
Research Progress on Postoperative Delirium in Elderly Patients Undergoing Cardiac Surgery

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Abstract: After cardiovascular surgery, patients often experience various neurological complications due to surgical factors. Delirium is one of the common complications, and cognitive impairment is the main manifestation of patients. The main cause of this complication is directly related to the long duration of cardiac surgery. Due to the long duration of extracorporeal circulation during surgery, it can easily affect cerebral perfusion and increase the possibility of postoperative delirium. According to relevant surveys, the likelihood of delirium occurring after cardiovascular surgery is 26% to 52%, and it increases with age. Once delirium occurs after cardiovascular surgery, it not only has a direct impact on the patient's prognosis, but also leads to confusion, increased hospitalization time and costs, and even poses a threat to the patient's life safety. According to statistics, the annual cost of postoperative delirium treatment in the United States is approximately \$38 to \$120 billion. Therefore, this article provides a review of the research progress on delirium in elderly patients after cardiac surgery.

Keywords: elderly; post cardiac surgery; delirium

1 The definition and pathophysiology of delirium

Delirium is a transient state of consciousness disorder accompanied by cognitive impairment caused by various reasons. Delirium is defined in the American Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-V) [1-4] as an acute episode of consciousness disorder, which can be accompanied by abnormal perceptual function, lack of concentration, incoherent thinking, and confusion, and can be divided into excitatory, inhibitory, and mixed types. After surgery, delirium is more likely to occur under the influence of surgical factors, especially between 24 and 72 hours after surgery, where delirium is highly likely to occur. After delirium occurs, there are also certain differences in the manifestations of different patients, mainly manifested as unstable consciousness, lack of concentration, restlessness, fear and hallucinations, sleep and directional disorders, etc. The symptoms of patients can show a rapid development trend in a short period of time and fluctuate during the treatment process. The mechanism of its occurrence is currently unclear, and research suggests that it may be related to the following theories.

1.1 Neurotransmitter theory

In the study of postoperative delirium inducing factors, abnormal neurotransmitter functions such as acetylcholine, dopamine, and serotonin are considered the main risk factors. Especially during the occurrence and development of delirium, acetylcholine plays a direct role. Cholinergic energy is widely involved in processes such as attention, arousal, sleep, and memory in the human body. If cholinergic function is lacking, the above activities and processes will be directly affected [5]; There is a correlation between postoperative cognitive impairment and elevated serum anticholinergic activity (SAA) levels. The reason is that after the increase of SAA levels, the concentration of acetylcholine in the serum tends to decrease, that is, cholinergic function decreases, increasing the probability of delirium. However, SAA levels may be influenced by anticholinergic drugs, their metabolites, and endogenous substances. Multiple studies [7,8] have found that preoperative use of pethidine, benzodiazepines, and anticholinergic drugs increases the likelihood of postoperative delirium. The reason is that the blood-brain barrier can block the central M receptors under the action of anticholinergic drugs, which can damage the cognitive function of patients and cause delirium.

1.2 Stress response theory

Treating delirium as an acute stress response is an explanation of the mechanism of delirium based on the stress response theory. Under stress response conditions, the hypothalamic pituitary adrenal cortex (HAP) axis is activated, leading to a significant increase in corticosteroid levels, resulting in metabolic and functional abnormalities in the hippocampus responsible for behavior, memory, emotion, and immune regulation, leading to

delirium [9,10]. Paschke et al. [11] found that after observing 144 patients with delirium after open heart surgery, the plasma cortisol concentration in all patients was significantly higher than normal levels. It may be related to the use of glucocorticoid drugs in all patients during surgery. Under the action of such drugs, there is a significant decrease in N-acetyltransferase activity in the pineal gland of patients, which directly affects the synthesis of melatonin. 5-HT metabolism is the main source of melatonin and has a regulatory effect on the sleep wake cycle. If the patient's body lacks or significantly decreases melatonin, It will affect the patient's perception of circadian rhythm changes, which can lead to delirium. In addition, under stress conditions such as anesthesia and surgery, when the patient's body is in a state of stress, a large number of white blood cells can adhere to the endothelial cells, affecting the release of oxygen free radicals and enzymes, and increasing the permeability of the endothelial cell membrane; After the blood-brain barrier is damaged, inflammatory mediators and catecholamine neurotransmitters in the peripheral blood can enter the central nervous system, leading to transient abnormalities in the concentration of central monoamine neurotransmitters and causing postoperative delirium.

1.3 Inflammatory response theory

Surgery is traumatic to the body, and after the trauma, the patient will produce pro-inflammatory cytokines such as interleukin and TNF-alpha, which will have a destructive effect on the blood-brain barrier. The microglial cells in the brain are activated after the destruction of the blood-brain barrier, leading to inflammatory reactions. The interaction between pro-inflammatory factors and the proliferation of activated microglial cells will lead to central inflammatory reactions, and the neurons will be apoptotic at a rapid rate in such an environment, leading to disorders of neurological functions, which will eventually lead to the occurrence of delirium. In patients undergoing cardiac surgery, the inflammatory response is more pronounced under the influence of multiple factors, such as arterial blockade and extracorporeal circulation, and the likelihood of delirium is higher.

2 Risk factors for postoperative delirium after cardiac surgery

2.1 Age

Advanced age is a recognized susceptibility factor for postoperative delirium, and it increases with age. It has been reported that the incidence of delirium in hospitalized elderly patients aged 65 and above can reach 50%. The reason is that the body function of elderly people is in a declining state, especially after the cerebral blood vessels gradually harden, the brain function declines, and nerve cells are more likely to die. Therefore, the older the age, the higher the possibility of delirium occurrence. Research has shown that in studies of elderly delirium patients, it has been found that the area of white matter lesions in the frontal lobe, parietal occipital lobe, and basal ganglia regions of patients significantly increases. As a result, the memory of elderly patients deteriorates and they are prone to cognitive dysfunction.

2.2 Basic diseases

Related studies have found that compared with ordinary patients, delirium patients have a higher proportion of primary diseases such as stroke, Parkinson's disease, and Alzheimer's disease, indicating a correlation between these underlying diseases and postoperative delirium. In addition, some studies suggest that the worse preoperative heart function, the higher the probability of postoperative mental symptoms, indicating a close correlation between preoperative heart function level and the likelihood of postoperative mental symptoms in patients.

2.3 Surgical method

The incidence of delirium after coronary artery combined valve surgery or ascending aortic surgery is significantly higher than that after coronary artery surgery; Compared with patients undergoing elective surgery, the incidence of postoperative delirium in emergency surgery is higher, and in emergency surgery, patients undergoing cardiac surgery in the ICU have the highest incidence of delirium.

2.4 Extracorporeal circulation

Long term extracorporeal circulation increases the incidence of postoperative delirium. Research has shown

that the incidence of delirium is 38.8% in patients with CPB \geq 100 minutes, and 20.5% in patients with CPB < 100 minutes. This suggests that the longer the duration of CPB, the higher the incidence of delirium. The reason is that the longer the duration of extracorporeal circulation, the longer the duration of cerebral blood hypoxia, embolism, ischemia-reperfusion injury, and hypoperfusion in patients, leading to systemic inflammatory reactions and other factors.

2.5 Mechanical ventilation and ICU time

Research has found a correlation between the incidence of delirium and the duration of mechanical ventilation. For every hour of prolonged ventilation, the incidence of postoperative delirium increases by 20%. The incidence of delirium in the ICU is directly proportional to the length of time patients stay in the ICU, and the two factors interact with each other. After postoperative delirium in ICU patients, the length of ICU hospitalization will be extended. On the one hand, although ICU patients have sufficient sleep time, their continuous sleep time is not long, showing a fragmented sleep state and abnormal sleep structure, mainly with an increase in N1 and N2 phases, and a decrease in N3 and rapid eye movement phases. On the other hand, benzodiazepines and opioids are more commonly used during mechanical ventilation in ICU patients and are also associated with delirium; A study has found that the use of opioids, benzodiazepines, and some psychoactive drugs significantly increases the risk of delirium in patients.

2.6 Other

Postoperative pain and concurrent infections can increase the incidence of delirium. For ICU patients, the vast majority of them are critically ill, and most patients experience severe pain symptoms during their stay in the ICU. Pain belongs to the body's stress response state, and delirium inducing factors are correlated with the body's stress state. Therefore, pain is also the main cause of delirium. A survey has shown that among postoperative delirium patients, the majority are accompanied by postoperative resting state body pain symptoms, and the incidence of delirium is directly proportional to the degree of body pain.

3 Preventive measures for postoperative delirium

In clinical practice, the diagnosis of delirium is mainly based on a comprehensive assessment of the patient's medical history, symptoms, and clinical examination. At present, in the diagnosis of delirium, the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), is used as the gold standard in clinical practice, and is also used in conjunction with the Intensive Care Delirium Screening Scale (ICD-SC), Ambiguity Assessment Method (CAM), International Classification of Diseases, 10th edition (ICD-10), and ICU Patient Ambiguity Assessment Method (CAM-ICU). However, regardless of the standard used, In the diagnosis of delirium, patients must have impaired attention and consciousness, so short-term changes in cognitive ability and consciousness disorders are also considered as clinical features of delirium. The key to diagnosis is to determine whether the patient has decreased arousal and consciousness clarity.

The application of ICDSC and CAM-ICU evaluation methods in the above scales provides a reliable basis for delirium assessment in ICU patients. Numerous studies have also confirmed that the consistency between ICDSC and CAM-ICU assessment methods in delirium assessment in the ICU is very high. In the evaluation items, ICDSC includes various factors such as emotion, sleep, hallucinations, directional ability, awakening cycle, inappropriate speech, etc. It can not only make qualitative diagnosis of negative and positive, but also has a higher positive detection rate for delirium diagnosis. CAM-ICU, due to its limited number of entries and simplicity, can accurately diagnose delirium qualitatively.

4 Treatment strategies for postoperative delirium

As mentioned earlier, the preoperative disease status, extracorporeal circulation time, mechanical ventilation and ICU time, as well as pain and concurrent infections, can all lead to the occurrence of delirium in elderly cardiac surgery patients. Therefore, in order to effectively prevent delirium, active treatment of the primary disease,

especially the toxic factors that cause delirium, should be carried out as much as possible during the treatment process, such as improving brain tissue perfusion, reasonable sedation. Effectively relieve pain and minimize the occurrence of delirium caused by stress reactions in the body due to psychological and physiological disorders in patients.

When treating delirium patients, dexmedetomidine is widely used in clinical practice. After entering the human body, the drug can exert a significant anti anxiety effect through the locus coeruleus receptor. At the same time, it can keep patients calm, exert analgesic effects, and effectively reduce the patient's stress response. Therefore, it has a good relieving effect on delirium symptoms. However, there is currently no research confirming that statins, haloperidol, antipsychotic drugs, and donepezil have a direct effect on shortening the duration and occurrence of delirium.

5 Summary

In summary, delirium is a common postoperative complication in elderly patients, especially after cardiac surgery. With the continuous improvement of cardiac surgery technology, age is no longer an absolute taboo for surgery. Therefore, the occurrence of postoperative delirium in the elderly still requires continuous attention from cardiologists. As for the treatment of delirium, no clear effect of a certain drug on delirium has been found so far. Therefore, actively removing the cause and reducing the risk factors for inducing delirium are still important aspects of delirium management.

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