Paradigm Academic Press
Journal of Innovations in Medical Research
ISSN 2788-7022
NOV. 2023 VOL.2, NO.11

Cognitive Dysfunction and Postoperative Cognitive Dysfunction — A System Review

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doi:10.56397/JIMR/2023.11.06

Abstract

Cognitive dysfunction is a common neurodegenerative disease, predominantly seen in elderly patients, characterized by significant declines in cognitive abilities, including memory, attention, executive function, and language abilities, which affect patients' daily lives and social functioning. The intricate etiology of cognitive dysfunction is attributed to a confluence of factors, involving biological factors, psychological factors, social factors, and other aspects. This comprehensive study aims to dissect the determinants of cognitive dysfunction and postoperative cognitive dysfunction, thereby laying the scientific foundation for devising effective prevention and treatment strategies.

Keywords: cognitive dysfunction, postoperative cognitive dysfunction, anesthesia, surgery

1. Cognitive Dysfunction

1.1 Definition of Cognitive Dysfunction

Cognition, the intelligent processing of the body to recognize and acquire knowledge, involves a series of voluntary, psychological, and social behaviors such as learning, memory, language, thinking, spirit, and emotion. Cognitive disorders refer to abnormalities in the higher intelligent processing of the brain related to learning, memory, and judgment, resulting in severe learning and memory disorders. This may be accompanied by aphasia, alexia, agnosia, or apraxia, among other pathological processes.

The foundation of cognition is the normal function of the cerebral cortex. Any factor that causes abnormal function and structure of the cerebral cortex can lead to cognitive disorders. Given the complexity of brain function and the interconnectedness of various types of cognitive disorders, cognitive issues in one domain can trigger abnormalities in another or multiple domains.

Cognitive functions is composed of multiple cognitive domains, including memory, calculation, temporal and spatial orientation, structural abilities, executive functions, language understanding and expression, and application. (Expert Consensus Group on the Prevention and Control of Cognitive Dysfunction in China, 2006)

Cognitive dysfunction is a common neurodegenerative disease that includes Alzheimer's disease, mild cognitive impairment, etc. The main feature of these diseases is the significant decline in cognitive abilities, which affects patients' daily lives and social functions. The mechanism of cognitive dysfunction is very complex, involving biological factors, psychological factors, social factors, and other aspects.

1.2 Classification of Cognitive Dysfunction

According to the differences in course and etiology, cognitive dysfunction can be divided into several types, including Alzheimer's disease, vascular cognitive impairment, frontotemporal dementia, Lewy body dementia, and Parkinson's disease-related cognitive impairment. Alzheimer's disease, frontotemporal dementia, and Lewy body dementia all belong to the category of degenerative dementia; another type is vascular dementia (VaD),

including multi-infarct dementia (MID), cerebral amyloid angiopathy, and arteriosclerotic leukoencephalopathy (Binswanger disease); in addition, there is a category of dementia where AD and VaD coexist, commonly known as mixed dementia (MD) etc. Dementia has three basic characteristics: ① is the acquired comprehensive decline of cognitive function, which is a reduction from the original level; ② is mostly progressive and irreversible (lasting for more than 6 months), and the cause is organic; ③ must be diagnosed without consciousness disorder. Here is a brief introduction to the common types of cognitive dysfunction.

Alzheimer's Disease (AD): Alzheimer's disease is the most common type of cognitive dysfunction, accounting for 60%-70% of all cognitive impairments. The main symptoms of the disease are progressive memory loss, cognitive impairment, and decline in daily living abilities. Neuropsychiatric symptoms (NPS) are core features of Alzheimer's disease and related dementias. Once thought to emerge primarily in people with late-stage disease, these symptoms are currently known to manifest commonly in very early disease and in prodromal phases, such as mild cognitive impairment. (Lyketsos CG, Carrillo MC, Ryan JM, Khachaturian AS, Trzepacz P, Amatniek J, Cedarbaum J, Brashear R & Miller DS, 2011) The etiology is not yet fully understood, and may be related to inflammatory responses, neurofibrillary tangles, and β-amyloid (Aβ) deposition (David S. Knopman, Helene Amieva, Ronald C. Petersen, et al, 2021). In addition, emerging genetic evidence indicates that in addition to the APOE*ε4 allele (an established risk factor for AD), GBA mutations and SCNA mutations and triplications are associated with cognitive decline in PD (Dag Aarsland, Byron Creese, Marios Politis, et al, 2017).

Vascular Cognitive Impairment (VCI): Vascular cognitive impairment is a type of cognitive dysfunction caused by cerebrovascular diseases, including ischemic stroke and hemorrhagic stroke, etc. The main cause of VCI is cerebrovascular lesions, such as atherosclerosis, hypertension, diabetes, etc. (Wiesje M. van der Flier, Ingmar Skoog, Julie A. Schneider, et al, 2018). The disease is characterized by damage to memory, language, and executive function, with a large fluctuation in symptoms, depending on the severity and location of the cerebrovascular lesions. Elimination of the seven most common modifiable risk factors for vascular dementia (obesity, hyper-tension, diabetes mellitus, high cholesterol, smoking, low level of education and cardiovascular disease) has been estimated to lead to a reduction of approximately one-third of dementia cases, particularly of vascular dementia (de Bruijn, R. F. A. G. et al, 2015; Norton, S., Matthews, F. E., Barnes, D. E., Yaffe, K. & Brayne, C, 2014).

Frontotemporal Dementia (FTD): Frontotemporal dementia is an early-onset progressive cognitive dysfunction, mainly characterized by abnormal social behavior, emotional apathy, and language impairment. FTD is characterised by predominant frontal or temporal atrophy, and atrophy in the frontoinsular region is especially indicative of frontotemporal dementia (Rosen HJ, Gorno-Tempini ML, Goldman WP, et al, 2002). Fluorodeoxyglucose PET, functional MRI, and single-photon-emission CT likewise show disproportionate hypoperfusion and hypometabolism in these regions (Le Ber I, Guedj E, Gabelle A, et al, & the French research network on FTD/FTD-MND, 2006). The term frontotemporal lobar degeneration encompasses the neurodegenerative diseases that give rise to these clinical syndromes and involve proteinopathies associated with frontotemporal network dysfunction (Boeve BF, Boxer AL, Kumfor F, Pijnenburg Y & Rohrer JD, 2022). And genetics is an important risk factor for frontotemporal dementia (Bang, J., Spina, S., & Miller, B. L, 2015). The etiology may be related to the loss of frontotemporal neurons and abnormal deposition of Tau protein. FTD can be divided into behavioral variant, semantic variant, and inflammatory variants, etc. However, it needs to be distinguished from the concept of normal aging. Normal aging is mainly characterized by memory decline, especially for recent events; but pathological memory disorders manifest as poor memory for both recent and remote events, and may also include symptoms such as confabulation and misattribution.

Lewy Body Dementia (LBD): Dementia with Lewy bodies and Parkinson's disease dementia, jointly known as Lewy body dementia, are common neurodegenerative conditions. LBD is characterized by fluctuating cognitive impairment, Parkinson's disease symptoms and psychiatric symptoms, etc. The etiology is related to the abnormal aggregation of Lewy bodies. Patients with Lewy body dementia present with a wide range of cognitive, neuropsychiatric, sleep, motor, and autonomic symptoms. Presentation varies between patients and can vary over time within an individual. Treatments can address one symptom but worsen another (Taylor JP, McKeith IG, Burn DJ, Boeve BF, Weintraub D, Bamford C, Allan LM, Thomas AJ & O'Brien JT, 2020). LBD can be divided into Parkinsonian, dementia, and mixed subtypes, etc.

Parkinson's Disease Dementia (PDD): Parkinson's Disease Dementia is a cognitive impairment that occurs in Parkinson's disease patients during the course of the disease, mainly characterized by damage to executive function, visuospatial ability, and memory. The etiology may be related to the loss of dopamine neurons and Lewy body formation. Dementia with Lewy bodies (DLB) and Parkinson's disease dementia (PDD) share many clinical, neurochemical, and morphological features. Despite clinical overlap, their diagnosis is based on an arbitrary distinction concerning the time of onset of motor and cognitive symptoms, namely as early cognitive

impairment in DLB and later onset following that of motor symptoms in PDD (Jellinger KA & Korczyn AD, 2018).

1.3 Factors Influencing Cognitive Dysfunction

Cognitive dysfunction refers to an impairment of an individual's cognitive abilities, causing difficulties in perception, memory, thinking, language, etc. Numerous factors can affect cognitive dysfunction, including age, genetics, diseases, lifestyle, etc. The following will analyze these influencing factors in detail.

Age: Age is a most important factor that affects cognitive dysfunction (Expert Consensus Group on the Prevention and Control of Cognitive Dysfunction in China, 2006). As we age, various physiological functions of the human body gradually decline, including brain function. Research has shown that the risk of developing cognitive dysfunction increases linearly with age. In the elderly population aged 65 and above, the incidence of cognitive dysfunction is higher.

Genetics: Genetic factors play a certain role in the onset of cognitive dysfunction. Some genetic factors may lead to issues such as loss of brain neurons and reduced synaptic plasticity, thereby increasing the risk of cognitive dysfunction. Familial cases of inherited cognitive dysfunction are not uncommon in clinical practice. Four genes were largely referred to: glucosyl-ceramidase (GBA), microtubule-associated protein tau (MAPT), apolipoprotein E (APOE) and catechol- O-methyltransferase (COMT) (Dag Aarsland, Byron Creese, Marios Politis, et al, 2017).

Disease: Many diseases may affect cognitive function, including Alzheimer's disease, vascular cognitive impairment, frontotemporal dementia, and Lewy body dementia, etc. These diseases can lead to issues such as loss of brain neurons, inflammation responses, and neurofibrillary tangles, which in turn can cause cognitive dysfunction. Additionally, some chronic diseases such as high blood pressure, diabetes, and high cholesterol may also increase the risk of cognitive dysfunction (Srikanth V, Sinclair AJ, Hill-Briggs F, Moran C & Biessels GJ, 2020).

Lifestyle: The impact of lifestyle on cognitive dysfunction should not be overlooked. Unhealthy habits, such as imbalanced diet, lack of exercise, insufficient sleep, smoking, and excessive alcohol consumption, may accelerate the decline of cognitive function (Jaroudi W, Garami J, Garrido S, Hornberger M, Keri S & Moustafa AA, 2017). On the contrary, maintaining a healthy lifestyle, including balanced diet, appropriate exercise, sufficient sleep, quitting smoking and limiting alcohol consumption, can help reduce the risk of cognitive dysfunction.

Psychological factors: Psychological factors such as stress, depression, anxiety, etc., may also affect cognitive function. Long-term mental stress and negative emotions can lead to issues such as imbalance of brain neurotransmitters and reduced hippocampal volume, which in turn can cause cognitive dysfunction (Dag Aarsland, Byron Creese, Marios Politis, et al, 2017). Therefore, maintaining a good mental state is essential for the maintenance of cognitive function.

There are numerous factors that can affect cognitive function, including age, genetics, diseases, lifestyle, and other aspects. Understanding these influencing factors can help us better understand the pathogenesis of cognitive dysfunction and provide more targeted measures for prevention and treatment. In real life, maintaining a healthy lifestyle, actively coping with stress, and preventing and timely treating related diseases can help reduce the risk of cognitive dysfunction.

2. Postoperative Cognitive Dysfunction

2.1 Definition of Postoperative Cognitive Dysfunction

Postoperative Cognitive Dysfunction (POCD) refers to the array of central nervous system complications that often affects elderly patients following surgery, typified by symptoms such as confusion, anxiety, personality alterations, and memory impairment. The term postoperative cognitive dysfunction encapsulates the changes in personality, social abilities, and cognitive abilities and skills that occur post-surgery. POCD is common, occurring in around 10-54% of individuals within first few weeks after surgery (Yang X, Huang X, Li M, Jiang Y & Zhang H, 2022). While some view POCD as the manifestation of intellectual function degeneration, characterized by a decline in memory and concentration, following surgery, others attribute it to the collective impact of multiple factors.

Initially, POCD was categorized into two types based on its onset time and clinical features: the early-onset type, referred to as delirium, typically occurs immediately after anesthesia and surgery; the other type, which persists for a longer duration, is denominated postoperative cognitive dysfunction. Currently, the consensus is that POCD results from the exacerbation of neural function decline in elderly patients, triggered by a confluence of factors, including surgery and/or anesthesia, on top of the pre-existing central nervous system degeneration. These interconnected factors can potentially disrupt the functionality of the nervous, endocrine, and immune systems.

2.2 Influencing Factors of Postoperative Cognitive Dysfunction

There are many factors that can affect postoperative cognitive function. Currently, the more accurate factors include age and inflammatory response. Other mechanisms, such as cholinergic imbalance, pain, brain vulnerability, and plasticity, are currently hot research topics.

Age: As age increases, the risk of postoperative cognitive impairment also increases. In the study by Kotekar (2014) et al., the incidence of POCD in patients aged 60 and 61-70 was 12.5% and 20.5%, respectively, and in those aged 71-80, it was 40.9%, and in those aged 80, it was 100%.

Gender: Sex is also an influencing factor of cognitive function. Due to the differences in physiology between men and women, such as hormonal levels and differences in reproductive systems, it has an impact on cognitive function. Studies have shown that the increased incidence of POCD in elderly women may be related to the reduction of estrogen secretion after menopause (Cao L, Wang K, Gu T, et al, 2014).

Anesthesia method: Currently, there is no conclusive research that can demonstrate the impact of anesthesia methods on the incidence of POCD, as contradictory results have been shown in numerous related studies. Rodrigue (2005) et al. due to the inclusion of only 37 cases, the study results were negative whereas the remaining two studies showed positive results (POCD incidence: general anesthesia > regional block). In Rasmussen (2003) et al.'s study, the events occurred on the 7th day after surgery. However, the study in Kermany (2015) et al., Liu (2014) et al. and Anwer (2006) et al. occurred on the 3rd day after surgery. And Kudoh (2004) et al. demonstrated that only on the first day after surgery, there was a difference between the two anesthesia methods.

Anesthesia drugs: One research indicates that sevoflurane can block the synaptic transmission of postsynaptic cholinergic neurons and inhibit long-term potentiation of hippocampal synapses, thereby affecting learning and memory (Yu XD, Zhang FX & Shi JS, 2019). And using ketamine may increase the risk of postoperative cognitive impairment. Cogan (2017) et al. found that ketamine can produce dose-dependent intermittent memory and working memory impairment in healthy volunteers, and it can have neuroprotective effects when used clinically after brain ischemia. Its mechanism may be through anti-inflammatory or anti-excitotoxic effects, and it can also reduce the incidence of POCD within 1 week after heart surgery.

Surgical operation: Large surgical procedures are more likely to result in POCD after surgery. POCD is particularly prevalent in elderly patients following large-scale surgeries, such as cardiovascular procedures and other major operations (Fodale V & Santamaria LB, 2003), especially after establishing extracorporeal circulation, POCD is more likely to occur, and the incidence rate of patients after discharge can reach as high as 50% to 80% (Alex Y & Edw NJ, 2003). In addition, hip surgery patients are often older and have more underlying complications. Factors such as the large incision and stress response during the hip surgery process can increase the risk of POCD in these patients. Therefore, the incidence rate of post-hip surgery POCD is second only to heart surgery (Yang J, Li P & Tang X, 2019). The occurrence of postoperative complications, such as infection, pneumonia, stroke, etc., may also increase the risk of postoperative cognitive disorders.

Inflammation: Central nervous system inflammation response is one of the recognized mechanisms of POCD occurrence. The mechanism by which central nervous system inflammation promotes the formation of POCD is that the pro-inflammatory factors (such as interleukin-6 and tumor necrosis factor-α) induced by invasive operations or drugs in the perioperative period, pass through the damaged blood-brain barrier into the central nervous system through direct or indirect pathways, activate neurons and microglia in the central nervous system, and produce a series of inflammatory mediators in the central nervous system (hippocampal brain region), mediating mitochondrial damage and decreased cell energy metabolism function, ultimately resulting in damage to the patient's memory and learning functions (Tang Y & Ouyang W, 2017).

In addition, a multitude of factors such as aging, surgical trauma, and infection can activate the immune system, resulting in an increase in the expression of inflammatory factors and causing peripheral inflammation. Research has confirmed that the excessive generation of inflammatory factors in the periphery can affect endothelial cells in the brain vasculature, weakening cell-to-cell connections and altering the permeability of the blood-brain barrier (BBB). This disruption also compromises the integrity of the BBB, allowing white blood cells to migrate more easily to the brain, ultimately leading to a central nervous system inflammatory response. Consequently, this results in the destruction of synaptic structures, neuron death, and a range of impaired brain function symptoms (Zhou Y, Wang J & Guo X, 2015).

Dex, as a highly selective alpha-2 adrenergic receptor agonist, can not only exerts sedative, analgesic, and sympatholytic effects but also protects the central nervous system by promoting sleep cycles close to physiological conditions, reducing neuroinflammatory responses, activating anti-apoptotic pathways, and stabilizing central hemodynamics. As such, it has become an essential preventive measure against postoperative cognitive dysfunction (Zhou C, Zhu Y, Liu Z, et al, 2016; Jin X, Jin C & Zhou Y, 2016).

Pain: Postoperative pain is a complex array of pathophysiological responses induced by surgical trauma, resulting from the interplay of various factors. It significantly affects the recovery of various systems and organs in the body, posing a considerable challenge to the restoration of respiratory function and mental status in patients (Pain L LF & Presse M, 2009). Research has found that post-surgical hyperalgesia is closely associated with POCD (Nie H, Zhao B, Zhang YQ, et al, 2012).

Gene: APOEε4 gene is the most extensively studied gene associated with the occurrence of postoperative cognitive dysfunction. It has three alleles, ε2, ε3, and ε4, which encode APOE2, APOE3, and APOE4 proteins, respectively. The ε4 subtype has the closest relationship with cognitive function. The APOEε4 allele of the apolipoprotein E gene has been proven to be a risk factor for Alzheimer's disease, poor outcomes following brain injury, and accelerated cognitive decline accompanying aging. In addition, a meta-analysis from Cao (2014) et al. revealed that the APOEε4 allele is associated with an increased risk of POCD within one week after surgery, but it showed no correlation with long-term POCD.

The Plasticity of the Brain: Traditional beliefs hold that the aging of the brain leads to inevitable decline. However, recent insights suggest that the brain possesses the ability to adapt and reorganize throughout life, enabling it to respond to neural damage and maintain neural stability. The study of Gutchess (2014) et al. observed results from extracranial nerve stimulation and functional magnetic resonance imaging, proposes that neural regeneration is one of the mechanisms of brain plasticity.

Frailty: Frailty is a risk factor for increased postoperative complications and increased mortality (Dicpinigaitis AJ, Kazim SF, Schmidt MH, et al, 2021; Castillo-Angeles M, Cooper Z, Jarman MP, et al, 2021). Frailty and cognitive impairment are common comorbid conditions in patients before surgery, and they both accompany and influence each other. In patients with a frail state, cognitive impairment can occur before surgery and be exacerbated, and the presence of cognitive impairment can also exacerbate the degree of frailty in patients before surgery. When both conditions coexist, patients may be at higher risk of surgery, and postoperative quality of life, disability, and even increased mortality may occur (Wang W, Si H, Yu R, et al, 2022).

2.3 The Interrelation Between Cognitive Dysfunction and Postoperative Cognitive Dysfunction

Cognitive dysfunction refers to the impairment of an individual's cognitive abilities, leading to obstacles in perception, memory, thinking, language, and other aspects. In contrast, postoperative cognitive dysfunction (POCD) refers to the central nervous system complications experienced by elderly patients after surgery, characterized by confusion, anxiety, personality changes, and memory impairment. Most POCD can recover within 3 months after surgery, but a few patients may experience long-term or permanent cognitive dysfunction (Guo Z & Cui L, 2014). The presence of cognitive dysfunction may increase the risk of postoperative cognitive dysfunction; secondly, postoperative cognitive dysfunction may be a manifestation of cognitive dysfunction; finally, both conditions may share some influencing factors, such as age and cardiovascular diseases.

2.3.1 Nosogenesis

Cognitive dysfunction is a clinical syndrome that is usually caused by various factors, such as neurodegenerative diseases, cerebrovascular diseases, brain inflammation, and head trauma. Its pathogenesis involves multiple aspects, including neuron loss, reduced synaptic plasticity, and imbalance of neurotransmitters. POCD, on the other hand, is a central nervous system complication experienced by elderly patients after surgery, and its specific pathogenesis is not yet clear. It may be related to factors such as surgical trauma, anesthetic drugs, and inflammatory responses. Qin Xiaoyu et al. pointed out that the brain is an organ with very high iron content, and ferroptosis may be related to the occurrence and development of POCD (Qin Xiaoyu & Wang Chun'ai, 2022).

2.3.2 Influencing Factors

The influencing factors of cognitive dysfunction include age, gender, educational level, cardiovascular diseases, diabetes, hypertension, etc. Meanwhile, POCD is driven by elements such as age, type of surgery, anesthetic technique, and surgical complications. Large surgical procedures are more likely to result in POCD. As age increases, the risk of postoperative cognitive impairment in patients also increases. Other factors such as drug use (antidepressants, anxiolytics, etc.), genetic factors, and social psychological factors (such as anxiety, depression, etc.) all have the possibility to increase the risk. There is a certain overlap between cognitive dysfunction and POCD in these influencing factors, such as age and surgical complications.

2.3.3 Diagnosis and Treatment

The occurrence of POCD can extend a patient's hospital stay, impair their quality of life, elevate postoperative mortality rates, and impose significant burdens on individuals and society. Therefore, early recognition and diagnosis of POCD, as well as timely and effective prevention and intervention, are crucial for minimizing adverse outcomes. The diagnosis of cognitive dysfunction primarily relies on an assessment of clinical manifestations, medical history, physical examination, and neuropsychological testing. Treatment, which is

targeted at the underlying cause, typically involves a combination of medication, rehabilitation training, and psychological therapy. Similarly, the diagnosis of POCD necessitates a comprehensive evaluation of clinical symptoms, surgical history, and neuropsychological assessment. Therapeutic approaches, which are customized to address the specific cause, again emphasize a combination of medication, rehabilitation training, and psychological therapy.

The diagnostic sequence for cognitive dysfunction (Li Shun-wei, 2006) is as follows: ① First, confirm whether there is cognitive dysfunction; ② Distinguish whether it is amnestic mild cognitive impairment (aMCI), vascular cognitive impairment (VCI), or other types; ③ Confirm whether there is dementia; ④ If there is dementia, distinguish which type it is, mainly whether it is reversible or irreversible dementia.

There are various scales for assessing cognitive impairment, such as the Mini-Mental State Examination (MMSE), the Hasegawa Dementia Scale (HDS), the Clock Drawing Test, and the 7-Minute Neurocognitive Screening Scale, etc. These scales are characterized by high sensitivity, low false negative rates, easy operation, portable, and time-saving (5-10 minutes). Other comprehensive and extensive cognitive screening scales include the Ma-ttis Dementia Rating Scale (DRS), the Alzheimer's Disease Assessment Scale - Cognitive Behavior Test (ADAS-cog), the Neurobehavioral Cognitive Status Examination (NCSE), the Cognitive Abilities Screening Instrument (CASI), and the Quick Cognitive Screening Test (QCST), etc. The use of these scales should be preceded by strict training, and they can only be applied in clinical settings after passing the examination.

2.4 Postoperative Delirium

2.4.1 An Overview of Postoperative Delirium

Postoperative delirium (POD) is a state of confusion that occurs within 7 days after surgery or before discharge. According to the 10th edition of the World Health Organization's International Classification of Diseases (ICD-10), the clinical features of POD include the sudden onset after surgery, attention deficit, changes in consciousness level, and disordered thinking (Zhou Jianxiong, Xu Mingzhe, Wang Rui, Tang Yidan & Yang Jing, 2019). Postoperative delirium usually occurs in middle-aged and elderly patients, especially those with chronic diseases or who undergo major surgery. It is a distressing and potentially dangerous condition that can have a significant impact on a patient's recovery and overall well-being (Inouye SK, Westendorp RG & Saczynski JS, 2014). In China, the incidence of postoperative delirium (POD) in patients aged 65 and above, who have undergone non-cardiac surgeries, ranges from 6.1% to 57.1%, with an overall prevalence of 11.1%. Notably, the rates of POD for thoracic, upper abdominal, spinal, and joint surgeries all exceed 15% (Tan Gang, Guo Xiangyang, Luo Ailun, Huang Yuguang & Xu Jianqing, 2011). Past research on delirium has pointed out that factors such as advanced age, cognitive or functional impairment, the number of comorbidities, a history of falls, and sensory deprivation are important triggers (Janssen TL, Alberts AR, Hooft L, Mattace-Raso F, Mosk CA & van der Laan L, 2019).

The diagnosis of POD primarily relies on clinical manifestations. The gold standard involves experienced psychiatrists conducting a detailed neuropsychiatric evaluation at the bedside, followed by diagnosis based on the fifth edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-V) or ICD-10 (Zhou Jianxiong, Xu Mingzhe, Wang Rui, Tang Yidan & Yang Jing, 2019). Due to the complexity of the diagnostic standard for delirium, researchers have established the most widely used diagnostic method internationally based on the diagnostic criteria of delirium in DSM-III-R, which is the Confusion Assessment Method (CAM) (Inouye SK, Van Dyck CH, Alessi CA, et al, 1990).

2.4.2 Prevention and Treatment of Postoperative Delirium

Most PODs are preventable, and early diagnosis is crucial for triggering clinical attention and effective treatment (Neufeld KJ, Leoutsakos JM, Oh E, Sieber FE, Chandra A, Ghosh A, Schretlen DJ & Needham DM, 2015). However, after the first episode of delirium, treatment or intervention after the episode has little impact on its severity, duration, or the possibility of recurrence. Therefore, primary prevention of delirium is crucial, such as pain management, sleep enhancement, visual and auditory aids， physical training, or dietary recommendations (Dasgupta M & Dumbrell AC, 2006).

Currently, there is no gold standard for the treatment of delirium. In practical application, multidomain treatment (which may not involve medication frequently) is the foundation of all delirium treatments. Prevention of delirium includes both drug and non-drug methods, among which the most commonly used non-drug method is the Hospital Elder Life Program (HELP). However, there is currently no compelling and replicable evidence of efficacy for drug-based research (Qin Xiaoyu & Wang Chun'ai, 2022). However, in the study by Sultan et al., the use of melatonin was found to significantly reduce the incidence of postoperative delirium (Sultan SS, 2010).

3. Conclusion

This article provides a comprehensive overview of the definitions, classifications, influencing factors, and

interrelationships between cognitive impairment and postoperative cognitive dysfunction. There is a certain connection between the two, regardless of their pathogenesis or development. Due to the complexity of the causes of cognitive impairment, this field remains a subject of urgent research, with new findings continually emerging, such as the APOEε4 gene as a biomarker. It is hoped that this article will provide clinical guidance and inspire future research directions.

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