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Construction and application of a stratified nursing intervention program for postoperative delirium after Stanford type A aortic dissection: a quasi-experimental trial

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Abstract

Background Postoperative delirium is a common and significant consequence in patients with type A aortic dissection following surgery; however, there is currently no effective postoperative care plan.

Objective The purpose of this study is to develop and evaluate the practical implementation of a stratified nursing intervention program for postoperative delirium in patients undergoing surgery for Stanford type A aortic dissection.

Methods A stratified nursing intervention program for postoperative delirium was created using a literature review, group discussions, and the Delphi method via expert mail inquiry. A quasi-experimental design was used, with patients admitted to the general ward of a tertiary hospital in Wenzhou, China, functioning as subjects. From September to December 2022, 43 patients were included in the control group and given standard treatment. From January to June 2023, 37 patients were recruited in the intervention group, receiving both routine care and the intervention plan. The intervention's effects were compared in the two groups.

Results The intervention group had considerably shorter delirium and hospital stays than the control group ($P < 0.05$), as well as higher patient satisfaction levels. There were no inadvertent extubations in the intervention group. When the incidence and beginning time of delirium in the general ward were compared, there were no significant differences between the two groups ($P > 0.05$).

Conclusion Implementing this nurse intervention in the ward context can shorten postoperative delirium and hospital stays, increase patient satisfaction with care, and improve patient prognosis and quality of life. This intervention will also serve as a great resource for future clinical management of postoperative delirium.

Trial registration The National Health Security Information Platform's Medical Research Registration Information System has registered this study under the registration number MR-33–22-022978.

Keywords Aortic dissection, Postoperative delirium, Delphi method, Nursing care plan, Clinical application

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Introduction

Aortic dissection is the leading cause of death from aortic illness, and surgical repair remains the primary treatment for immediate rescue and, ultimately, patient survival. The rupture of type A aortic dissection being a critical and severe emergency situation. Postoperative delirium (POD) is an acute neurocognitive illness produced by surgical stress that is characterized by variations in the state of consciousness and impairment in attention, consciousness, and cognitive capacity (American Psychiatric Association, 2015). The operating time of type A aortic dissection takes longer, profound hypothermic circulatory arrest lasts longer, and the operation within the ascending aorta and aortic arch affects brain tissue perfusion, so the incidence of POD is higher than that of other cardiac surgeries (Li et al. 2022). The current literature reported the incidence rate to be between 14.04 and 55.68%(Lu et al. 2024; Zeng et al. 2021).

Patients with type A aortic dissection frequently require substantial volumes of anesthetic medicines and blood products during surgery, which puts them at risk for water-electrolyte imbalances, acid–base problems, and a variety of post-operative complication (such as important organ dysfunction, hemodynamic instability). This clearly increases the complexity and difficulty of nursing care, making POD management more onerous. Patients who undergo aortic dissection surgery often spend 6 to 10 days in the intensive care unit (ICU) (Li et al. 2022). They can be shifted to a general ward once their circulatory and respiratory systems are stable and tracheal intubation is withdrawn. However, the ICU-specialized care environment does not promote POD recovery (Erbay Dalli et al. 2023), and because there is no specific treatment for delirium, many patients continue to experience or develop delirium after being transferred from the ICU to the general ward. As a result, these patients require continued medical monitoring and intervention, even after they have been transferred to the ward. The median length of hospital stay for patients receiving aortic dissection surgery is 19.0 to 22.5 days (Lin et al. 2023). POD increases a patient's risk of nosocomial infection, death, and medical costs (Mart et al. 2021), as well as extend the length of hospital stay by 2 to 3 days (Jin et al. 2020). When delirium develops in the ICU, the 1-year survival rate is two to four times lower than that of non-delirium patients. When delirium occurs on a general ward, the risk of death is 1.5 times higher after 1 year (Pieri et al. 2020). As a result, effective prevention and timely treatment of POD can not only enhance patient outcomes but also optimize the advantages of medical resources.

The current delirium management recommendations and expert consensus documents describe the risk factors, evaluation and screening procedures, clinical symptoms, prevention, and treatment of POD in the ICU and ward. Despite these resources, medical staff still vary significantly in their abilities to detect and manage delirium early on (Yu et al. 2019). Some research has focused on the successful prevention of POD by addressing hypoxemia, dehydration, and malnutrition, providing enough pain management, and encouraging early movement (Unal et al. 2022). Others have looked into the benefits of cognitive function training, music therapy, and including family caregivers in the cardiac perioperative period to lower the risk of POD (Jiang et al. 2024; Kappen et al. 2023; Lin et al. 2024). However, there are few studies on stratified intervention nursing for postoperative delirium. Stratified nursing allows for the sensible allocation of medical resources based on the severity of the disease and the nursing needs of patients, ensuring they receive appropriate treatment and care, as well as the prevention of medical resource waste, consequently enhancing nursing quality. Currently, research on stratified nursing for postoperative delirium (POD) is mostly based on the ICU delirium assessment scale (Cai 2024), which has limitations such as unspecific stratified nursing and the absence of a systematic nursing plan. Furthermore, there are no study studies on this subject in general wards. Thus, developing a rigorous and systematic hierarchical nurse intervention plan for POD in general wards is critical.

The purpose of this study is to investigate a hierarchical nursing intervention program for postoperative delirium in general wards and evaluate its clinical application success, with the goal of serving as a reference for future postoperative delirium prevention and treatment in clinical settings.

Methods

Delphi method application

The Delphi method is a method in which investigators create a questionnaire and consult with expert group members using back-to-back communication in accordance with the specified approach. Following repeated consultation and feedback, the expert group's viewpoints gradually become more concentrated, and the research project is ultimately evaluated based on the experts' thorough judgments. It can accomplish the goal of brainstorming and complete development of study content through the consultation of specialists from different locations, cultural backgrounds, and expertise (Wang et al., 2018). This study uses the Delphi approach to develop a stratified nursing intervention program for POD in general wards based on literature research and group discussions, and then applies it to clinical practice to investigate the application effect, as seen in Fig. 1.

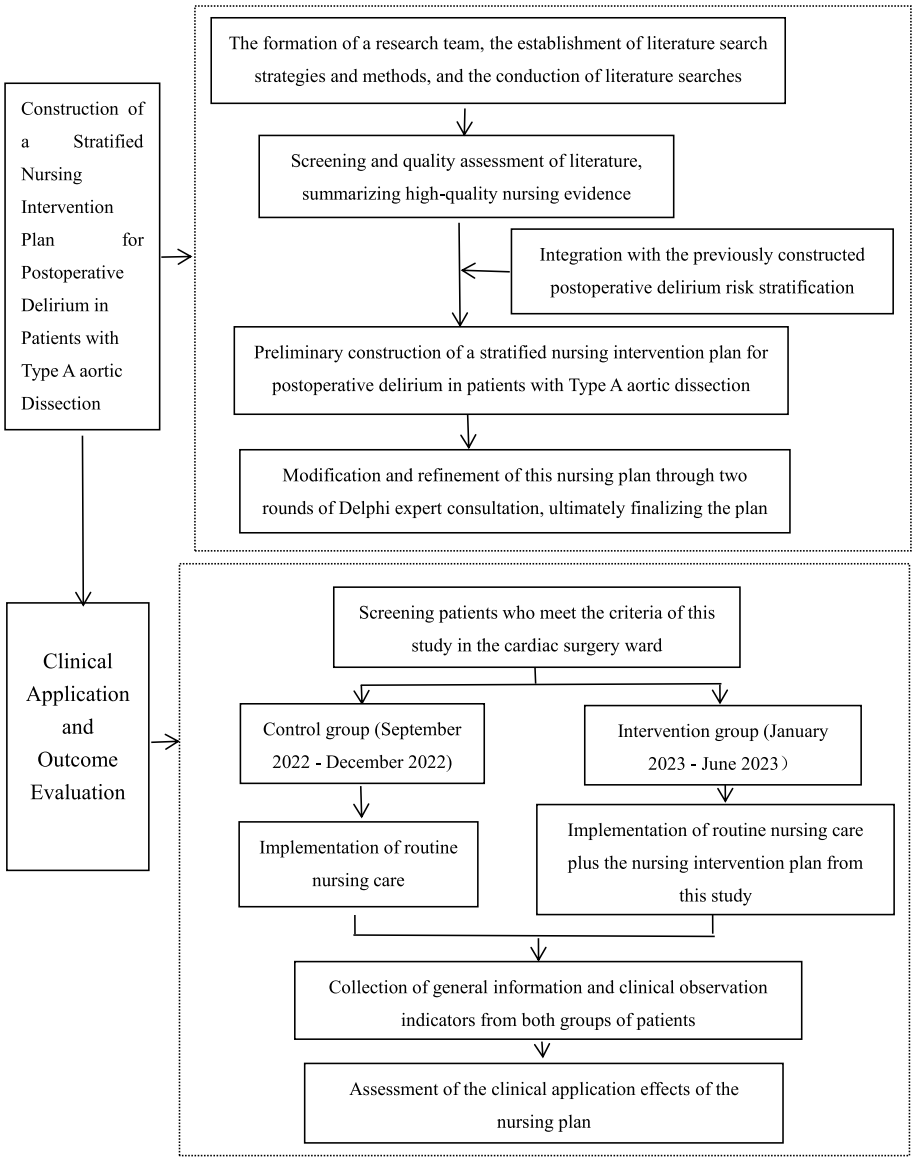

Fig. 1 Research framework diagram

Develop a stratified nursing intervention plan for POD

To obtain clinical practice guidelines and pertinent studies, a thorough literature search was done across multiple local and international databases and organizations. Appendix 1 describes the procedure of searching for literature and assessing its quality. Following the literature evaluation, group discussions were organized to plan a tiered nursing intervention program for POD in patients with Stanford type A aortic dissection. The initial draft of the strategy served as the foundation for the expert consultation questionnaire and inclusion/exclusion criteria. The nursing plan was modified and revised with the help of Delphi experts, resulting in the final document.

Quasi-experimental trial design

A quasi-experimental trial was designed to evaluate the efficacy of the POD nursing care plan developed for this study. Interventions for POD were implemented using the stratified nurse intervention technique (Table 1). This quasi-experimental study was conducted in the general ward of the cardiac surgery department at a university-affiliated hospital in Wenzhou, Zhejiang Province. All patients underwent surgery by three main surgeons and were transferred to the general ward, where they were treated and cared for by professionally trained nurses.

Table 1 Nursing care plan for 2 groups patients

Control group intervention methods		Experimental group intervention methods	
Regular nursing intervention		**Stratified nursing protocol for intervention**	
1.Nursing evaluation		**1. Nursing evaluation**	
1.1 Delirium judgment	The technique of identifying symptoms was used to monitor delirium. When a patient exhibits behavioral abnormalities (aggression towards others, indifference, impatience, etc.), hallucinations, and disorientation, and the diagnostic criteria for delirium are the same as those in the intervention group; delirium may be present. Assessment by the responsible nurse once a day	**1.1 Delirium judgment**	The responsible nurse would use the Nu-DESC scale to assess, with a total score of ≥ 1 indicating the possibility of delirium. The diagnosis of delirium: Consult a psychiatrist, and confirm the diagnosis of delirium according to the relevant content in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders. The high-risk group and those with delirium were assessed once per shift, and the low-risk group was assessed once per day
		1.2 Delirium risk stratification	Using a risk prediction scoring model to differentiate high-risk groups and low-risk groups for non-delirious patients
		1.3 Delirium risk factors assessment	Risk factors are assessed using the Delirium Risk Factor Assessment Form and the Delirium High Risk Medication Assessment Form. Low-risk groups are assessed once at admission and at any change in condition; high-risk groups and delirium patients are assessed daily
2. Nursing measures		**2. Nursing measures**	
2.1 Regular nursing	①changes in blood pressure, heart rate, blood oxygen saturation, and 24-h intake and output; ② postoperatively routine analgesia, phlegm and anti-inflammatory treatment, the indicators monitoring lab, exception handling in a timely manner; ③responsible nurses assisted and oversaw limb function exercise; ④ provide a quiet and comfortable ward environment to encourage sleep	**2.1 Stratified care management**	①the low-risk group was given routine care, and targeted interventions were implemented if any risk factors were present ②The high-risk group and those with delirium were given routine care in addition to the early mobility, pain, sleep, cognitive function, physiological needs, and complication management outlined in this protocol, and the variable factors were adjusted based on the results of daily assessments
2.2 Patient care for delirium	The degree of delirium was noted, and consequences stemming from the condition were noted. Medication and physical constraint were administered to patients experiencing acute delirium	**2.2 Management of delirium patients**	Non-severe delirium patients were managed in the same way as above. Severe delirium patients were given routine care in addition to following the doctor's orders for nighttime sedation; the use of psychiatric restraints was implemented using assessment and discontinuation forms to assess the patient's restraint needs; and nursing safety management was carried out
2.3 Health education	Responsible nurses conducted propaganda and education on the ward environment, visiting system, postoperative pipeline, rehabilitation exercise, food management, anticoagulation management, and other relevant topics. When a delirium occurs, the nurse educates families about the delirium, introduces successful cases, and encourages families to accompany	**2.3 Family support**	In addition to routine education, the group members would provide video, pamphlets, and classroom instruction to family members on delirium-related knowledge on days 1, 3, and 5 after the patient's admission, to help them understand the risk factors of delirium, recognize symptoms and signs of an attack, and care methods

Participants

Delphi method participants

Following a group discussion by the research group, specialists in nursing, anesthesiology, and clinical medicine were chosen for this study. Expert inclusion criteria are as follows: (1) nursing or clinical experts from a tertiary comprehensive hospital; (2) have clinical work experience in the treatment and nursing of delirium after aortic dissection, and are familiar with research in this field; (3) clinical work experience of more than 10 years, with a professional title of deputy senior or higher; (4) voluntarily and continuously participate in the entire correspondence inquiry process.

Empirical study participants

The research, which ran from September 2022 to June 2023, included hospitalized patients with type A aortic dissections in the general ward of cardiac surgery at a tertiary hospital in Wenzhou. Patients were assigned to the control group from September to December 2022, whereas patients were admitted to the intervention group from January to June 2023. The requirements for inclusion are as follows: (1) preoperative aortic CT angiography for type A aortic dissection; (2) no history of delirium; and (3) open heart surgery with extracorporeal circulation. (4) Must be at least eighteen. Exclusion criteria as follows: (1) mortality in the hospital; (2) patient requested to discontinue treatment since the underlying sickness was progressing uncontrollably; (3) has a history of mental illness, long-term alcoholism, or drug addiction; (4) suffers from cognitive impairment, such as mental retardation or dementia; (5) due to geographical and cultural differences, unable to talk in Mandarin or dialect; (6) patients or family members requested withdrawal from the research; (7) due to therapeutic needs, patients were relocated to different departments or hospitals.

To calculate the sample size, the two-sample rate formula was used: $n1 = n2 = \frac{\left[\mu_{\alpha/2}\sqrt{2\overline{p}(1-\overline{p})}+\mu_{\beta}\sqrt{p1(1-p1)+p2(1-p2)}\right]^2}{(p1-p2)^2}$. According to a recent data from China, the incidence of POD is 55.68% (Zeng et al. 2021). Zhang et al. also observed a 13.5% incidence of POD in the ICU following the adoption of a delirium nursing program (Zhang et al. 2015). As a result, the incidence of POD in the control group ($p1$) was established at 0.5568, and in the intervention group ($p2$) at 0.135. Using a 1:1 sample size ratio for the intervention and control groups, and α and β values of 0.05 and 0.1, the two-sided test result produced $n1 = n2 = 24.5889$. To account for any potential sample size loss, an additional 20% was added, resulting in a minimum of 30 cases in both the control and intervention groups.

Data collection

Delphi method part

Two members of the research team contacted the experts, answered the experts' questions, distributed and retrieved the questionnaires, and sorted out, analyzed, and extracted the consultation results. The questionnaires were sent out and withdrawn by email after the experts confirmed their consent. In order to ensure that experts completed the consultation within the specified time, the time node was reminded 1 week before the questionnaire was collected, and the interval between each round of consultation was 3 weeks. Items with mean importance assignment ≥ 4.00 and coefficient of variation < 0.25 were retained, and each item was modified, deleted, or supplemented in combination with expert opinions and suggestions. After completing the questionnaire modification, the study moved on to the following phase of expert consultation until the feedback from the experts was more consistent, at which time the consultation was ended, resulting in the final draft of the program. This study involved two rounds of expert consultations. The correspondence questionnaire contains the experts' basic information, the importance and feasibility of each issue, and the familiarity and judgment foundation of each item.

Empirical study part

The data collection in this section was done collaboratively by the study team members and the relevant nurses. The data obtained mostly consisted of patients' general information and intervention result. Patients' general information was gathered through a review of electronic medical records by research team members. The nurse in charge carried out the intervention program as outlined above, recording the incidence of delirium, the time of the first occurrence, the length, and the occurrence of unplanned extubation. At 4:00 p.m. each day, study team members reviewed nursing records to collect outcome indicators and, when in question, consulted the nurse on the relevant shift.

The broad information that patients collect was developed based on a literature review and discussions within the research group (Chen et al. 2021; Feinkohl et al. 2017; Galyfos et al. 2017; Milisen et al. 2020). Including demographic and sociological data and disease status data, such as gender, age, education level, drinking, diabetes, hypertension, length of critical care unit (ICU) stays, deep hypothermic circulatory arrest time, preoperative blood lactate levels, and other postoperative problems.

The outcome measures for this study were developed based on previous research and discussions within the research group (Zhang et al. 2020). The major end measure was the rate of delirium in the general ward following

surgery. Secondary outcomes were the occurrence time of delirium in the general ward, the duration of delirium, the rate of unplanned extubation, the length of stay in the general ward, and inpatients' satisfaction scores regarding nursing care.

The Nursing Delirium Screening Scale (Nu-DESC) was used to screen for delirium in the intervention group, with five clinical symptoms assessed: disorientation, behavioral abnormalities, verbal communication abnormalities, delusions/hallucinations, and psychomotor retardation. Each item was rated on the presence and intensity of clinical symptoms, using a scale of 0 (none), 1 (mild), and 2 (moderate to severe), with a maximum score of 10. A total score of 1 or higher suggested the presence of delirium (Neufeld et al. 2013). According to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (American Psychiatric Association, 2015), patients suspected of having delirium were referred to a psychiatrist to confirm the diagnosis. Patients in the control group were observed using a delirium symptom recognition technique. Any odd behavior, such as apathy, irritation, violence, hallucinations, or disorientation, was immediately reported to the attending physician, indicating the possibility of delirium. The diagnostic criteria for delirium in the control group were the same as in the intervention group. Delirium was resolved in both the intervention and control groups when the patient's abnormal behaviors, hallucinations/illusions, inappropriate verbal communication, and confusion stopped.

Unplanned extubation was described as the patient's willful or unintentional removal of the tube that did not correspond to the diagnostic or treatment plan. It refers primarily to tubes other than endotracheal tubes (e.g., deep venous catheters, closed chest drains, gastric tubes). The length of stay in the general ward was determined from the day the patient was transferred from the ICU to the date of release.

Wang Lu et al. established the Inpatients' Satisfaction with Nursing Work Scale, which was used to assess patient satisfaction with nursing care (Wang et al., 2014). This questionnaire contains 28 closed items and 1 open item, each evaluated on a scale of 1 to 5, with a minimum of 28 points and a maximum of 140 points. Higher scores imply that patients are more satisfied with their nursing care. The scale had a split-half reliability of 0.882 and Cronbach's α reliability coefficient of 0.939. A member of the study team completed it face-to-face on the day of discharge and collected it on the spot.

Quality control

In the research team, one deputy chief physician serves as team leader, responsible for overall work coordination and allocation, as well as providing guidance on disease treatment, medication, condition observation, rehabilitation exercises, and other related content; the head nurse serves as deputy leader, in charge of team management and daily communication with physicians. Before implementing the program, members of the study team taught the cardiac surgery nurses on the hierarchical nursing intervention for a week to ensure that they fully understood the program's content and could use the assessment tools appropriately. Regular medical and nursing meetings were conducted to discuss the program's implementation status. To form a Wechat working group for doctors and nurses in order to communicate patients' conditions and nursing effects in a timely manner, at the same time, we seek to foster a positive nurse-patient connection by clearly explaining the purpose and coordination of nursing intervention to patients and their families in order to improve their knowledge and compliance.

Data analysis

A database was created with Microsoft Excel, and data analysis was performed using SPSS 25.0 software. In the expert consultation section, the questionnaire's successful recovery rate and recommendation ratio were employed to convey the positive degree of experts. Expert authority was represented using the authority coefficient (Cr), judgment basis coefficient (Ca), and familiarity coefficient (Cs). The coefficient of variation (Cv) and Kendall's W were employed to quantify the degree of coordination between expert judgments. The mean value of importance assignment and full score rate of the items was used to illustrate the level of concentration of experts' viewpoints. Measurement data with normal distribution were presented as mean ± SD. The comparison between groups was performed using the independent sample t test. Measurement data that did not fit the normal distribution were reported as median and quartile, and group comparisons were performed using the Mann–Whitney U test. Count data were presented as examples and percentages, and the chi-square test or Fisher's exact test was used to compare groups. P-values < 0.05 were considered statistically significant.

Ethical considerations.

This study was approved by the First Affiliated Hospital of Wenzhou Medical University's clinical research ethics committee (Approval number: Clinical Research Luncheon (YS2022) No. (211)) and carried out in accordance with the ethical principles of the Declaration of Helsinki and the National Research Legislation. Before the intervention, the research team members accurately and totally informed the patients or guardians about the study's purpose, significance, substance, benefits, and dangers. The patients or guardians signed the informed consent form with their full knowledge.

Registration and inquiry

This study has been registered in the Medical Research Registration Information System of the National Health Security Information Platform, with registration number: MR-33–22–022978. The website for inquiries is www.yxyj.org.cn/www.medicalresearch.org.cn.

Results

Delphi method results

The stratified nursing intervention plan for POD for Stanford type A aortic dissection developed in this study includes six aspects: delirium judgment, delirium risk stratification, delirium risk related assessment, stratified care management, management of patients with delirium, and family support. For detailed content, please refer to Table 3.

Basic information on experts

This study included 19 experts from seven major hospitals in three cities: Shanghai, Guangdong, and Zhejiang. Four (21.05%) were men, while 15 (78.95%) were women. The experts' ages ranged from 36 to 52 years, with an average age of 44.63 ± 4.94 years. Their job experience ranged from 11 to 34 years, with an average of 22.74 ± 6.76 years. The selected specialists' educational backgrounds include 3 (15.79%) postgraduates and 16 (84.21%) undergraduates, including 15 (78.94%) nursing specialists, 2 (10.53%) medical specialists, and 2 (10.53%) anesthetists.

The degree of experts' authority and positive

In the first round, 19 questionnaires were given and 19 were returned, resulting in a validity rate of 100.00%, with 15 experts making recommendations (78.95%). In round 2, 19 questionnaires were given and 18 were returned, resulting in an effective recovery rate of 94.74%. Seven experts provided suggestions, yielding a recommendation rate of 38.89%. The experts used the Likert5 grading technique to assess the importance of each indicator and made suggestions for improvements, additions, and removals. It is usually considered that an expert authority coefficient (Cr) greater than 0.7 implies a high level of expert trust (Han et al. 2021). Table 2 shows the authoritative coefficients for the first and second rounds, which were 0.875 and 0.900, respectively. It reveals that the experts in this study have a strong sense of self-evaluation authority and trust.

Degree of harmonization of expert advice

Delphi experts' opinions are typically examined using the coefficient of variance (CV) and Kendall's coefficient of coordination (Kendall's W). A good indicator is defined as Cv < 0.25 (Zhang, 2019). On a scale of 0 to 1, a higher value indicates stronger agreement. In this study, the entry CV for the first round of expert inquiry is 0.05 ~ 0.30, with a W of 0.160. In the second round, the entry CV is 0 ~ 0.23, while the W is 0.177. Expert opinion indicates that this inquiry for expert coordination degree is more advanced after two rounds of expert inquiry for fundamental consistency.

Table 2 Results of two rounds of Delphi survey on expert authority coefficients

	Sample number	The coefficient of familiarity	The coefficient of basis of judgment	The coefficient of authority
First round	19	0.853	0.897	0.875
Second round	18	0.867	0.913	0.900

Concentration of expert opinion

To determine the focus of Delphi expert input, the significance index assignment mean and full mark rate are commonly utilized. The study's first round had a mean value of importance assignment of 3.84 ~ 4.95 for each question, a standard deviation of 0.23 ~ 1.20, and a complete score rate ranging from 76.84 to 98.95%. In the next iteration, the average significance level for each item ranged from 4.00 to 4.94, with a standard deviation of 0.24 ~ 0.96. The overall completion rate ranged from 80.00 to 98.89%. Following two rounds of professional consultation, it was clear that each item's concentration was improving.

Results of expert correspondence

The major modifications between the two rounds of expert consultation are as follows: (1) It is proposed to separate "Delirium Determination and Related Assessment" into "Delirium Determination" and "Delirium-Related Assessment" since experts think that diagnosing delirium and assessing related risk factors are two distinct processes. As a result, the nursing evaluation was changed to "delirium judgment," "risk stratification," and "risk factor assessment." (2) After the patient was transferred to the general ward, it was suggested that the delirium assessment tool be changed from the original Confusion Assessment Method (CAM) to the Nursing Delirium Screening Scale (Nu-DESC). Because the CAM is primarily appropriate to senior patients above the age of 65 (Inouye et al. 1990), and this study has not yet screened the individuals' ages, the Chinese version of the Nu-DESC was employed, as indicated by specialists. (3) Experts propose using objective techniques to assess a patient's requirement for restraint before and during physical constraint to avoid exacerbating delirium

Table 3 Stratified care intervention program for postoperative delirium after type A aortic dissection

Item	Content	Implementers
1. Nursing assessment		
1.1 Delirium judgment	1.1 The presence of delirium was determined by the nurse-in-charge on the day of transfer using Nu-DESC, which assesses five clinical features: disorientation, behavioral abnormality, verbal communication abnormality, illusions/hallucinations, and psychomotor retardation, each of which is scored according to the presence or absence and severity of clinical symptoms: absent = 0, mild = 1, moderately severe = 2, with a maximum score of 10. Delirium is likely to be present when the total score is ≥ 1. Diagnosis of delirium: Consultation with a psychiatrist was requested to confirm the diagnosis of delirium according to the relevant content in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition. Frequency of assessment: 1 assessment per shift for high-risk group and delirium, 1 assessment per day for low-risk group	Nurse doctor
1.2 Delirium risk stratification	1.2.1 A risk prediction scoring model was used to differentiate non-delirium patients into high- and low-risk groups. The model scoring criteria were: age > 55.5 years (1 point), male (1 point), preoperative lactate value > 1.85 mmol/L (1 point), duration of deep hypothermic circulatory arrest > 36.5 min (1 point), length of stay in the CCU > 8.5 days (2 points), and postoperative comorbidity with other complications (1 point). When the score was ≤ 4, the person was at low-risk of delirium; when the score was ≥ 5, the person was at high-risk of delirium	Nurse
1.3 Delirium risk-related assessment	1.3.1 Risk factors are assessed using the Delirium Risk Factor Assessment Form and the Delirium High Risk Medication Assessment Form. The low-risk group was once assessed on admission and at the change in condition; the high-risk group and those with delirium were assessed once daily	Nurse doctor
Nursing care measures		
2.1 Stratified care management	2.1.1 Those in the high-risk group and those with delirium implemented the early activity, pain, sleep, cognitive function, physiological needs, and complication management developed in this protocol in addition to routine care, and timely correction of risk factors for delirium based on daily assessments	Nurse
	① Early activity management. Patients were helped to move passively in bed on the day of transfer. On the 2nd day, those who could move actively were helped to sit at the bedside and assisted to move their lower limbs. For those who can stand for ≥ 5 min, they can try to assist the bedside walking and gradually move to the ward corridor, 2 times/day, 10–20 min/time	Nurse rehabilitation therapist
	② Pain management. Assessed by numerical rating scale (NRS) with expected target NRS ≦ 3 points. Non-pharmacological interventions include massage for pain other than wounds, cold therapy for procedural pain management, relaxation, and breathing exercises. Pharmacologic interventions: intravenous pumping of remifentanil injection for severe pain and irritability	Nurse
	③ Sleep management. Turn cell phones to vibrate mode; check and lower monitor volume to reduce false alarms; change medications at night before micropump alarms. Ask patients if they need to provide eye masks and earplugs	Nurse
	④ Cognitive function exercise. Assess patients' cognitive function using the MMSE scale. Place a clock and calendar in the room; avoid unnecessary environmental changes and ensure 1 familiar family member is with the patient during hospitalization. Remind the patient of today's date and time each morning. Tell the patient what stage of recovery he/she is at and what cooperation he/she needs to do today	Nurse
	⑤ Physiologic needs management. After transferring to the ward, the indications for removal of the indwelling urinary catheter were assessed daily, and the indwelling urinary catheter was removed as early as possible. Patients were asked about urination and defecation, and those who had not relieved their bowels for ≥ 3 days were given 40 ml of Keserol in the anus according to the doctor's instructions	Nurse
	⑥Complication management. Good respiratory management, every 2 h turn over and pat the back, do deep breathing training, follow the doctor's prescription of nebulized inhalation 3 times/day, guide effective sputum coughing, sputum coughing is not good to use stimulating sputum removal method. Maintain oxygen saturation > 90%. If it is below 90%, give oxygen according to medical advice. Early detection and active cooperation with doctors to treat infections; avoid unnecessary intubation	Nurse
	2.1.2 The low-risk group was given routine care, and the targeted interventions in the above program were implemented if risk factors existed, such as cold therapy, relaxation, and respiratory training before chest tube removal for those with significant pain, and pain medication for those with severe pain that could not be relieved, as prescribed by the doctor	Nurse

Table 3 (continued)

Item	Content	Implementers
2.2 Management of patients with delirium	2.2.1 Those with non-severe delirium are managed as above	Nurse
	2.2.2 In addition to the routine care of severe delirium patients, the following management was implemented: ① sedation management, dexmedetomidine night sedation (21:00 to 06:00 the next day) as prescribed by the doctor, with the goal of mild sedation, and vigilance for bradycardia and hypotension; ② constraint management, the use of psychiatric protective constraints implementation assessment form and lifting the assessment form to assess the patient's constraint needs scientifically, and the implementation of the principle of individualized reduction of constraints, least constraints; ③ Nursing safety management, the implementation of access control management at the entrance and exit of the ward, to avoid patient loss and escape; confiscation of scissors, fruit knives, sharps, etc. at the patient, to avoid injuries	Nurse
2.3 Family support	2.3.1 Health education. In addition to routine education, on the 1st, 3rd, and 5th days after the patient's transfer, the team members explained delirium-related knowledge to the family members by means of videos, leaflets, classroom lectures, etc. The education focused on what delirium is, prevention techniques, indicators of onset, and how to manage with it	Nurse
	2.3.2 Family participation. ①Instruct family members to monitor the patient's symptoms and signs daily and report any delirium to healthcare personnel promptly. ② Encourage family members to engage in early postoperative rehabilitation and interact regularly during hospitalization. ③ Provide delirium care by being patient and tolerant of the patient's odd behavior. Use positive motivational language to encourage the patient and help them return to normal mental state as soon as feasible	Patient's family

symptoms caused by over-restraint. As a result, this procedure assesses the restraint needs of patients with delirium using the Psychiatric Protective Restraint Implementation Assessment Form and the Release Assessment Form (Chinese Nursing Association Mental Health Professional Committee, 2022). (4) Based on expert feedback, change "delirium management" and "guidance on nursing skills for family members" to "management of patients with delirium" and "family support." Remove "prohibit chair movement at the nurse's station," "adjust monitor alarm parameters as needed," and "medication assessment" and combine its contents with "delirium risk management." Add the frequency of health education (on the first, third, and fifth days of transferring to the ward) to family support; and modify the form to include watching videos, distributing pamphlets, classroom lectures, and other forms of health education. After two rounds of correspondence, the experts' perspectives progressively converged, resulting in the final copy of the program, which mostly contained nursing assessment and nursing measures (Table 3).

Empirical study results

This study began with 83 patients (44 in the control group and 39 in the intervention group), research process, loss of control in 1 case (unable to communicate due to cultural differences), loss of intervention group in 2 cases (need for treatment courtyard), and finally 80 patients, ages 25 to 76 (53.36 ± 12.20), with 60 cases (75.0%) male and 20 cases (25.0%) female. Table 4 shows two patient groups with similar demographics, such as age, gender, education level, diabetes, high blood pressure, alcohol use, preoperative blood lactic acid level, deep hypothermic circulatory arrest time, length of hospital stays in the ICU, and postoperative complications. There was no statistically significant difference ($P > 0.05$) between groups.

Primary outcomes: incidence of POD

Table 5 compares the postoperative delirium incidence rates among patients in the general ward between the two groups. The delirium diagnosis results showed no significant difference in postoperative delirium incidence rates between the two groups ($\chi^2 = 0.199$, $P = 0.655$).

Secondary outcomes

a. The occurrence time of POD in the general ward: According to the data in Table 6, both groups had 10 patients with delirium on the day of transfer to the general ward. Six patients in the control group and two in the intervention group developed POD after being transferred to the general ward. However, there was no statistically significant difference in the timing of delirium onset between the two groups.
b. Length of stay and duration of delirium in the general ward: Patients in the intervention group had significantly shorter duration of delirium and length of stay in the general ward than those in the control group,

Table 4 The general information of two groups of patients

project		Control group ($n=43$)	Intervention group ($n=37$)	Test statistic	*P*
Sex (cases (percentage, %))	Male	34 (56.7)	26 (43.3)	0.821[1]	0.365
	Female	9 (45.0)	11 (55.0)		
Diabetes (cases (percentage, %))	No	34 (55.7)	27 (44.3)	0.408[1]	0.523
	Yes	9 (47.4)	10 (52.6)		
Drinking (cases (percentage, %))	No	17 (53.1)	15 (46.9)	0.008[1]	0.927
	Yes	26 (54.2)	22 (45.8)		
Hypertension (cases (percentage, %))	No	17 (63.0)	10 (37.0)	1.392[1]	0.238
	Yes	26 (49.1)	27 (50.9)		
Other postoperative complications (cases (percentage, %))	No	29 (48.3)	31 (51.7)	2.833[1]	0.092
	Yes	14 (70.0)	6 (30.0)		
Education level (cases (percentage, %))	Illiteracy	4 (57.1)	3 (42.9)	1.530[1]	0.675
	Primary school	16 (55.2)	13 (44.8)		
	Junior high school	9 (42.9)	12 (57.1)		
	High school and above	14 (60.9)	9 (39.1)		
Age ($\bar{x}\pm s$)		52.98 ± 13.20	53.81 ± 11.08	−0.303[2]	0.763
Preoperative blood lactic acid (mmol/L, $M(P_{25}, P_{75})$)		2.50 (1.80, 3.90)	2.30 (1.50, 3.78)	−0.584[3]	0.559
Deep hypothermic circulatory arrest time (min, $M(P_{25}, P_{75})$)		22.00 (19.00, 26.00)	21.00 (17.50, 28.00)	−0.213[3]	0.831
Length of hospital stays in the intensive care unit (days, $M(P_{25}, P_{75})$)		7.00 (5.00, 9.00)	6.00(5.00, 6.00)	−1.891[3]	0.059

[1] χ^2-score

[2] *t-score*

[3] *z*-score

Table 5 Comparison of postoperative delirium-related conditions and satisfaction scores between two groups of patients

		Control group ($n=43$)	Intervention group ($n=37$)	Value of statistics	*P*
Postoperative delirium (%)	Yes	16 (37.2)	12 (32.4)	0.199[a]	0.655
	No	27 (62.8)	25 (67.6)		
Length of hospital stay (days)		14.02 ± 5.58	11.86 ± 3.61	2.079[b]	**0.041***
Delirium duration (days)		7.81 ± 2.71	4.67 ± 2.35	3.211[b]	**0.004***
Satisfaction score (points)		119.33 ± 11.91	124.35 ± 9.71	3.178[b]	**0.044***

[a] For chi-square test

[b] For the T test

* Represent $P<0.05$

Table 6 The first occurrence time of POD in the general ward was compared between the two groups

First time	All delirium cases ($n=28$)		Delirium cases in the control group ($n=16$)		Delirium cases in the intervention group ($n=12$)		*P*
	n	%	*n*	%	*n*	%	
Day of transfer	20	71.4	10	62.5	10	83.3	0.401*
After the transfer	8	28.6	6	37.5	2	16.7	

*Fisher's exact test

with a statistically significant difference between the two groups, as shown in Table 5.

c. Unplanned extubation: In the control group, 41 patients were intubated upon transfer to the general ward, and three patients suffered unplanned extubation throughout their hospital stay, resulting in a 7.3% incidence. In the intervention group, 37 patients were intubated, with no unplanned extubations throughout the hospital stay. The two groups showed no significant difference ($\chi^2=1.185$, $P=0.276$).

d. Comparison of inpatients' satisfaction scores regarding nursing care: The intervention group had significantly higher satisfaction scores for nursing care than the control group, with a statistically significant difference between the two groups, as shown in Table 5.

Discussion

In this study, we gathered relevant literature, recommendations, and expert opinion on the prevention and treatment of adult POD from local and foreign sources. We developed and validated a tiered nursing intervention program for POD in aortic dissection patients using group talks and Delphi expert consultations. Unlike earlier research (Sullinger et al. 2017; Zhang et al. 2017, 2020), this approach uses a delirium risk stratification model to determine the risk levels of patients who have not yet acquired delirium following surgery. It incorporates varied delirium and risk factor assessments based on different risk categories, as well as tailored therapies in conjunction with assessment results, with the goal of achieving stratified prevention and nursing for POD. Second, this strategy was implemented in a regular cardiac surgery ward, which differed greatly from earlier studies that used intensive care units (Sullinger et al. 2017). It provides a more systematic and targeted treatment approach for delirium nursing once patients are transferred to general wards, as well as a theoretical foundation for future POD nursing in wards. Third, the protocol focuses on patient safety in general wards. Compared to previous nursing programs for postoperative delirium in surgical patients, earlier programs (Sullinger et al. 2017; Zhang et al. 2017) were effective in lowering the incidence of POD and shortening the length of stay in the intensive care unit. However, they do not discuss nursing safety management. This could be attributable to the fact that their study was conducted in an intensive care unit, where patients had recently had surgical trauma and were in a rather fragile state. As a result, there were no nurse safety hazards such as elopement, injury, self-harm, or bed falls due to POD. However, the possibility of unintentional extubation owing to restlessness, pain, or discomfort should be considered. However, our study was conducted in a general ward, where patients were in the recovery stage of their illness and had some freedom of movement. Following the beginning of delirium, episodes such as escape, loss, injury, self-harm, falling out of bed, and falls may occur. Therefore, it is necessary to incorporate nursing safety management, such as implementing access control at ward entrances and exits, confiscating scissors and fruit knives from patients, and having family members provide 24-h companionship. Furthermore, throughout the process of restraint management, this program uses the Psychiatric Protective Restraint Implementation Evaluation Form and the Release Evaluation Form (Chinese Nursing Association Mental Health Professional Committee, 2022) to objectively assess the patient's restraint requirements. For those who demonstrate aggressive conduct owing to delirium, the philosophy of customized reduced restriction and least constraint is followed, with restraint utilized as a last resort. This not only protects the safety of patient treatment and care, but also prevents delirium symptoms from worsening as a result of excessive constraint. Finally, this approach involves family members in the delirium nursing management team and gives delirium-related information to family members who are at risk of delirium or are experiencing delirium, to lessen their worry and increase their coping ability when the patient's delirium hits (SIGN, 2019).

Non-pharmacological and multicomponent delirium preventative care methods have been shown to reduce the occurrence of delirium (Strijbos et al. 2013). The results of this study revealed that there was no significant benefit in reducing the frequency of POD in patients with type A aortic dissection in the general surgery ward, which contradicted earlier studies on patients admitted to the ICU following surgery (Song et al. 2022; Zhang et al. 2015). The reason could be related to the program's many implementation nodes and participants. In terms of implementation schedule, past studies began their interventions as soon as patients reached the intensive care unit following surgery. They were able to assess and intervene for delirium at an earlier stage, which contributed to their success in lowering the incidence of postoperative delirium (POD). The implementation phase of this study began after the patients were transferred from the intensive care unit to the general ward. Delirium affects more than half of patients soon after admission to the critical care unit (Mart et al. 2021), and its symptoms continue even after transfer to general wards. Therefore, there was no significant reduction in the incidence of POD in patients after the implementation of this plan. Previous studies mostly focused on individuals undergoing coronary artery bypass grafting and cardiac valve replacement surgery (Song et al. 2022; Zhang et al. 2015). Compared to these patients, those who undergo type A aortic dissection surgery experience more complex and dangerous condition changes, a larger incidence of POD, and considerably greater difficulty managing POD. This could possibly explain why the influence on delirium incidence was non-significant. In addition, during the implementation of different programs, we also focused on the differences between individuals, as each patient's recovery and response to nursing interventions varies.

Some patients may require more extensive and prolonged nursing interventions to reduce the incidence of delirium effectively.

The study's findings demonstrate that patients in the intervention group had a much shorter duration of POD in the general ward than those in the control group, with a statistically significant difference between the two groups. This suggests that the intervention approach effectively shortened the duration of POD for patients on the ward. This nurse intervention's rather extensive approach to delirium control could be the reason. During the intervention process, nurses utilized the Nu-DESC scale to screen all patients for routine delirium, which helped to reduce the number of missed POD diagnoses. Early and effective intervention by interdisciplinary departments such as medical, nursing, rehabilitation, and nutrition was used to remedy controllable causes and prevent the continued progression of adverse factors, hence minimizing the duration of POD. The nursing intervention defined explicit goals and quality control requirements for each metric, including blood oxygen saturation > 90%, analgesia target NRS ≥ 3 points, and postoperative defecation within 3 days. This not only enhances the operability of nursing interventions, but it also aids in evaluating postoperative nursing quality, assuring the application of various nursing measures, and thereby contributing to the reduction of delirium length. Pain and sleep deprivation are known risk factors for POD (Farasat et al. 2020; Sampson et al. 2020). They not only cause the occurrence of POD, but also have a detrimental impact on its development, increasing symptoms and extending its duration. This plan employs non-pharmacological measures such as massage, cold therapy, relaxation techniques, and breathing exercises to manage pain actively. If these approaches prove inadequate, a reasonable application of opioid analgesics is implemented, utilizing a multimodal analgesic approach to keep the patient's pain at a level below mild (Zhang et al. 2020). In general wards, roommates and the use of therapeutic equipment were the leading causes of sleep disruption at night. As a result, the care plan instructed all personnel to set their mobile phones to vibration mode at night to reduce noise. Checks and monitor volume reductions were performed to prevent false alarms, and medication delivery was timed before micropump alerts to avoid sleep disruptions. These approaches significantly improved patients' sleep and postoperative pain control, lowering delirium symptoms and minimizing the length of POD. According to studies, exercise can reduce the length of delirium by one day and help with delirium resolution at discharge (Lozano-Vicario et al. 2024). Passive activities began the day patients were moved to the ward. On the second day, patients who were able to move were helped to sit up in bed and move their lower limbs. If they stood for more than 5 min, patients were assisted in walking by their beds or outside the hospital. Early activity management helps to prevent the negative effects of prolonged bed rest on physical and cognitive capabilities, improves patients' mood, and promotes better sleep, so positively altering the course of postoperative delirium and reducing its duration.

Previous studies have shown that patients with delirium had a significantly longer hospital stay than those without delirium (Dziegielewski et al. 2021). The study's findings revealed that the intervention group's length of stay in the general ward was shorter than that of the control group, with a statistically significant difference between the two groups, indicating that the program could effectively shorten patients' postoperative hospital stays. Research has revealed that the longer the duration of POD, the longer the hospital stay for patients, and it is connected with an increased rate of inpatient mortality (Lee et al., 2018). As a result, when patients are already experiencing delirium, this approach actively manages it to limit its duration and severity, allowing patients to recover to a normal mental and psychological state more rapidly, minimizing their length of stay in the general ward. Family members are seen as crucial care partners, and their involvement is critical in preventing and minimizing the onset of delirium, resulting in numerous benefits for both patients and caregivers (Mitchell et al. 2017). Therefore, this nursing strategy involves family members on the delirium care management team, fostering a tight doctor-patient cooperative relationship that accelerates postoperative recovery and shortens patients' hospital stays.

Previous research has shown that the hours of darkness and agitation associated with delirium are significant risk factors for unexpected extubation (Lu et al. 2015; Shen et al. 2022). In patients with type A aortic dissection, POD is largely hyperactive, with symptoms worsening at night (SIGN, 2019; He et al. 2020), leading to an increased risk of accidental extubation. However, the outcomes of this study demonstrated that the effect of nursing interventions on reducing the frequency of accidental extubation among hospitalized patients with type A aortic dissection was not significant, with no statistically significant difference detected between the two groups. This may be related to the small sample size of this study, as well as the fact that it is highly valued by hospital administrators and clinical nurses as one of the sensitive indicators of hospital care quality (controlling the risk factors for unplanned extubation, improving the methods of securing tubes, and establishing and improving hospital supervision mechanisms), which may have

contributed to the prevention of unplanned extubation (Zhu et al. 2019).

Patient satisfaction is a key measure for determining the quality of medical services. Medical staff should prioritize not only medical technology quality and service attitude, but also humanistic care in the medical nursing process, as well as harmonic and effective communication between doctors and patients (Zhang et al. 2021). In this study, hospitalized patients in the intervention group reported considerably better satisfaction levels with nursing work than those in the control group. This could be because, after implementing this approach, their emotional experience during the disease treatment process improved, making patients feel cared for, respected, and appreciated by medical personnel. Thus, They got more compassionate medical nursing care and excellent communication on illness treatment, medication, delirium care, and rehabilitation exercises, which increased their satisfaction with nursing job. Nursing should give not just technical services, but also excellent information and psychological support. This nursing intervention, on the one hand, assists family members in acquiring delirium-related knowledge through continuous and diverse health education, thereby boosting their ability to manage with the condition. On the other hand, it timely recognizes and addresses negative feelings of family members during the caregiving process through tight doctor-patient interaction, offering psychological support. This could also explain why patients in the intervention group reported better satisfaction with nursing work than those in the control group.

Limitations

This study of a POD stratified nursing care plan was found to be specific, reliable, and effective for patients undergoing aortic dissection surgery. However, this study is not without limits. First, in order to avoid contamination among the research subjects, this study adopted a quasi-experimental design; so not at the same time the implementation of different intervention methods, not the object of study randomly assigned, cannot do "blind" test group; the limitations of these designs are that our research results may cause bias. Second, the use of a single location and a small sample size for clinical research may also affect the extrapolation of the results to a certain extent. Third, because the main purpose of this study is to verify that the stratified nursing intervention program is scientific and effective, the low-risk group and high-risk group were not compared, and the influence of the intervention program on different groups cannot be judged. Fourth, it is also possible that literature from more countries was not included in the protocol construction phase due to language limitations, which may not cover the content of the protocol comprehensively.

Conclusions

This study's stratified nursing intervention plan for POD in patients with type A aortic dissection is based on a previously developed POD risk prediction score model. This strategy allows for the deployment of several degrees of nurse interventions based on the evaluated risk levels. This study has shown that, while this intervention does not reduce the incidence or number of new cases of POD in patients with type A aortic dissection on general wards, it does significantly reduce the duration of POD and length of stay. Furthermore, it reduces the number of unnecessary extubations and increases patient satisfaction with nursing care. These findings can serve as a reference for the advancement of POD nursing practices in China. In the future, we need to continue to improve the research content, expand the sample size, and establish cooperation with different centers to further explore the intervention effect of this nursing intervention on POD in patients with type A aortic dissection.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13741-025-00495-y.

Additional file1

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Authors' contributions

Xueping Li and Miaomiao Zheng conducted the literature research, data collation, and analysis. This article is mainly written by Xueping Li. Chaohong Chen and Ailin Lin participated in manuscript revision and data analysis. Huai Zhang is a statistical expert responsible for the statistical analysis and verification of all data in this article. Yuanbo Wu is responsible for clinical treatment, administration of medication, and other related consultations. Zhiqin Yin made great contributions to research and design, and played an indispensable role in manuscript revision. All the authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the principles outlined in the Declaration of Helsinki and approved by the ethics committee in clinical research of the First Affiliated Hospital of Wenzhou Medical University (Approval number: Clinical Research Luncheon (YS2022) No. (211)). Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests
The authors declare no competing interests.

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References

American Psychiatric Association. Diagnostic and statistical manual of mental disorders(Zhang Daolong et al, translation). BeiJin: Peking University Press; 2015;586–7.

Cai Jingjing. The impact of stratified nursing with CAM-ICU scoring strategy on the incidence of delirium in ICU cardiac surgery patients. Chin Med Guide. 2024;22(20):66–9. https://doi.org/10.15912/j.issn.1671-8194.2024.20.020.

Chen H, Mo L, Hu H, Ou Y, Luo J. Risk factors of postoperative delirium after cardiac surgery: a meta-analysis. J Cardiothorac Surg. 2021;16(1):113. https://doi.org/10.1186/s13019-021-01496-w.

Dziegielewski C, Skead C, Canturk T, Webber C, Fernando SM, Thompson LH, Foster M, Ristovic V, Lawlor PG, Chaudhuri D, Dave C, Herritt B, Bush SH, Kanji S, Tanuseputro P, Thavorn K, Rosenberg E, Kyeremanteng K. Delirium and associated length of stay and costs in critically ill patients. Crit Care Res Pract. 2021;2021:6612187. https://doi.org/10.1155/2021/6612187.

Erbay Dalli Ö, Kelebek Girgin N, Kahveci F. Incidence, characteristics and risk factors of delirium in the intensive care unit: an observational study. J Clin Nurs. 2023;32(1–2):96–105. https://doi.org/10.1111/jocn.16197.

Farasat S, Dorsch JJ, Pearce AK, Moore AA, Martin JL, Malhotra A, Kamdar BB. Sleep and delirium in older adults. Curr Sleep Med Rep. 2020;6(3):136–48. https://doi.org/10.1007/s40675-020-00174-y.

Feinkohl I, Winterer G, Spies CD, Pischon T. Cognitive reserve and the risk of postoperative cognitive dysfunction. Dtsch Arztebl Int. 2017;114(7):110–7. https://doi.org/10.3238/arztebl.2017.0110.

Galyfos GC, Geropapas GE, Sianou A, Sigala F, Filis K. Risk factors for postoperative delirium in patients undergoing vascular surgery. J Vasc Surg. 2017;66(3):937–46. https://doi.org/10.1016/j.jvs.2017.03.439.

Han S, Jia X, Zhu R, Cao Y, Xu Z, Meng Y. Gastroenterology nurse prescribing in China: a Delphi method. J Adv Nurs. 2021;77(3):1228–43. https://doi.org/10.1111/jan.14645.

He Q, Xue C, Li B, Yan X, Lv S, Jin Z, Yu Bo. Characteristics and risk factors of delirium after hybrid surgery in patients with Standford type A aortic dissecting aneurysm. Shaanxi Medical Journal. 2020;49(11):1432–5. https://doi.org/10.3969/j.issn.1000-7377.2020.11.016.

Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. Ann Intern Med. 1990;113(12):941–8. https://doi.org/10.7326/0003-4819-113-12-941.

Jiang Y, Xie Y, Fang P, Shang Z, Chen L, Zhou J, Yang C, Zhu W, Hao X, Ding J, Yin P, Wang Z, Cao M, Zhang Y, Tan Q, Cheng D, Kong S, Lu X, Liu X, Sessler DI. Cognitive training for reduction of delirium in patients undergoing cardiac surgery: a randomized clinical trial. JAMA Netw Open. 2024;7(4):e247361. https://doi.org/10.1001/jamanetworkopen.2024.7361.

Jin Z, Hu J, Ma D. Postoperative delirium: perioperative assessment, risk reduction, and management. Br J Anaesth. 2020;125(4):492–504. https://doi.org/10.1016/j.bja.2020.06.063.

Kappen PR, Mos MI, Jeekel J, Dirven CMF, Kushner SA, Osse RJ, Coesmans M, Poley MJ, van Schie MS, van der Holt B, Klimek M, Vincent A. Music to prevent deliriUm during neuroSurgerY (MUSYC): a single-centre, prospective randomised controlled trial. BMJ Open. 2023;13(6): e069957. https://doi.org/10.1136/bmjopen-2022-069957.

Li XP, Wang L, Zhang H, Xing AZ, Chen CH, Yin ZQ. Construction and evaluation of risk prediction model of postoperative delirium in patients with Stanford type A aortic dissection. Chin J Nurs. 2022;57(8):950–7. https://doi.org/10.3761/j.issn.0254-1769.2022.08.009.

Lin Y, Liang T, Zhang X, Peng Y, Li S, Huang X, Chen L. Early goal-directed mobilization in patients with acute type A aortic dissection: a randomized controlled trial. Clin Rehabil. 2023;37(10):1311–21. https://doi.org/10.1177/02692155231169822.

Lin L, Peng Y, Huang X, Li S, Chen L, Lin Y. A family intervention to prevent postoperative delirium in patients undergoing cardiac valve surgery: a randomized controlled study. Heart Lung. 2024;63:1–8. https://doi.org/10.1016/j.hrtlng.2023.09.002.

Lozano-Vicario L, Zambom-Ferraresi F, Zambom-Ferraresi F, M, L. S. d. A., Galbete-Jiménez, A., Muñoz-Vázquez Á, J., Cedeno-Veloz, B. A., De la Casa-Marín, A., Ollo-Martínez, I., Fernández-Irigoyen, J., Santamaría, E., San Miguel Elcano, R., Ortiz-Gómez, J. R., Romero-Ortuño, R., Izquierdo, M., & Martínez-Velilla, N. Effects of exercise intervention for the management of delirium in hospitalized older adults: a randomized clinical trial. J Am Med Dir Assoc. 2024;25(8): 104980. https://doi.org/10.1016/j.jamda.2024.02.018.

Lu S, Jiang Y, Meng F, Xie X, Wang D, Su Y. Risk factors for postoperative delirium in patients with Stanford type A aortic dissection: a systematic review and meta-analysis. J Cardiothorac Surg. 2024;19(1):16. https://doi.org/10.1186/s13019-024-02485-5.

Wang, Lu., Shi, Teiying., Yin, Anchun., & Liu, Qigui. Development and Evaluation of Scale of Inpatient Satisfaction with Nursing Service. J Nurs. 2014;37-40,41. https://d.wanfangdata.com.cn/periodical/ChlQZXJpb2RpY2FsQ0hJTmV3UzIwMjQwNzA0Eg9uZmhseGIyMDE0MDMwMTIaCHoyMzN5enRw

Lu, Xiaoyan., Wang, Yuyu., & Wang, Fang. Unplanned extubation Delirium Nursing. Journal of Continuing Nursing Education, 2015;474–475. https://d.wanfangdata.com.cn/periodical/ChlQZXJpb2RpY2FsQ0hJTmV3UzIwMjQwNzA0Eg9oc2p4enoyMDE1MDUwNDMaCHM3NnZld2l6

Lee H, Ju JW, Oh SY, Kim J, Jung CW, Ryu HG. Impact of timing and duration of postoperative delirium: a retrospective observational study. Surgery. 2018. https://doi.org/10.1016/j.surg.2018.02.001

Mart MF, Williams Roberson S, Salas B, Pandharipande PP, Ely EW. Prevention and management of delirium in the intensive care unit. Semin Respir Crit Care Med. 2021;42(1):112–26. https://doi.org/10.1055/s-0040-1710572.

Mental Health Professional Committee of Chinese Nursing Association. Expert consensus on the implementation and removal of protective restraints in psychiatry. Chin J Nurs. 2022;57(2):146–51. https://doi.org/10.3761/j.issn.0254-1769.2022.02.003.

Milisen K, Van Grootven B, Hermans W, Mouton K, Al Tmimi L, Rex S, Detroyer E. Is preoperative anxiety associated with postoperative delirium in older persons undergoing cardiac surgery? Secondary data analysis of a randomized controlled trial. BMC Geriatr. 2020;20(1):478. https://doi.org/10.1186/s12877-020-01872-6.

Mitchell ML, Kean S, Rattray JE, Hull AM, Davis C, Murfield JE, Aitken LM. A family intervention to reduce delirium in hospitalised ICU patients: a feasibility randomised controlled trial. Intensive Crit Care Nurs. 2017;40:77–84. https://doi.org/10.1016/j.iccn.2017.01.001.

Neufeld KJ, Leoutsakos JS, Sieber FE, Joshi D, Wanamaker BL, Rios-Robles J, Needham DM. Evaluation of two delirium screening tools for detecting post-operative delirium in the elderly. Br J Anaesth. 2013;111(4):612–8. https://doi.org/10.1093/bja/aet167.

Pieri M, De Simone A, Rose S, De Domenico P, Lembo R, Denaro G, Landoni G, Monaco F. Trials focusing on prevention and treatment of delirium after cardiac surgery: a systematic review of randomized evidence. J Cardiothorac Vasc Anesth. 2020;34(6):1641–54. https://doi.org/10.1053/j.jvca.2019.09.028.

Sampson EL, West E, Fischer T. Pain and delirium: mechanisms, assessment, and management. Eur Geriatr Med. 2020;11(1):45–52. https://doi.org/10.1007/s41999-019-00281-2.

Shen M, Feng Z, Chen X, Zhang Y. Data mining and analysis of unplanned extubation in adult inpatients. Chinese Nursing Management. 2022;22(2):233–7. https://doi.org/10.3969/j.issn.1672-1756.2022.02.014.

Song YM, Yang MQ, Ling Y, Lin QY. Effects of nursing delirium preventive interventions in the intensive care unit on delirium management in patients after cardiac surgery. Chinese Nursing Management. 2022;22(4):507–11. https://doi.org/10.3969/j.issn.1672-1756.2022.04.006.

Strijbos MJ, Steunenberg B, van der Mast RC, Inouye SK, Schuurmans MJ. Design and methods of the Hospital Elder Life Program (HELP), a multicomponent targeted intervention to prevent delirium in hospitalized older patients: efficacy and cost-effectiveness in Dutch health care. BMC Geriatr. 2013;13:78. https://doi.org/10.1186/1471-2318-13-78.

Sullinger D, Gilmer A, Jurado L, Zimmerman LH, Steelman J, Gallagher A, Dupre T, Acquista E. Development, implementation, and outcomes of a delirium protocol in the surgical trauma intensive care unit. Ann Pharmacother. 2017;51(1):5–12. https://doi.org/10.1177/1060028016668627.

The Scottish Intercollegiate Guidelines Network. Risk reduction and management of delirium. 2019 https://www.sign.ac.uk/our-guidelines/risk-reduction-and-management-of-delirium/. (12 May 2022)

Unal N, Guvenc G, Naharci M. Evaluation of the effectiveness of delirium prevention care protocol for the patients with hip fracture: a randomised controlled study. J Clin Nurs. 2022;31(7–8):1082–94. https://doi.org/10.1111/jocn.15973.

Wang Honghong, Zou Haiou, et al. Research methods in nursing. In: Li Zheng,Liu Yu. Beijin: People's Health Publishing House; 2018;52.

Yu J, Zhang A, Chen J. Research progress on the ICU nurses' cognition, attitude and assessment of delirium in ICU. Chinese Nursing Management. 2019;19(3):462–5. https://doi.org/10.3969/j.issn.1672-1756.2019.03.029.

Zeng B, Bai SJ, Liu DL, Gao Q, Huang ZY. Effect of early postoperative systemic inflammatory response syndrome (SIRS) on the short-term outcome of patients with acute Stanford type A aortic dissection. Chinese Journal of Clinical Thoracic and Cardiovascular Surgery. 2021;28(7):796–800. https://doi.org/10.7507/1007-4848.202006060.

Zhang Maomao. (2019). Construction of a self-expression-based benefit discovery intervention program for breast cancer patients, *Anhui Medical University.* https://d.wanfangdata.com.cn/thesis/ChJUaGVzaXNOZXdTMjAyNDAxMDkSCUQwMTgwNzk4NRoIMTVoaWx5dmg%3D

Zhang WY, Qiu WJ, Gu JJ, Hu WL, YE, W.Q. Application and effect analysis of a deliriun nursing intervention program in patients underwent coronary artety bypass grafting during the ICU stay. Chin J Nurs. 2015;50(8):917–21. https://doi.org/10.3761/j.issn.0254-1769.2015.08.004.

Zhang W, Sun Y, Liu Y, Qiu W, Ye X, Zhang G, Zhang L. A nursing protocol targeting risk factors for reducing postoperative delirium in patients following coronary artery bypass grafting: Results of a prospective before-after study. Int J Nurs Sci. 2017;4(2):81–7. https://doi.org/10.1016/j.ijnss.2017.02.002.

Zhang Y, Zhang H, Wang S, Xing Yi, Liu J, Ma Y, Gao Na. Construction and application of perioperative delirium nursing management protocol for patients over 80 years old with hip fracture. Chinese Nursing Management. 2020;20(9):1422–8. https://doi.org/10.3969/j.issn.1672-1756.2020.09.029.

Zhang, Xian., Cheng, Jing., Yi, Jingna., Zhang, Qiushi., & Zhang, Zhenxiang. (2021). Status and influencing factors of inpatient satisfaction of tertiary general hospitals in Zhengzhou City based on medical experience. Med Soc. 34(6);18–21,30. https://doi.org/10.13723/j.yxysh.2021.06.004

Zhu H, Liu Z, Wang Ya, Huang M, Huang D, Song J. Risk monitoring of unplanned extubation in hospitalized patients in general hospitals of Sichun province. Journal of Nursing. 2019;34(20):36–9. https://doi.org/10.3870/j.issn.1001-4152.2019.20.036.

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