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Research Progress on the Current Status and Risk Factors of Postoperative Delirium in Elderly Patients Undergoing Urological Surgery

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Abstract: With the rapid acceleration of population aging in China, the number of elderly patients undergoing urological surgery has increased year by year, accompanied by a rising incidence of postoperative delirium (POD). This article provides a comprehensive review of the current status, clinical characteristics, and associated risk factors of postoperative delirium in elderly urological patients. Patient-related factors such as advanced age, multiple comorbidities, cognitive impairment, and malnutrition significantly increase the risk of POD. In addition, perioperative factors—including inappropriate preoperative medication use, the extent of surgical trauma, choice of anesthesia, and inadequate postoperative pain management—also play critical roles. A thorough understanding of these risk factors is beneficial for clinicians to develop targeted preventive strategies and to improve postoperative recovery outcomes in elderly patients.

Keywords: Urology; elderly patients; postoperative delirium; current status; risk factors; research progress

Introduction

Postoperative delirium is an acute neurocognitive disorder with a relatively high incidence among elderly patients, particularly those undergoing urological surgery. POD not only prolongs hospital stay and increases medical costs and nursing burden, but may also exacerbate cognitive impairment, severely affecting postoperative recovery and long-term quality of life. Therefore, a systematic exploration of the current characteristics and related risk factors of postoperative delirium in elderly urological patients is of significant clinical relevance and practical value.

1. Incidence of Postoperative Delirium in Elderly Urological Patients

Existing studies report variability in the incidence of postoperative delirium among elderly patients undergoing urological surgery; however, the overall incidence remains relatively high. Multiple large-scale epidemiological investigations have shown that the incidence of POD in elderly urological patients ranges from approximately 15% to 35% [1], which is notably higher than that observed in other surgical specialties. The incidence is even higher—exceeding 40%—in patients undergoing major procedures such as radical

prostatectomy, radical cystectomy, and nephrectomy. Age is a significant determinant of POD occurrence, with patients aged over 75 years exhibiting a markedly higher incidence compared with those aged 65–74 years. Regarding sex distribution, male patients account for a higher proportion due to the high prevalence of prostate-related diseases requiring surgical intervention, and consequently present a relatively higher risk of delirium. Seasonal variation has also been observed, with higher incidence rates reported during winter, possibly related to reduced sunlight exposure and vitamin D deficiency. From a geographical perspective, reported incidence rates are generally higher in developed countries than in developing regions, which may be associated with differences in diagnostic criteria and the completeness of monitoring systems.

2. Patient-Related Risk Factors for Postoperative Delirium in Elderly Urological Patients

2.1 Age

Age is recognized as the most critical independent risk factor for postoperative delirium. Its underlying mechanisms involve age-related degenerative changes across multiple physiological systems. With advancing age, the number of neurons decreases, synaptic connectivity weakens, and neurotransmitter synthesis capacity declines, leading to reduced compensatory ability of the central nervous system. In addition, elderly patients exhibit impaired blood–brain barrier function and decreased drug clearance capacity, making them more susceptible to the effects of anesthetics and analgesics. Previous studies have demonstrated that for each additional year of age, the risk of postoperative delirium increases by approximately 3%–5% [2]. Patients aged over 80 years have a two- to threefold higher incidence compared with those aged 65–69 years. Advanced-age patients are often burdened with multiple chronic diseases and polypharmacy, and the interactions among these factors further amplify the likelihood of delirium occurrence.

2.2 Comorbidities

The coexistence of multiple comorbidities significantly increases the risk of postoperative delirium in elderly urological patients, with cardiovascular, respiratory, and endocrine–metabolic diseases exerting the most pronounced effects. Cardiovascular conditions such as hypertension, coronary artery disease, and arrhythmias impair cerebral blood perfusion, resulting in insufficient oxygen supply to brain tissue and thereby triggering delirium. Respiratory diseases, including chronic obstructive pulmonary disease and asthma, can cause hypoxemia and hypercapnia, directly compromising central nervous system function. In patients with diabetes mellitus, inadequate glycemic control may lead to metabolic disturbances in brain cells, as both hyperglycemia and hypoglycemia are associated with delirium. Endocrine disorders such as thyroid dysfunction and adrenal insufficiency disrupt neurotransmitter balance through hormonal dysregulation. Furthermore, a prior history of cerebrovascular disease predisposes patients to neuropsychiatric symptoms, further increasing the risk of postoperative delirium.

2.3 Baseline Cognitive Function

Preoperative cognitive reserve is an important predictor of postoperative delirium. Elderly individuals with intact cognitive function generally exhibit stronger stress resilience. Patients with mild cognitive impairment are often capable of independent daily living under normal conditions; however, exposure to major stressors such as surgical trauma and anesthetic agents can precipitate rapid cognitive deterioration. In patients with established cognitive disorders, including Alzheimer's disease and vascular dementia, structural and functional damage to neural networks renders postoperative delirium nearly inevitable. Individuals with lower educational attainment typically possess reduced cognitive reserve and are therefore more vulnerable to cognitive dysfunction under comparable stress conditions. Patients with a prior history of psychiatric disorders, such as depression or anxiety, exhibit dysregulated neuroendocrine responses and heightened stress sensitivity. The use of standardized assessment tools—such as the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA)—provides objective evaluation of preoperative cognitive status, facilitating the identification of high-risk populations and the implementation of targeted preventive strategies.

2.4 Nutritional Status

Malnutrition is a key risk factor for postoperative delirium, and its underlying mechanisms involve

multiple aspects, including protein–energy deficiency and deficiencies of vitamins and minerals. Reduced serum albumin levels indicate impaired protein synthesis and increased catabolism, which directly compromise the integrity of neuronal cell membranes and the synthesis of neurotransmitters. Both low and excessively high body mass index (BMI) values are associated with an increased risk of delirium: a low BMI reflects inadequate nutritional intake, whereas a high BMI is often accompanied by chronic inflammation and metabolic dysregulation. Thiamine (vitamin B1) deficiency may lead to Wernicke encephalopathy, characterized by disturbances of consciousness and cognitive impairment. Deficiencies in vitamin B12 and folate interfere with DNA synthesis and myelin formation. Vitamin D deficiency is closely associated with neuroinflammation and cognitive decline. In addition, trace elements such as zinc, copper, and selenium play essential roles in enzymatic regulation and antioxidant defense; deficiencies in these elements may result in neurological dysfunction [3]. Preoperative nutritional support can improve patients' overall physiological status, enhance tolerance to surgical trauma, and reduce the incidence of postoperative complications, including delirium.

3. Perioperative Risk Factors for Postoperative Delirium in Elderly Urological Patients

3.1 Preoperative Preparation and Concomitant Medications

The adequacy of preoperative preparation and the use of concomitant medications exert a substantial impact on the development of postoperative delirium in elderly urological patients. Inappropriate medication use and insufficient preparation may serve as important precipitating factors. Commonly used anxiolytic and sedative agents, particularly benzodiazepines, are prone to paradoxical reactions in elderly patients, manifesting as agitation, excitability, or even delirium. Abrupt discontinuation of long-term benzodiazepine therapy may precipitate withdrawal syndromes, further increasing the risk of postoperative delirium. Although opioid analgesics are effective for pain control, their central nervous system depressant effects may mask early manifestations of delirium, leading to delayed diagnosis. Elderly patients exhibit increased sensitivity to opioids, whereby standard doses may induce pronounced sedation; excessive dosing significantly elevates the risk of respiratory depression. Anticholinergic medications, commonly present in both prescription and over-the-counter drugs, are well recognized for their adverse effects on cognitive function, and a higher cumulative anticholinergic burden is associated with an increased risk of postoperative delirium.

Excessively prolonged preoperative fasting may result in dehydration, electrolyte imbalances, and abnormal fluctuations in blood glucose levels, all of which can precipitate delirium. Sleep deprivation is also common in the preoperative period due to anxiety, unfamiliar environments, and medical interventions, leading to reduced sleep quality and impaired cerebral recovery capacity. Inadequate psychological preparation, coupled with insufficient understanding of the surgical procedure and expected outcomes, may further intensify stress responses and contribute to the development of postoperative delirium [4].

3.2 Surgical Factors

Surgery itself constitutes a powerful stressor, and the degree of surgical trauma, operative duration, and technical complexity are closely associated with the development of postoperative delirium. Major and complex procedures, such as radical cystectomy and radical nephrectomy, involve prolonged operative time, substantial blood loss, and extensive tissue injury, resulting in significantly higher delirium incidence compared with minor or intermediate surgeries.

Patients undergoing operations lasting longer than three hours have a two- to threefold increased risk of delirium compared with those undergoing shorter procedures, potentially due to prolonged anesthesia exposure, hemodynamic instability, and intensified inflammatory responses. Intraoperative hypotension is a critical risk factor; a mean arterial pressure below 65 mmHg sustained for more than 10 minutes can adversely affect cerebral perfusion. Age-related impairment of cerebral autoregulation renders elderly patients particularly vulnerable to cerebral ischemia and hypoxia during blood pressure fluctuations. Large-volume blood transfusion and fluid administration may induce dilutional coagulopathy, electrolyte disturbances, and thermoregulatory dysfunction, all of which are associated with delirium development [5]. Surgical site also appears to influence delirium risk;

pelvic surgeries may affect neural structures involved in cognitive function. Additionally, patients undergoing emergency surgery—owing to limited preparation time and compromised physiological status—generally exhibit a higher incidence of postoperative delirium than those undergoing elective procedures [6].

3.3 Postoperative Management

The quality of postoperative management directly affects the onset and progression of postoperative delirium in elderly urological patients. Poor pain control, infectious complications, and environmental factors are common precipitating contributors. Although postoperative pain is an unavoidable physiological response, persistent and severe pain activates the sympathetic nervous system, leading to elevated blood pressure and heart rate, increased stress hormone release, and heightened cerebral metabolic demand. Inappropriate analgesic strategies may obscure changes in mental status, delaying delirium recognition. Postoperative infections—particularly urinary tract and pulmonary infections—are common complications; bacterial endotoxins and inflammatory mediators can affect central nervous system function by crossing the blood–brain barrier. Fever itself exacerbates delirium symptoms, as each 1 °C increase in body temperature raises cerebral metabolic rate by approximately 7%, with elderly patients demonstrating heightened sensitivity. Improper antibiotic use may disrupt gut microbiota balance, generating neurotoxic metabolites that impair brain function. Environmental factors such as noise, excessive lighting, and frequent staff movement disrupt normal sleep–wake cycles and aggravate cognitive dysfunction. Although intensive care units facilitate close monitoring, high-intensity medical interventions, frequent alarms, and physical restraints may increase delirium risk. The absence of family companionship and emotional support represents a significant psychological stressor, with loneliness and fear further precipitating or worsening delirium symptoms.

Conclusion

Postoperative delirium in elderly urological patients is a multifactorial and complex clinical syndrome arising from the combined effects of patient-related factors, surgical stress, and perioperative management. With the acceleration of population aging and continuous advancements in medical technology, the clinical importance of this condition has become increasingly evident. A systematic review of existing evidence indicates that major patient-related risk factors include advanced age, comorbidities, baseline cognitive status, and nutritional condition, while inappropriate management at various perioperative stages also plays a decisive role.

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