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Research Progress on Olfactory Memory in Elderly Patients during Perioperative Period**Wang Guilong^{1,2}, Liu Meng¹, Zhang Yi¹, Song Nengshu¹, Tan Xu¹, Xu XiongKun¹ and Gao Hong^{3,*}**¹Department of Anesthesiology, Zijin County People's Hospital, Guizhou Province, Guiyang 552100, China²College of Anesthesiology, Guizhou Medical University, Guiyang 550004, Guizhou, China³Department of Anesthesiology, Affiliated Hospital of Guizhou Medical University, Guiyang, Guizhou 550004**Publication Dates**

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Abstract

With the intensifying aging population, perioperative management of elderly patients has become increasingly crucial, particularly with growing attention to cognitive functions. As a vital component of cognitive function, olfactory memory profoundly impacts postoperative recovery and quality of life in older patients. Recent studies indicate that olfactory memory during perioperative care may be influenced by multiple factors, including surgical type, anesthesia methods, and postoperative environments. These changes not only affect patients' olfactory experiences but may also trigger cascading effects on their overall cognitive functions and emotional states. However, current research in this field remains limited, especially regarding in-depth exploration of the specific mechanisms and clinical significance of olfactory memory changes. This article aims to review the latest research progress on olfactory memory in perioperative elderly patients, analyze its changes and influencing factors, and explore its clinical implications to provide guidance for comprehensive rehabilitation strategies.

Keywords: Elderly patient; Olfactory Memory; Cognitive Function; Postoperative Recovery

Introduction

With the global aging population, elderly patients face unique challenges during perioperative care. Changes in olfactory memory are particularly noteworthy as they may significantly impact postoperative recovery and quality of life. This sensory memory is not only closely linked to emotional and psychological states but also interacts with other cognitive functions. Research indicates that the prevalence of olfactory dysfunction among individuals aged 65 and above can reach as high as 40%, and it tends to increase with age [1], and loss of olfaction may be associated with age-related cognitive disorders such as Alzheimer's disease and mild cognitive impairment (MCI) [2]. During surgical procedures, multiple factors including anesthetic effects, surgical stressors, and postoperative physiological changes may affect olfactory memory in older patients. These multifaceted influences could further compromise their cognitive performance and emotional well-being [3].

In recent years, research on olfactory memory in elderly patients during perioperative care has significantly increased, highlighting its crucial role in postoperative rehabilitation. For instance, studies have shown a significant correlation between postoperative cognitive impairment and olfactory dysfunction in older patients [4]. Furthermore, olfactory memory impairment may be intertwined with mental health issues such as depression and anxiety in elderly patients [5]. Therefore, gaining deeper insights into olfactory memory changes and their influencing factors in perioperative elderly patients holds important clinical significance for improving their postoperative recovery and quality of life.

In this context, We will review the research progress on olfactory memory in elderly patients during perioperative procedures, exploring its role in postoperative recovery, cognitive function, and mental health, and analyzes potential factors affecting olfactory memory. Through comprehensive analysis of existing literature, we aim to provide theoretical foundations and practical guidance for better consideration of olfactory memory in perioperative management of elderly patients.

Basic Concepts of Olfactory Memory and Its Importance in Elderly Patients

Definition and Mechanism of Olfactory Memory

Olfactory memory refers to an individual's ability to recognize, recall, and reproduce odors. This complex neural process primarily relies on specific brain regions including the olfactory bulb, hippocampus, and prefrontal cortex. Olfactory information is first transmitted through olfactory receptors to the olfactory bulb, then processed by the olfactory cortex before reaching other brain regions. Research indicates that olfactory memory is not only closely related to the physiological mechanisms of olfaction but also interacts with emotions and memories. For instance, certain odors can evoke strong emotional responses and memory recollections -a phenomenon particularly evident in elderly patients whose olfactory memories are often deeply tied to their self-identity and life experiences [6]. Moreover, the decline of olfactory memory may serve as an early indicator of cognitive decline in older adults. Studies have shown a significant correlation between olfactory dysfunction and neurodegenerative diseases such as Alzheimer's disease [7].

The Effect of Olfactory Memory on Cognitive Function

Olfactory memory plays a vital role in cognitive function, particularly among elderly patients. Research indicates that declining olfactory function is closely associated with age-related cognitive decline in seniors, including impaired attention, memory, and executive functions [8]. For instance, olfactory training has been shown to improve memory and attention in patients with mild cognitive impairment, possibly because olfactory stimuli enhance blood flow in specific brain regions, thereby boosting neural activity related to memory [9]. Moreover, well-maintained olfactory memory helps elderly individuals better recognize environmental smells, which improves their quality of life and self-efficacy [10]. For older adults, smell serves not only as a crucial way to perceive the external world but also as a significant carrier of emotions and memories, evoking profound personal experiences and emotional responses. Therefore, maintaining olfactory memory is essential for the overall cognitive health of elderly patients [11].

Changes in Olfactory Memory in Elderly Patients during Perioperative Period

The Similarity and Difference between Normal and Pathological Aging

Aging is an inevitable process in living organisms, which widely affects an individual's physiological functions and health status. The differences between normal aging and pathological aging, especially in animal and human models, provide important research perspectives. Normal aging is usually defined as physiological changes caused by genetic and environmental factors in individuals without obvious disease effects. This process is gradual and involves physiological aging of all organs [12]. However, pathological aging manifests as age-related diseases such as Alzheimer's disease and cardiovascular disease, with complex and diverse mechanisms [13,14].

Assessment of Olfactory Memory Before and After Surgery

Perioperative olfactory memory in elderly patients shows significant changes before and after surgery. Studies indicate that postoperative olfactory recognition thresholds are generally lower than preoperative levels, with both short-term and delayed memory of olfactory recall declining significantly on days 3 and 7 post-surgery [3]. Additionally, olfactory assessment tools such as the Connecticut Chemical Sensory Clinical Research Center (CCCRC) olfactory test demonstrate marked deterioration in olfactory recognition and memory abilities among elderly patients, with this decline showing a positive correlation with cognitive decline [15]. These changes may be associated with perioperative systemic anesthesia, inflammatory responses, and neurodegenerative alterations [16]. Therefore, evaluating olfactory memory during perioperative care not only helps understand cognitive function changes but also provides early indicators for postoperative cognitive impairment interventions.

Age and the Relationship with Olfactory Memory

The relationship between age and olfactory memory is closely observed. Research indicates that olfactory function generally declines in older adults, with this decline showing a significant correlation with cognitive deterioration. Specifically, olfactory capacity peaks between ages 20 to 40 before gradually diminishing, particularly evident in elderly individuals [17]. Studies reveal that older patients demonstrate significantly lower performance in olfactory recognition and memory tests compared to younger populations, which may be linked to neurostructural degeneration and metabolic changes in the brain [18]. Moreover, the decline in olfactory memory correlates with early symptoms of neurodegenerative diseases like

Alzheimer's disease, suggesting olfactory function could serve as an early biomarker for cognitive decline [19]. Therefore, understanding age-related impacts on olfactory memory is crucial for developing targeted cognitive interventions for elderly patients.

Influence of Perioperative Factors on Olfactory Memory

Perioperative factors significantly influence olfactory memory in elderly patients, primarily including aspects such as anesthesia types and surgical procedures. These factors not only affect patients' olfactory functions but may also lead to long-term cognitive impacts. With the increasing number of elderly individuals undergoing surgeries, understanding the effects of perioperative factors on olfactory memory has become particularly crucial.

Effects of Anesthesia Types on Olfactory Memory

Anesthesia type is a critical factor influencing olfactory memory during perioperative care. Studies demonstrate significant variations in how different anesthetics affect olfactory memory. For instance, a clinical trial compared the effects of sevoflurane and halothane inhalation on post-microtuberculosis surgery olfactory memory. The results showed that while both anesthetics showed no significant difference in olfactory function, patients receiving sevoflurane experienced marked olfactory memory decline within three hours post-surgery, whereas halothane did not exhibit similar negative effects [20]. Additionally, transdermal electroacupuncture stimulation (TEAS) has been found to improve postoperative olfactory memory impairment in sevoflurane-anesthetized patients, suggesting that anesthesia types may influence olfactory memory through alterations in neurobiological markers like melatonin levels [21]. Therefore, careful consideration of anesthesia type selection is essential in perioperative management of elderly patients to minimize potential impacts on olfactory memory.

Association between Surgical Type and Olfactory Memory

The type of surgery is also a crucial factor influencing perioperative olfactory memory. Different surgical procedures may affect patients' physiological and psychological states, thereby impacting olfactory memory formation and recovery. For ins-

tance, neurosurgical operations might directly damage the brain's olfactory processing regions, consequently affecting olfactory memory development [22]. A study on brain tumor patients revealed that postoperative cognitive decline correlates positively with specific brain area damage during surgery, particularly in olfactory and memory-related regions [23]. Additionally, the complexity and duration of the procedure can influence postoperative recovery processes, which in turn affects olfactory memory restoration. Therefore, considering surgical type-related impacts on olfactory memory when planning procedures could help improve postoperative recovery and quality of life for elderly patients.

Relationship between Olfactory Memory and Postoperative Rehabilitation

The Role of Olfactory Memory in Postoperative Emotional Regulation

Olfactory memory plays a vital role in postoperative emotional regulation. Research indicates a strong connection between olfaction and emotional responses, as olfactory stimuli can activate brain regions associated with mood, thereby influencing patients' emotional states. During perioperative care, elderly patients frequently experience emotional challenges such as anxiety and depression, which may hinder postoperative recovery. Olfactory memory helps alleviate these negative emotions by evoking positive memories of pleasant experiences. For instance, specific scents can activate positive recollections, promoting emotional improvement and psychological stability [24]. Moreover, the restoration of olfactory memory may be closely linked to patients' overall psychological state and rehabilitation outcomes. Therefore, utilizing olfactory stimulation for emotional regulation during postoperative recovery could serve as an effective therapeutic strategy.

The effect of Olfactory Memory on Postoperative Cognitive Recovery

Olfactory memory plays a crucial role not only in emotional regulation but also significantly impacts postoperative cognitive recovery. Research indicates an association between olfactory dysfunction and declining cognitive abilities, particularly in elderly patients where preserved olfactory memory may facilitate cognitive rehabilitation. Olfactory stimuli enhance neural plasticity by activating relevant brain regions, thereby improving cognitive functions such as memory and attention

[24]. During postoperative recovery, effective maintenance and training of olfactory memory in elderly patients could enhance cognitive function restoration and reduce risks of postoperative cognitive impairment. Therefore, evaluating and intervening in olfactory memory for older patients may become a vital strategy to improve surgical outcomes. By optimizing the application of olfactory stimulation, we can provide comprehensive rehabilitation support for elderly patients and promote improvements in their postoperative quality of life.

Future research direction and clinical application

Exploration of Olfactory Memory Interventions

With the deepening research on olfactory memory in elderly patients, interventions targeting olfactory memory have gradually become a research hotspot. Olfactory memory training is recognized as having positive effects on cognitive function, particularly among older adults at risk of cognitive decline. For instance, the Mind Your Nose (MYN) trial demonstrated that olfactory memory training (OMT) significantly improved olfactory memory in elderly patients, with participants showing marked performance enhancement after 20 days of training [25]. Moreover, olfactory memory training not only improves performance in trained tasks but also exhibits positive transfer effects on untrained visual memory tasks, suggesting that olfactory training may contribute to overall cognitive improvement [25]. Future research should focus on exploring the effectiveness of different types of olfactory interventions and evaluating their clinical applicability, aiming to provide more personalized cognitive intervention strategies for elderly patients.

The potential for Individualized Perioperative Management

Personalized perioperative management demonstrates significant potential in improving surgical outcomes for elderly patients. With deeper understanding of their physiological and psychological characteristics, tailored treatment plans can better address individualized needs. For instance, studies show that personalized perioperative nutrition management significantly enhances postoperative recovery quality while reducing complication rates [26]. Additionally, elderly-specific pain management strategies are gaining attention, as research indicates multimodal analgesia effectively reduces postopera-

tive pain and decreases opioid dependence [27]. Future research should focus on integrating personalized strategies across all perioperative phases—preoperative assessment, intraoperative monitoring, and postoperative rehabilitation—to achieve better clinical outcomes and patient satisfaction. Furthermore, incorporating emerging biomarkers and AI technologies provides precise data support and decision-making foundations for precision perioperative care [28].

Conclusion

The significant changes in olfactory memory observed during perioperative periods in elderly patients have been increasingly recognized in recent studies. As a vital sensory system, olfaction not only impacts physiological functions but also plays a crucial role in emotional and cognitive aspects. By gaining deeper insights into olfactory memory mechanisms, we can better understand their role in postoperative recovery processes.

Current research findings indicate that elderly patients may experience a decline in olfactory memory during the perioperative period, which is associated with multiple factors including age, surgical type, anesthesia method, and preoperative psychological state. However, the perspectives and conclusions in these studies are not entirely consistent. On one hand, some research emphasizes that diminished olfactory memory may lead to postoperative cognitive dysfunction and reduced quality of life. On the other hand, other studies suggest that changes in olfactory memory could positively impact patients' emotional well-being and postoperative adaptation. This discrepancy highlights the need for cautious consideration of interactions between various factors when analyzing and interpreting research results, and preoperative olfactory testing should be included in cognitive risk assessments in future.

In future research, balancing these diverse perspectives and findings is crucial. We should explore the causal relationship between olfactory memory and postoperative recovery through multicenter large-sample studies, while further developing effective intervention strategies to enhance olfactory memory function in elderly patients. Interventions such as olfactory training and environmental factor optimization may provide more comprehensive rehabilitation support for older patients.

In conclusion, research on olfactory memory changes in elderly patients during perioperative care not only enhances postoperative recovery outcomes but also improves their overall quality of life. Future studies should adopt a multidimensional approach to provide robust clinical guidance, helping older patients navigate perioperative challenges smoothly and regain their health and enjoyment of life.

Conflicts of Interest

The authors declare no conflict of interest regarding the publishing of this paper

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