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# Impact of general anesthesia on postoperative cognitive function in elderly patients

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**Abstract**--The prevalence of surgical intervention in elderly patients is increasing; around one-third of all surgeries and 40% of all outpatient and elective surgeries are performed among patients over 65 years of age. General anesthesia is one of the most common anesthesia methods during surgical procedures. It is essential to investigate the impact of general anesthesia on perioperative cognitive function, especially postoperative cognitive function (POCF), in elderly patients because general anesthesia has been confirmed to be related to POCF in the early postoperative period. This aims to highlight the impact of general anesthesia on postoperative cognitive function in elderly patients and the significance of lifelong cognitive health in an aging population, and to improve the clinical outcome of elderly patients undergoing surgery in the future by proposing areas for future research.

**Keywords**--General Anesthesia, Elderly Patients, POCF.

## 1. Introduction

In recent decades, a substantial number of the global population has entered old age, and the trend is expected to continue in the future. The prevalence of surgical intervention in elderly patients is increasing; around one-third of all surgeries and 40% of all outpatient and elective surgeries are performed among patients over 65 years of age. General anesthesia is one of the most common anesthesia methods during surgical procedures. It is essential to investigate the impact of general anesthesia on perioperative cognitive function, especially postoperative cognitive function (POCF), in elderly patients because general anesthesia has been confirmed to be related to POCF in the early postoperative period. This aims to highlight the impact of general anesthesia on postoperative cognitive function in elderly patients and the significance of lifelong cognitive health in an aging population, and to improve the clinical outcome of elderly patients undergoing surgery in the future by proposing areas for future research.

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POCF is a concerning issue nowadays. The elderly constitute a large proportion of the surgical population, and the incidence of dementia also increases with age. Therefore, in the perioperative period, elderly patients are in urgent need of better drugs, strategies, methods, and criteria to prevent POCF in the early postoperative period. The activation and the autonomic nervous system activity are also affected by postoperative cognitive disorders such as delirium. POCF in the elderly is multifactorial, and the mechanism is complex, involving multiple disciplines. The above mechanistic experiments, analyses, and clinical experiments are done in acute conditions, while hundreds of reasons can affect the postoperative cognitive function of the elderly in chronic conditions. Therefore, far from a cure for prevention, a variety of in-depth research in action must be conducted on cognitive theory, animal experiments, and clinical experiments. In summary, the effect of general anesthesia on elderly patients' postoperative cognitive function is a complex problem, and more in-depth research is still needed to pinpoint the exact areas that can improve prevention.

## **2. General Anesthesia: Mechanisms and Effects**

The physiological mechanisms by which general anesthesia works are not completely understood, but they are known to affect key neurotransmitter systems within distinct neural pathways and modify the activity of the synapses within those pathways. Although interest has risen considerably, various questions about postoperative cognitive disorders remain incompletely studied. The effect of the anesthetic dose on the brain is central to the development of cognitive dysfunction after surgery: no anesthetic agent is inherently safer with respect to cognitive dysfunction. Whether every episode of perioperative sedation or every anesthetic necessarily leads to a transient dose-dependent reduction in the processing ability of the post-surgical central nervous system is a critical area of physiological and clinical interest. Mechanistically, the cornerstone of anesthetic central nervous actions is the synaptic GABAergic activity growth and/or N-methyl-D-aspartate receptor-mediated channels of excitation. Propofol is also effective in reducing the reuptake of dopamine; isoflurane and sevoflurane bind to dopamine transporters in dopamine and serotonin via hypocretin-orexin neurons, and isoflurane is also able to break down serotonin metabolism. More recently, it has been indicated that anesthetics may also function to reduce the efficacy of the excitatory structures. Reducing the activity of synaptic vesicle glycoprotein 2A by anesthetics interrupts the proper release of excitatory neurotransmitters at the nerve terminal, slows it temporarily, and deepens anesthesia. Damage to the SV2A stimulus can extend the same as seen in epilepsy or spinal cord injury. Currently, the dual-mechanistic explanation is neurologically based, which manifests the short-lived, dose-dependent, functional value of anesthesia. However, it has been proposed on the basis of pharmacological investigations that cognitive dysfunction is the object of general anesthesia because SV2A is central to the standard central neurocognitive process. (Yang et al., 2015)(Chen & Li, 2017)

## **3. Postoperative Cognitive Dysfunction in Elderly Patients**

There is increasing attention on postoperative cognitive dysfunction (POCD), especially in elderly patients who seem to be vulnerable and who typically

undergo invasive and major surgeries. POCD is associated with poor performance on everyday activities post-surgery and a detrimental quality of life among patients. While both uneventful surgery and anesthesia can impair cognition and accelerate neurocognitive pathology, anesthesia may independently cause cognitive damage. During anesthesia, patients may experience alterations in short-term memory, processing speed, and executive function, such as long-duration performance of difficult tasks, attentiveness, or judgment among other domains. Patients who receive surgery and anesthesia with general or neuraxial in combination with general anesthesia seem to have an earlier onset of cognitive dysfunction beginning at cessation of anesthetic medications until seven days after surgery, with cognitive dysfunction duration ranging from a maximum of 3 months to one year. Age-advanced adults are more inclined to have POCD than younger adults, such that 30% of older adults who receive surgery will experience substantial cognitive decline. The most affected cognitive domains necessary in an aging adult are memory, orientation, language, complex attention, and perceptual-motor functions, which are required for precise care in healthcare or while driving. Studies indicate that two to seven days after surgery, the onset of cognitive dysfunction appears to be highest and can last up to 4 weeks or 3 months. Cognitive dysfunction may manifest earlier or last longer. (Lin et al., 2015)

#### **4. Risk Factors for Postoperative Cognitive Dysfunction in Elderly Patients**

Postoperative cognitive dysfunction (POCD) is defined as a significant decrease in the intellectual functions of the brain in elderly patients after anesthesia and surgery, especially in the domains of attention, concentration, working memory, and psychomotor speed. A large number of factors can contribute to POCD, including the treatment itself and psychosocial mechanisms that respond to psychological stress related to hospitalization and surgery. The literature identifies different risk factors for POCD in elderly people, as well as the additional risk that several of them, when present in the same subject, contribute to the occurrence of POCD. Choosing the factors that can affect the occurrence of POCD, we can include them in three sections: the factors before interventions (preoperative), during the interventions (intraoperative), and after the interventions (postoperative). (van et al. 2015)(Xiao et al., 2015)

Preoperative risk stratification should include the suspected presence of a dementiform syndrome, an assessment of vascular diseases, especially vascular dementia, the level of education, and intercurrent or pre-existing depression. Intraoperatively, some suspect anesthetics have been indicated, as well as the duration of surgery. Postoperatively, the patient's health status is important, and the ability to recover the preoperative cognitive level in a relatively shorter time is crucial. Identifying patients at the highest risk of developing POCD preoperatively and those with the potential for complete recovery can guide important perioperative and operative decision-making. It is important to have brief and detailed information on factors that increase the risk of developing cognitive dysfunction in these elderly people. This information will help surgical teams and the affected elderly to discuss preoperative care, explain the risks, and prepare for additional care in these high-risk groups. Identifying the factors responsible for developing POCD can lead to intervention. The hypothesis is that reducing the

incidence and duration of cognitive dysfunction would have an important impact on patients' health and functioning after surgery.

## 5. Strategies for Mitigating Postoperative Cognitive Dysfunction

POCD is multifactorial; an individualized preoperative assessment based on the molecular, cellular, and cerebral structural state of elderly patients should be performed. A preoperative female sex, low educational level, alcohol consumption, cognitive dysfunction, geriatric depression, impaired activities of daily living, and comorbidity were proven to be risk factors associated with POCD in elderly patients. Intraoperatively, a geriatric multidisciplinary approach is essential; anesthesiologists, surgeons, and geriatric specialists should cooperate in providing care and support tailored to the physical, psychological, emotional, and social aspects of elderly patients. Protocols for the perioperative care of elderly patients, both pharmacological and non-pharmacological, should be delicately chosen, ensuring consistent evidence-based practice that must be interpreted and integrated into individualized elderly patient needs. Postsurgery, elderly patients should receive pre-discharge education about their POCD-related risk and outcome from their anesthesiologists and nurses to improve understanding and awareness of POCD. Carefully selected non-pharmacological management options to rehabilitate cognitive effects in those who develop POCD can include aspects of cognitive behavioral strategies and structured clinical care, accompanied by close monitoring and supportive care of the patient. The benefit of age-specific postoperative interventions focusing on neurocognitive outcomes is not clear-cut, as clear clinically effective regimens are still to be agreed upon. (Gan et al. 2015)(Amado et al. 2015)(Rijnen et al. 2015)

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