [19]. The delirium assessment consists of two steps. First, the arousal level is assessed by the Richmond Agitation-Sedation Scale (RASS), which is a 10-degree scale for sedation and agitation evaluation (Table 1) [20]. If the patient is not responsive to verbal stimuli (i.e., RASS score ≤ -4), the following delirium assessment will be aborted and the patient is recorded as comatose.

Table 1: Richmond Agitation Sedation Scale (RASS) [20]

Score	Term	Description
+4	Combative	Overtly combative, violent, immediate danger to staff
+3	Very agitation	Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated	Frequent non-purposeful movement, fights ventilator
+1	Restless	Anxious but movements not aggressive or vigorous
0	Alert and calm	
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/contact) to voice (10 seconds)
-2	Light sedation	Briefly awakens with eye contact to voice (less than 10 seconds)
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

When the RASS score is equal to or greater than -3, delirium will be evaluated using the CAM-ICU. The CAM-ICU assessment consists of four key features (Table 2):

- (1) Acute onset of a change in mental status or a fluctuating level of consciousness;
- (2) Inattention;
- (3) Disorganized thinking;
- (4) An altered level of consciousness.

The patient is diagnosed as delirious if both features 1 and 2, and either feature 3 or 4 are present.

Table 2: Confusion Assessment Method for Intensive Care Unit (CAM-ICU) [13]

Features	Score	Check here if Present
Feature 1: Acute Onset or Fluctuating Course		
Is the patient different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?	Either question Yes	☐
Feature 2: Inattention		
Letters Attention Test (See training manual for alternate pictures) Directions: Say to the patient, "I am going to read you a series of 10 numbers. Whenever you hear the letter '8,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart. 6 8 5 9 8 3 8 8 4 7 or 1 8 7 5 8 4 8 8 3 6 Errors are counted when patient fails to squeeze on the letter "8" and when the patient squeezes on any letter other than "8"	Number of Errors > 2	☐
Feature 3: Altered Level of Consciousness		
Present if the actual RASS score is anything other than alert and calm (0)	RASS anything other than 0	☐
Feature 4: Disorganized Thinking		
Yes/No Questions (Use group A or group B to test, if necessary, group A and B can be used interchangeably) A: 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail? B: 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Does two pounds weigh more than one pound? 4. Can you use a hammer to saw wood? Errors are counted when the patient incorrectly answers a question. Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers) *If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger" An error is counted if patient is unable to complete the entire command.	Combined number of errors >1	☐
Overall CAM-ICU	Criteria Met	☐ CAM-ICU Positive (Delirium Present)
CAM-ICU positive: feature 1 plus 2 and either 3 or 4 present	Criteria Not Met	☐ CAM-ICU Negative (No Delirium)

Four researchers will be trained before the initiation of the study. They are clinical research fellows and will not be involved in the patients' clinical care. An expert from the Department of Psychiatric will be invited to provide the training. The training course consists of four phases:

- (1) Group training: information about delirium, RASS scores, and the CAM-ICU will be provided; a video demonstrating the detailed conduction of the CAM-ICU assessment will also be presented.
- (2) One-on-one bedside instruction at the bedside.
- (3) Practice: trainees will evaluate patients on their own every day for one week, during which time the trainees will be able to contact the expert regarding any issues that occur with the evaluations.
- (4) Examination: Each trainee will evaluate five patients who have been pre-assessed by the expert. Different results in the delirium assessments between the trainee and the expert will be discussed until agreement is reached.

6. Delirium assessments

During the study, routine clinical practice of anesthesia and postoperative care are followed, and no attempts will be made to change or influence the routine clinical management.

After confirming enrolment, one of the four trained researchers will perform the delirium assessment. Delirium will be assessed in each patient at three time points:

- (1) Immediately after enrolment;
- (2) From 08:00 to 10:00 on postoperative day one in the ICU;
- (3) From 08:00 to 10:00 on postoperative day three in the ICU or in the neurosurgical ward.

The assessment performed immediately after enrolment will be used to diagnose emergence delirium, and the assessments performed on postoperative day one and day three will be used to diagnose postoperative delirium [21]. According to the postoperative delirium assessments, the patients will be divided into two groups:

- (1) Group with postoperative delirium: delirium is diagnosed on postoperative day one and/or day three;
- (2) Group without postoperative delirium: delirium is not diagnosed on both postoperative day one and day three.

7. Light, noise, pain, and sleep evaluations

Immediately after postoperative delirium assessment in each patient, levels of environmental noise and light will be measured using a sound meter (model GM1352, BENETECH, Shenzhen, China) and a light detector (model GM1020, BENETECH, Shenzhen, China), respectively, positioned within 10-centimetre of the patient's ear. Levels of pain and sleep quality will be evaluated by numerical rating scales (NRSs) [22, 23]. The use of restraint will also be documented.

8. Exclusion after the enrolment and withdrawn

Patients who remain comatose (i.e., RASS score ≤ -4) during the delirium assessments on both postoperative day one and day three will be excluded. Patients who are unable to communicate due to

blindness, hearing loss, or sensory and mixed aphasia will also be excluded. The number and reasons for exclusion after enrolment will be documented.

Each enrolled patient will have the right to withdraw his/her consent at any time during the study period.

9. Follow-up

Patients will be followed up until hospital discharge, death or 90 days after enrolment, whichever occurs first.

10. Data collection

A case report form (CRF) is designed for data collection. Demographics and preoperative data, anesthesia-related data, surgery-related data, data from the time of ICU admission, data from during the ICU stay before the postoperative delirium assessment on postoperative day one, and follow-up data will be collected from the hospital records, anesthesia records, surgical records, ICU nursing records, and hospital bills (Table 3).

Table 3: Data collection

Data	Sources
Demographics and preoperative data	
Sex (male or female)	Hospital records
Age (years)	Hospital records
Weight (kg)	Hospital records
Height (cm)	Hospital records
BMI (kg/m ²)	Hospital records
Education level (years)	Hospital records
History of smoke	Hospital records
History of alcohol abuse	Hospital records
Medical history (hypertension, coronary artery disease, diabetes mellitus, ischemic stroke, or hydrocephalus)	Hospital records
Long-term (> 1 month) use of antidepressants, benzodiazepines, and antiepileptic	Hospital records
American Society of Anesthesiologists (ASA) classification (I, II, III, or IV)	Anesthesia records
Anesthesia-related data	
Anesthesia method (balanced or total intravenous anesthesia)	Anesthesia records
Use of anesthetics during operation	Anesthesia records
Use of analgesics during operation	Anesthesia records
Use of anticholinergic during operation	Anesthesia records
Amount of bleeding during operation (mL)	Anesthesia records
Blood transfusion during operation	Anesthesia records
Fluid balance during operation (mL)	Anesthesia records
Episode of hypotension during operation	Anesthesia records

Duration of operation (min)	Surgical records
Surgery-related data	
Position (supine or lateral)	Surgical records
Nature of the intracranial lesion (cerebrovascular diseases, benign or malignant tumor)	Pathological reports
Frontal approach craniotomy	Surgical records
Lesion location (frontal, limbic system, dominant hemisphere, and multifocal)	Surgical records
Data collected at the ICU admission	
Glasgow Coma Scale (score)	ICU nursing records
Body temperature (°C)	ICU nursing records
Presence of endotracheal tube, central venous catheter, and intracranial drainage tube	ICU nursing records
Pulse oxygen saturation (%)	ICU nursing records
Blood glucose (mmol/L)	ICU nursing records
Hematocrit (%)	ICU nursing records
Data collected during the ICU stay before the delirium assessment on postoperative day 1	
Emergence delirium (none, come, hyperactive, or hypoactive delirium)	On-spot evaluation
Need of mechanical ventilation	ICU nursing records
Use of patient-controlled intravenous analgesia (PCIA)	ICU nursing records
Use of mannitol, nimodipin, steroid, and prophylactic use of antiepileptic	ICU nursing records
Presence of epilepsy	ICU nursing records
Sedatives for controlling of agitation (midazolam and/or propofol)	ICU nursing records
Use of analgesics (fentanyl and/or flurbiprofen axetil)	ICU nursing records
Serum Na (mmol/L), serum K (mmol/L), serum Cr (μmol/L), and serum albumin (g/L)	ICU nursing records
Fluid balance (mL)	ICU nursing records
First postoperative CT scan (hematoma, ischemia, midline shift, and bi-frontal pneumocephalus)	CT reports
During postoperative delirium assessment	
Use of physical restraint	On-spot evaluation
Light (lux)	On-spot evaluation
Noise (dB)	On-spot evaluation
Pain assessment (NRS score)	On-spot evaluation
Sleep quality assessment (NRS score)	On-spot evaluation
Outcome data	
ICU discharge at postoperative day one	Hospital records
Accidental removal of tubes and catheters	ICU nursing records
Unplanned reoperation within 72 hours	Hospital records
Unplanned ICU readmission within 7 days	Hospital records
Hospital mortality	Hospital records
Postoperative LOS (days)	Hospital records
Hospital expenses (Chinese Yuan)	Hospital bills

11. Statistical analysis

Statistical analysis will be performed independently by the Clinical Trial and Research Center, Beijing Tiantan Hospital, Capital Medical University.

Categorical variables are expressed as counts and percentages. Continuous data will be checked for normal distribution by the Kolmogorov-Smirnov test and are reported as the means and standard deviations (SDs) or the medians (interquartile ranges [IQRs]), when applicable.

The incidence of postoperative delirium and 95% confidence interval (CI) are calculated. Univariate analyses between the group with and without postoperative delirium will be performed. Categorical variables are analyzed by the Pearson chi-square test and Fisher's exact test for variables with small cell counts. Comparison of continuous data will be performed by the unpaired t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. Possible interactions between variables for the risk of postoperative delirium will be evaluated.

Factors with p values less than 0.05 in the univariate analyses and interaction analyses will be used to construct the multivariate risk model for postoperative delirium using the stepwise backward logistic regression. Odds ratios and their 95% CIs are used to assess the independent contributions of significant factors. The Hosmer-Lemeshow test will be used to determine the appropriateness of the model.

Statistical analyses will be performed using SPSS 20.0 (SPSS Inc., Chicago, IL, USA). A p value of less than 0.05 is considered statistically significant.

12. Sample size

According to standard recommendations, 10 cases of interest (postoperative delirium) will be required for each degree of freedom in the multivariate model for a reliable fit [24]. Given that no study has investigated the prevalence and risk factors of postoperative delirium in patients after intracranial surgery, we selected the low incidence of postoperative delirium (13%) reported in non-cardiac postoperative patients [25]. With 10% compensation for possible missing data, 800 cases will be sufficient to identify 10 risk factors for postoperative delirium in our cohort of patients, with $\alpha = 0.05$ and power = 0.85

13. Quality control

- (1) All researchers will be trained on the study procedures.
- (2) Four researchers will be trained on the RASS scoring and the CAM-ICU before the initiation of the study. They are clinical research fellows and will not be involved in patients' clinical care.
- (3) A streamlined CRF will be used for data collection.
- (4) All data and documents will be carefully preserved by the investigators.

14. Ethics and written informed consent

The study protocol is compliant with STROBE guideline. The study protocol must be approved by the Ethics Committee before the study can be started.

For every potential participant, investigators have the responsibilities to fully explain the study purpose,

procedures, as well as possible risks in a written informed manner. They must let every potential participant know that he/she has the right to withdraw his/her consent at anytime during the study period. Every potential participant must be given a written informed consent. Every participant or the authorized surrogate of the patient must sign the consent before they can be enrolled in the study. Written informed consents will be kept as a part of the study documents.

15. Conflicts of interests

None declared.

16. Case Report Form

Postoperative Delirium in Adult Patients
after Elective Intracranial Operation under General Anesthesia:
A Prospective Cohort Study

Case Report Form

Department of Critical Care Medicine
Beijing Tiantan Hospital, Capital Medical University

Screen No.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Recruitment No.	<input type="text"/> <input type="text"/> <input type="text"/>
Medical record No.	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Abbreviation name	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Investigator_recruitment	<input type="text"/> <input type="text"/> <input type="text"/>
Investigator_assessment	<input type="text"/> <input type="text"/> <input type="text"/>
Investigator_data collection	<input type="text"/> <input type="text"/> <input type="text"/>
Date (YYYY-MM-DD)	201 <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Refuse to participate	☐ Yes ☐ No
Exclusion after enrolment	☐ Yes ☐ No

Illustration

- This is a prospective cohort study.
- Fully explain the study purpose, procedures, as well as possible risks should be performed in a written informed manner. Potential participants must know their rights to withdraw consents at anytime during the study period. Every participant or the authorized surrogate of the patient must sign the consent before they can be enrolled in the study.
- All recorded data must be timely, accurate and complete.
- Every page and every item of the CRF must be completed.
- Fill “√” in the “□” to indicate selection. “NA” to indicate “cannot provide” or “not applicable”.
- Patient’s abbreviated name should be recorded in the form of left aligned acronym of Chinese phonetic alphabet. For example: Zhang Wei should be recorded as ZW, and Zhang Xiao-Wei should be recorded as ZXW.
- Numeric data should be recorded with decimals provided as □.□ in the form.
- The time should be recorded in the form of hh:mm using a 24-hour clock. For example: 9:35 in the morning should be recorded as: 09:35; 2:05 in the afternoon should be recorded as: 14 :05.
- If error(s) occurs in filling data, please use ONE strikethrough line and refill the correct data, and sign name of the corrector and date of correction.
 - Do not cover the original data.
 - Do not use the eraser or correction fluid.
 - Do not cross more than one strikethrough line.
- Please see Instructions for the RASS and the CAM-ICU assessments at the end of the form.
- If investigators have any questions during the study, please contact Drs. Jian-Xin Zhou, Hua-Wei Huang, and Chun-Mei Wang.
 - **Dr. Jian-Xin Zhou: 67098019**
 - **Dr. Hua-Wei Huang: 67098451**
 - **Dr. Chun-Mei Wang: 67096518**

Screen and Recruitment

Investigator_screening&recruitment: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Inclusion criterion:

Adult patients after elective intracranial operation under general anesthesia and admitted to the ICU

Please check the hospital records and examine the patient for exclusion

Age ≤18-years-old	☐ Yes ☐ No
Non-Chinese speaker	☐ Yes ☐ No
Surgery	
Transsphenoidal surgery	☐ Yes ☐ No
Cerebrospinal fluid (CSF) shunt	☐ Yes ☐ No
CSF drainage surgery	☐ Yes ☐ No
Deep brain stimulation (DBS) surgery for epilepsy and nocturnalmyoclonus	☐ Yes ☐ No
Preoperative coma (Glasgow Coma Scale, GCS ≤ 8)	☐ Yes ☐ No
Preoperative mental retardation due to Parkinson's disease and dementia	☐ Yes ☐ No
History of psychosis	☐ Yes ☐ No
Pregnant or lactating;	☐ Yes ☐ No
Moribund condition with low likelihood of survival for more than 24 hours	☐ Yes ☐ No
Admitted to the ICU after 20:00	☐ Yes ☐ No

If there is no exclusion criterion, please fully explain the study purpose, procedures, as well as possible risks during the study to the patient or the authorized surrogate of the patient.

Signed the consent and documented: ☐Yes ☐No

If Yes, please go next page.

Or, stop here and mark on the title page of CRF as "Refuse to participate".

Please call research members for delirium assessment and data collection:
6518, 6637, 8451, 8449, or 8450.

The first delirium assessment (after enrolment)

Investigator_assessment: ☐☐☐

Data (YYYY/MM/DD): 20☐☐/☐☐/☐☐

Time (HH:MM): ☐☐ : ☐☐

Richmond Agitation Sedation Scale (RASS)

Score	Term	Description	
+4	Combative	Overtly combative, violent, immediate danger to staff	☐
+3	Very agitation	Pulls or removes tube(s) or catheter(s); aggressive	☐
+2	Agitated	Frequent non-purposeful movement, fights ventilator	☐
+1	Restless	Anxious but movements not aggressive or vigorous	☐
0	Alert and calm		☐
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/contact) to voice (10 seconds)	☐
-2	Light sedation	Briefly awakens with eye contact to voice (less than 10 seconds)	☐
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)	☐
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	☐
-5	Unarousable	No response to voice or physical stimulation	☐

The patient is not responsive to verbal stimuli (i.e. RASS score $\leq$ -4): comatose ☐Yes ☐No

If all "No", please go to next page.

Confusion Assessment Method for Intensive Care Unit (CAM-ICU)

Feature 1: Acute Onset or Fluctuating Course	Score	Check here if Present
<p>Is the patient different than his/her baseline mental status?</p> <p>OR</p> <p>Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?</p>	<p>Either question</p> <p>Yes</p>	☐
Feature 2: Inattention		
<p>Letters Attention Test (See training manual for alternate pictures)</p> <p>Directions: Say to the patient, "I am going to read you a series of 10 numbers. Whenever you hear the letter '8,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart. 6 8 5 9 8 3 8 8 4 7 or 1 8 7 5 8 4 8 8 3 6</p> <p>Errors are counted when patient fails to squeeze on the letter "8" and when the patient squeezes on any letter other than "8"</p>	<p>Number of Errors > 2</p>	☐
Feature 3: Altered Level of Consciousness		
<p>Present if the actual RASS score is anything other than alert and calm (0)</p>	<p>RASS anything other than 0</p>	☐
Feature 4: Disorganized Thinking		
<p>Yes/No Questions (Use group A or group B to test, if necessary, group A and B can be used interchangeably)</p> <p>A: 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail?</p> <p>B: 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Does two pounds weigh more than one pound? 4. Can you use a hammer to saw wood?</p> <p>Errors are counted when the patient incorrectly answers a question. Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers)</p> <p>*If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger"</p> <p>An error is counted if patient is unable to complete the entire command.</p>	<p>Combined number of errors >1</p>	☐
Overall CAM-ICU	Criteria Met	☐ CAM-ICU Positive (Delirium Present)
CAM-ICU positive: feature 1 plus 2 and either 3 or 4 present	Criteria Not Met	☐ CAM-ICU Negative (No Delirium)

The patient is diagnosed as delirious if both features 1 and 2, and either feature 3 or 4 are presented.

Data collection

Demographic, preoperative, anesthesia, and surgery

Please fill in below items from hospital records, anesthesia records, surgical records, and ICU nursing records.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐/☐☐/☐☐

Time (HH:MM): ☐☐ : ☐☐

Demographic and preoperative data

Data	Sources	Results
Sex	Hospital records	☐ male ☐ female
Age	Hospital records	☐ ☐ years
Weight	Hospital records	☐ ☐ kg
Height	Hospital records	☐ ☐ ☐ cm
Education level	Hospital records	☐ ☐ years
History of smoke	Hospital records	☐ yes ☐ no
History of alcohol abuse	Hospital records	☐ yes ☐ no
History of hypertension	Hospital records	☐ yes ☐ no
History of coronary artery disease	Hospital records	☐ yes ☐ no
History of diabetes mellitus	Hospital records	☐ yes ☐ no
History of ischemic stroke	Hospital records	☐ yes ☐ no
History of hydrocephalus	Hospital records	☐ yes ☐ no
Long-term (> 1 month) use of antidepressants	Hospital records	☐ yes ☐ no
Long-term (> 1 month) use of benzodiazepines	Hospital records	☐ yes ☐ no
Long-term (> 1 month) use of antiepileptic	Hospital records	☐ yes ☐ no
American Society of Anesthesiologists classification	Anesthesia records	☐ I ☐ II ☐ III ☐ IV

➔ Next page

Anesthesia-related data

Data	Sources	Results
Use of anesthetics during operation	Anesthesia records	☐ propofol ☐ midazolam ☐ dexmedetomidine ☐ isoflurane ☐ sevoflurane
Use of analgesics during operation	Anesthesia records	☐ fentanyl ☐ sufentanil ☐ remifentanil
Use of anticholinergic during operation	Anesthesia records	☐ yes ☐ no
Amount of bleeding during operation	Anesthesia records	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> mL
Blood transfusion during operation	Anesthesia records	☐ yes ☐ no
Amount of blood transfusion	Anesthesia records	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> mL
Fluid balance during operation	Anesthesia records	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> mL
Episode of hypotension during operation*	Anesthesia records	☐ yes ☐ no
Duration of operation	Anesthesia records	<input type="text"/> <input type="text"/> <input type="text"/> min

* Defined as systolic blood pressure < 95 mmHg, or in case of a baseline value < 119 mmHg, a decrease of more than 20% from baseline value.

Surgery-related data

Data	Sources	Results
Body position	Surgical records	☐ supine ☐ lateral
Frontal approach craniotomy	Surgical records	☐ yes ☐ no
Lesion location involvement	Surgical records	frontal ☐ yes ☐ no limbic system ☐ yes ☐ no dominant hemisphere ☐ yes ☐ no multifocal ☐ yes ☐ no

Data collected at the ICU admission

Data	Sources	Results
Glasgow Coma Scale, scores	ICU nursing records	eye ☐ vocal ☐ motor ☐
Body temperature	ICU nursing records	<input type="text"/> <input type="text"/> <input type="text"/> °C
Presence of endotracheal tube	ICU nursing records	☐ yes ☐ no
Presence of central venous catheter	ICU nursing records	☐ yes ☐ no
Presence of intracranial drainage tube	ICU nursing records	☐ yes ☐ no
Pulse oxygen saturation	ICU nursing records	<input type="text"/> <input type="text"/> %
Blood glucose	ICU nursing records	<input type="text"/> <input type="text"/> <input type="text"/> mmol/L
Hematocrit	ICU nursing records	<input type="text"/> <input type="text"/> <input type="text"/> %

Delirium assessment on postoperative day 1

Investigator_assessment: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Richmond Agitation Sedation Scale (RASS)

Score	Term	Description	
+4	Combative	Overtly combative, violent, immediate danger to staff	☐
+3	Very agitation	Pulls or removes tube(s) or catheter(s); aggressive	☐
+2	Agitated	Frequent non-purposeful movement, fights ventilator	☐
+1	Restless	Anxious but movements not aggressive or vigorous	☐
0	Alert and calm		☐
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/contact) to voice (10 seconds)	☐
-2	Light sedation	Briefly awakens with eye contact to voice (less than 10 seconds)	☐
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)	☐
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	☐
-5	Unarousable	No response to voice or physical stimulation	☐

The patient is unable to communicate due to

blind ☐Yes ☐No

hearing loss ☐Yes ☐No

sensory aphasia ☐Yes ☐No

mixed aphasia ☐Yes ☐No

The patient is not responsive to verbal stimuli (i.e. RASS score $\leq$ -4): comatose ☐Yes ☐No

If all "No", please go next page.

Confusion Assessment Method for Intensive Care Unit (CAM-ICU)

Feature 1: Acute Onset or Fluctuating Course	Score	Check here if Present
<p>Is the patient different than his/her baseline mental status?</p> <p>OR</p> <p>Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?</p>	<p>Either question</p> <p>Yes</p>	☐
Feature 2: Inattention		
<p>Letters Attention Test (See training manual for alternate pictures)</p> <p>Directions: Say to the patient, "I am going to read you a series of 10 numbers. Whenever you hear the letter '8,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart. 6 8 5 9 8 3 8 8 4 7 or 1 8 7 5 8 4 8 8 3 6</p> <p>Errors are counted when patient fails to squeeze on the letter "8" and when the patient squeezes on any letter other than "8"</p>	<p>Number of Errors > 2</p>	☐
Feature 3: Altered Level of Consciousness		
<p>Present if the actual RASS score is anything other than alert and calm (0)</p>	<p>RASS anything other than 0</p>	☐
Feature 4: Disorganized Thinking		
<p>Yes/No Questions (Use group A or group B to test, if necessary, group A and B can be used interchangeably)</p> <p>A: 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail?</p> <p>B: 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Does two pounds weigh more than one pound? 4. Can you use a hammer to saw wood?</p> <p>Errors are counted when the patient incorrectly answers a question. Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers)</p> <p>*If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger"</p> <p>An error is counted if patient is unable to complete the entire command.</p>	<p>Combined number of errors >1</p>	☐
Overall CAM-ICU	Criteria Met	☐ CAM-ICU Positive (Delirium Present)
CAM-ICU positive: feature 1 plus 2 and either 3 or 4 present	Criteria Not Met	☐ CAM-ICU Negative (No Delirium)

The patient is diagnosed as delirious if both features 1 and 2, and either feature 3 or 4 are presented.

Please put the sound meter and light detector at the head of the patient's bed

Numerical rating scale_pain: ☐☐

Numerical rating scale_sleep: ☐☐

Light: ☐☐ Lux

Noise: ☐☐ dB

Restraint: ☐ yes ☐ no

Data collection

During the ICU stay before the delirium assessment on postoperative day 1

Please fill in below items from ICU nursing records, hospital records and CT reports.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20//

Time (HH:MM): :

Data collected during the ICU stay before the delirium assessment on postoperative day 1

Data	Sources	Results
Need of mechanical ventilation	ICU nurse records	☐ yes ☐ no
Use of mannitol	ICU nurse records	☐ yes ☐ no
Use of nimodipin	ICU nurse records	☐ yes ☐ no
Use of steroid	ICU nurse records	☐ yes ☐ no
Prophylactic use of antiepileptic	ICU nurse records	☐ yes ☐ no
Presence of epilepsy	ICU nurse records	☐ yes ☐ no
Sedatives for controlling of agitation	ICU nurse records	midazolam ☐ yes ☐ no propofol ☐ yes ☐ no
Use of patient-controlled intravenous analgesia (PCIA)	ICU nurse records	☐ yes ☐ no
Use of analgesics besides PCIA	ICU nurse records	Fentanyl ☐ yes ☐ no flurbiprofen ax ☐ yes ☐ no
Serum Na	Hospital records	<input type="text"/> <input type="text"/> <input type="text"/> mmol/L
Serum K	Hospital records	<input type="text"/> <input type="text"/> mmol/L
Serum Cr	Hospital records	<input type="text"/> <input type="text"/> <input type="text"/> μmol/L
Serum albumin	Hospital records	<input type="text"/> <input type="text"/> <input type="text"/> g/L
Fluid balance	ICU nurse records	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> mL

The first postoperative CT scans (please check CT reports for date and time)

Data (YYYY/MM/DD): 20//

Time (HH:MM): :

Data	Sources	Results
Presence of hematoma	CT reports	☐ yes ☐ no
Presence of ischemia	CT reports	☐ yes ☐ no
Presence of midline shift	CT reports	☐ yes ☐ no
Presence of bi-frontal pneumocephalus	CT reports	☐ yes ☐ no

Delirium assessment on postoperative day 3

Investigator_assessment: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Richmond Agitation Sedation Scale (RASS)

Score	Term	Description	
+4	Combative	Overtly combative, violent, immediate danger to staff	☐
+3	Very agitation	Pulls or removes tube(s) or catheter(s); aggressive	☐
+2	Agitated	Frequent non-purposeful movement, fights ventilator	☐
+1	Restless	Anxious but movements not aggressive or vigorous	☐
0	Alert and calm		☐
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/contact) to voice (10 seconds)	☐
-2	Light sedation	Briefly awakens with eye contact to voice (less than 10 seconds)	☐
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)	☐
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation	☐
-5	Unarousable	No response to voice or physical stimulation	☐

The patient is unable to communicate due to

blind ☐Yes ☐No

hearing loss ☐Yes ☐No

sensory aphasia ☐Yes ☐No

mixed aphasia ☐Yes ☐No

The patient is not responsive to verbal stimuli (i.e. RASS score $\leq$ -4): comatose ☐Yes ☐No

If any one “yes”, please check assessment on postoperative day 1 (page).

If the patient is unable to communicate and/or not responsive to verbal stimuli on both postoperative day 1 and day 2, please mark on the title page of CRF as “exclusion after enrolment”.

If all “No”, please go next page.

Confusion Assessment Method for Intensive Care Unit (CAM-ICU)

Feature 1: Acute Onset or Fluctuating Course	Score	Check here if Present
<p>Is the patient different than his/her baseline mental status?</p> <p>OR</p> <p>Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?</p>	<p>Either question</p> <p>Yes</p>	☐
Feature 2: Inattention		
<p>Letters Attention Test (See training manual for alternate pictures)</p> <p>Directions: Say to the patient, "I am going to read you a series of 10 numbers. Whenever you hear the letter '8,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart. 6 8 5 9 8 3 8 8 4 7 or 1 8 7 5 8 4 8 8 3 6</p> <p>Errors are counted when patient fails to squeeze on the letter "8" and when the patient squeezes on any letter other than "8"</p>	<p>Number of Errors > 2</p>	☐
Feature 3: Altered Level of Consciousness		
<p>Present if the actual RASS score is anything other than alert and calm (0)</p>	<p>RASS anything other than 0</p>	☐
Feature 4: Disorganized Thinking		
<p>Yes/No Questions (Use group A or group B to test, if necessary, group A and B can be used interchangeably)</p> <p>A: 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail?</p> <p>B: 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Does two pounds weigh more than one pound? 4. Can you use a hammer to saw wood?</p> <p>Errors are counted when the patient incorrectly answers a question. Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers)</p> <p>*If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger"</p> <p>An error is counted if patient is unable to complete the entire command.</p>	<p>Combined number of errors >1</p>	☐
Overall CAM-ICU	Criteria Met	☐ CAM-ICU Positive (Delirium Present)
CAM-ICU positive: feature 1 plus 2 and either 3 or 4 present	Criteria Not Met	☐ CAM-ICU Negative (No Delirium)

The patient is diagnosed as delirious if both features 1 and 2, and either feature 3 or 4 are presented.

Please put the sound meter and light detector at the head of the patient's bed

Numerical rating scale_pain: ☐☐

Numerical rating scale_sleep: ☐☐

Light: ☐☐ Lux

Noise: ☐☐ dB

Restraint: ☐ yes ☐ no

Data collection

Follow-up on postoperative day 7

Please fill in below items from ICU nursing records, hospital records, pathology reports, and hospital bills.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Pathology report:

benign tumor ☐Yes ☐No

malignant tumor ☐Yes ☐No

cerebrovascular diseases ☐Yes ☐No

Data	Sources	Results
ICU discharge at postoperative day one	ICU nursing records	☐ yes ☐ no
Accidental removal of tubes and catheters	ICU nursing records	☐ yes ☐ no
Unplanned reoperation within 72 hours	Hospital records	☐ yes ☐ no
Unplanned ICU readmission within 7 days	Hospital records	☐ yes ☐ no
Hospital mortality	Hospital records	☐ yes ☐ no
Postoperative length of stay in hospital	Hospital records	☐ ☐ ☐ days
Hospital expenses	Hospital bills	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ CNY

If the patient has been discharged from the hospital or dead, stop follow-up.

Or, continue follow-up on postoperative day 14.

Data collection

Follow-up on postoperative day 14

Please fill in below items from ICU nursing records, hospital records, pathology reports, and hospital bills.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐☐/ ☐☐☐☐/ ☐☐☐☐

Time (HH:MM): ☐☐ : ☐☐☐☐

Pathology report: **If pathology data have been collected on postoperative day 7, please leave blank.**

benign tumor ☐Yes ☐No

malignant tumor ☐Yes ☐No

cerebrovascular diseases ☐Yes ☐No

Data	Sources	Results
ICU discharge at postoperative day one	ICU nursing records	☐ yes ☐ no
Accidental removal of tubes and catheters	ICU nursing records	☐ yes ☐ no
Unplanned reoperation within 72 hours	Hospital records	☐ yes ☐ no
Unplanned ICU readmission within 7 days	Hospital records	☐ yes ☐ no
Hospital mortality	Hospital records	☐ yes ☐ no
Postoperative length of stay in hospital	Hospital records	☐ ☐ ☐ days
Hospital expenses	Hospital bills	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ CNY

If the patient has been discharged from the hospital or dead, stop follow-up.

Or, continue follow-up on postoperative day 30.

Data collection

Follow-up on postoperative day 30

Please fill in below items from ICU nursing records, hospital records, pathology reports, and hospital bills.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Data	Sources	Results
ICU discharge at postoperative day one	ICU nursing records	☐ yes ☐ no
Accidental removal of tubes and catheters	ICU nursing records	☐ yes ☐ no
Unplanned reoperation within 72 hours	Hospital records	☐ yes ☐ no
Unplanned ICU readmission within 7 days	Hospital records	☐ yes ☐ no
Hospital mortality	Hospital records	☐ yes ☐ no
Postoperative length of stay in hospital	Hospital records	☐ ☐ ☐ days
Hospital expenses	Hospital bills	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ CNY

If the patient has been discharged from the hospital or dead, stop follow-up.
Or, continue follow-up on postoperative day 60.

Data collection

Follow-up on postoperative day 60

Please fill in below items from ICU nursing records, hospital records, pathology reports, and hospital bills.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐☐/☐☐☐/☐☐☐

Time (HH:MM): ☐☐ : ☐☐

Data	Sources	Results
ICU discharge at postoperative day one	ICU nursing records	☐ yes ☐ no
Accidental removal of tubes and catheters	ICU nursing records	☐ yes ☐ no
Unplanned reoperation within 72 hours	Hospital records	☐ yes ☐ no
Unplanned ICU readmission within 7 days	Hospital records	☐ yes ☐ no
Hospital mortality	Hospital records	☐ yes ☐ no
Postoperative length of stay in hospital	Hospital records	☐ ☐ ☐ days
Hospital expenses	Hospital bills	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ CNY

If the patient has been discharged from the hospital or dead, stop follow-up.
Or, continue follow-up on postoperative day 90.

Data collection
Follow-up on postoperative day 90
The final follow-up

Please fill in below items from ICU nursing records, hospital records, pathology reports, and hospital bills.

Investigator_data collection: ☐☐☐

Data (YYYY/MM/DD): 20☐☐/☐☐/☐☐

Time (HH:MM): ☐☐ : ☐☐

Data	Sources	Results
ICU discharge at postoperative day one	ICU nursing records	☐ yes ☐ no
Accidental removal of tubes and catheters	ICU nursing records	☐ yes ☐ no
Unplanned reoperation within 72 hours	Hospital records	☐ yes ☐ no
Unplanned ICU readmission within 7 days	Hospital records	☐ yes ☐ no
Hospital mortality	Hospital records	☐ yes ☐ no
Postoperative length of stay in hospital	Hospital records	☐ ☐ ☐ days
Hospital expenses	Hospital bills	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ CNY

Instruction: Delirium assessment

First, the arousal level is assessed by the Richmond Agitation-Sedation Scale (RASS):

Richmond Agitation Sedation Scale (RASS)

Score	Term	Description
+4	Combative	Overtly combative, violent, immediate danger to staff
+3	Very agitation	Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated	Frequent non-purposeful movement, fights ventilator
+1	Restless	Anxious but movements not aggressive or vigorous
0	Alert and calm	
-1	Drowsy	Not fully alert, but has sustained awakening (eye opening/contact) to voice (10 seconds)
-2	Light sedation	Briefly awakens with eye contact to voice (less than 10 seconds)
-3	Moderate sedation	Movement or eye opening to voice (but no eye contact)
-4	Deep sedation	No response to voice, but movement or eye opening to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

If the patient is not responsive to verbal stimuli (i.e. RASS score $\leq$ -4), please document as comatose.

As RASS is equal to or greater than -3, continue to next step: Confusion Assessment Method for Intensive Care Unit (CAM-ICU) assessment. The CAM-ICU assessment consists of four key features:

Feature 1 Acute onset of mental status change or fluctuating level of consciousness;

Feature 2 Inattention;

Feature 3 Disorganized thinking;

Feature 4 Altered level of consciousness.

Confusion Assessment Method for Intensive Care Unit (CAM-ICU)

Feature 1: Acute Onset or Fluctuating Course	Score	Check here if Present
Is the patient different than his/her baseline mental status? OR Has the patient had any fluctuation in mental status in the past 24 hours as evidenced by fluctuation on a sedation/level of consciousness scale (i.e., RASS/SAS), GCS, or previous delirium assessment?	Either question Yes	☐
Feature 2: Inattention		
Letters Attention Test (See training manual for alternate pictures) Directions: Say to the patient, "I am going to read you a series of 10 numbers. Whenever you hear the letter '8,' indicate by squeezing my hand." Read letters from the following letter list in a normal tone 3 seconds apart. 6 8 5 9 8 3 8 8 4 7 or 1 8 7 5 8 4 8 8 3 6 Errors are counted when patient fails to squeeze on the letter "8" and when the patient squeezes on any letter other than "8"	Number of Errors > 2	☐
Feature 3: Altered Level of Consciousness		
Present if the actual RASS score is anything other than alert and calm (0)	RASS anything	☐

		other than 0	
Feature 4: Disorganized Thinking			
<p>Yes/No Questions (Use group A or group B to test, if necessary, group A and B can be used interchangeably)</p> <p>A: 1. Will a stone float on water? 2. Are there fish in the sea? 3. Does one pound weigh more than two pounds? 4. Can you use a hammer to pound a nail?</p> <p>B: 1. Will a leaf float on water? 2. Are there elephants in the sea? 3. Does two pounds weigh more than one pound? 4. Can you use a hammer to saw wood?</p> <p>Errors are counted when the patient incorrectly answers a question. Command Say to patient: "Hold up this many fingers" (Hold 2 fingers in front of patient) "Now do the same thing with the other hand" (Do not repeat number of fingers)</p> <p>*If the patient is unable to move both arms, for 2nd part of command ask patient to "Add one more finger"</p> <p>An error is counted if patient is unable to complete the entire command.</p>		Combined number of errors >1	☐
Overall CAM-ICU	Criteria Met	☐ CAM-ICU Positive (Delirium Present)	
CAM-ICU positive: feature 1 plus 2 and either 3 or 4 present	Criteria Not Met	☐ CAM-ICU Negative (No Delirium)	

The patient is diagnosed as delirious if both features 1 and 2, and either feature 3 or 4 are presented.

Instruction: Numeric Rating Scale for pain and sleep

Levels of pain and sleep quality are evaluated by the numerical rating scale (NRS), which are only done if the RASS score is equal to or greater than -3. We will evaluate the NRS immediately after the postoperative delirium assessment.

The NRS is an 11-point scale which requires the patient to choose a number from 0 to 10. In the pain assessment, "0" indicates no pain and "10" indicates the worst imaginable pain. In the sleep quality assessment, "0" is the equivalent of the best possible sleep and "10" is the equivalent of the worst possible sleep.

When explaining the scale, the investigator could show his/her fingers to the patient from "0" to "10" in order to make the patient understand more easily. The patient could show the result with their fingers (intubated) or say it directly. Zero can be shown by the investigator to make a circle with the thumb and index finger.

Instruction: Sound Meter and light detector

Levels of environmental noise and light will be measured by a sound meter (model GM1352, BENETECH, Shenzhen, China) and a light detector (model GM1020, BENETECH, Shenzhen, China), respectively.

The two instruments are positioned within 10-centimeter of the patient's ear.

The noise measurements are averaged in the 30 minutes after postoperative delirium assessment.

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18. Description of the study and written informed consent

Postoperative Delirium in Adult Patients after Elective Intracranial Operation under General Anesthesia: a Prospective Cohort Study

Description of the study and written informed consent

1. We invite you to participate in this study

We invite you to participate in this prospective cohort study investigating the “incidence and risk factors of postoperative delirium in adult patients after elective intracranial operations under general anesthesia”. The study is organized by Department of Critical Care Medicine in Beijing Tiantan Hospital and will be performed in Neurosurgical Intensive Care Unit (ICU), Beijing Tiantan Hospital, Capital Medical University. We are expected to enroll 800 participants among patients who will be admitted to the ICU after elective intracranial operations.

Before you decide to participate in the study, please read the following description carefully which will help you to understand the purpose and contents of the study, to understand the potential benefits from the study that it may bring to you, as well as the potential risks that you may encounter during the study. You are welcome to discuss your concerns with your doctor, relatives and/or friends freely before making the decision. If you have any questions or would like to get more information about the study, please do contact us.

2. What is the purpose of the study?

Delirium is a common problem after major surgery and is associated with prolonged ICU and hospital stay, increased short-term postoperative adverse events, worsened quality of life after surgery, increased mortality, and increased hospital costs. Preliminary data have shown that admission category of neurosurgery seems likely to be an independent risk factor for the development of delirium during patients’ stay in the ICU. However, only few postoperative delirium studies included patients after intracranial operation. Up to now, we don’t know exactly how many patients develop postoperative delirium after intracranial operations and what factors put the patient in risk of delirium.

We speculate that delirium is prevalent in patients after intracranial operations. The purpose of the present study is to investigate the incidence and identify the risk factors of postoperative delirium in adult patients after elective intracranial operations under general anesthesia.

3. Do I have to participate in?

The decision to participate in the study is entirely voluntary. You make the decision to take part in or not, and can withdraw consent at any time without giving any reasons during the study. If you decide to

participate in, please sign the written informed consent form. You can keep a signed informed consent form and a copy of study description. Withdrawal from the study does not affect your treatments throughout your hospital stay. In such case, your data and information will not be used in the study. On the other hand, if you or we think the study is affecting your normal treatment or outcome, the researchers will also stop the study.

During the period of study participation, please tell researchers your true medical history and current physical status, as well as whether you have participated in any other studies currently or recently, or if you have any newly developed discomfort.

4. If I participate in, what do I need to do?

If you agree to participate in this study, we will give a recruitment number and establish medical records for you. We will collect your demographic and preoperative information before the operation; we will see you and assess consciousness and delirium immediately after enrolment, and assess consciousness, delirium, pain severity, subjective sleep quality, and use of restraints at 8:00 to 10:00 on postoperative day one and day three. Each assessment will last about five minutes or less. During the rest period of postoperative hospitalization, we will follow you up by reviewing the hospital records, ICU nursing records, and pathology reports. All the above inspection and assessment are free of charge and the only thing you need to do is to cooperate with our investigators.

5. Will participation in this study bring me extra cost or reward?

This is an observational study. During the study, routine practice of anesthesia and postoperative care will be followed. Participation in the study will not bring you extra cost or give you any extra rewards.

6. Do I get any benefit from participating in the study?

Participation in the study will help us to diagnose and prevent delirium earlier. The results of this study may help to improve the postoperative management of patients in the future and bring benefits to more patients.

7. Are there any potential risks or adverse effects to me?

This is a non-interventional study. During the study, routine clinical practice of anesthesia and postoperative care are followed, and no attempts will be made to change or influence the routine clinical management. The study itself will not bring risks and adverse effects to the participant. However, if you think the study is affecting your normal treatment or outcome, please feel free to contact the researchers.

8. Will my personal information be confidential?

Some data obtained from you during the study will be published in the form of scientific papers, but your personal information (including name, medical record number, age, education and etc.) will be

kept confidential and your personal privacy will be protected according to law. Non-research team personnel will not be allowed to obtain your information, unless permitted by yourself. Your information (recorded in written or other formats) will be preserved for five years and then destroyed five years after the end of the study. If the information needs to be preserved for more than 5 years, we will obtain your permission by telephone, and will inform you how long and in what way your information will be preserved and used in the future. All research members and institutions involved in the study will maintain confidentiality. In order to ensure that the study is carried out in accordance with the regulations, administrative members or the ethics committee members may access your personal information when necessary.

9. How can I get more information?

If you have any questions about the study, or suffer from any discomfort and injury during the study, or want to obtain more information of the study, please do not hesitate to contact the research members: Chun-Mei Wang MD and Hua-Wei Huang MD (Tel: 67098450).

If you have any questions regarding the ethical issues of the study, please contact the Institutional Review Board office of Beijing Tiantan Hospital, Capital Medical University (Tel: 67098555).

When necessary, you can also contact the Department of Medical Service of Beijing Tiantan Hospital, Capital Medical University (Tel: 67098027).

**Postoperative Delirium in Adult Patients
after Elective Intracranial Operations under General Anesthesia:
a Prospective Cohort Study**

Signature page

Informed consent and signature:

I have read the informed consent for this trial carefully. The study protocol has been explained to me in full detail. I totally understand the purpose and nature of the study, as well as my rights and risks during the study.

I would like to participate in the study voluntarily; and I can confirm that I cooperate with the research members according to the study protocol and the contents listed in informed consent and participate in the study throughout the entire course of the study.

Patient
(or legally authorized representative)

Printed Name (or legally authorized representative)	Signature	Date

<Relationship between legally authorized representative and patient (e.g., parent or legal guardian)>

Person Obtaining Consent

Printed Name & Title	Signature	Date