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Research Progress on the Selection of Anesthesia Methods for Elderly Patients Undergoing Hip Fracture Surgery

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Abstract

Hip fractures occur frequently in elderly patients, and there is a broad clinical consensus favoring early surgical intervention. However, hip fracture surgery is often prolonged, and elderly patients commonly present with multiple comorbidities, reduced tolerance to anesthetic agents, diminished metabolic capacity, and delayed postoperative recovery. Inappropriate intraoperative anesthesia methods can therefore increase the risk of postoperative cognitive dysfunction and instability of vital signs, leading to greater financial burden and impaired postoperative quality of life. Consequently, the selection of an appropriate anesthesia method is of significant importance for improving surgical safety and clinical outcomes. Based on these considerations, this article reviews the selection of anesthesia methods for elderly patients undergoing hip fracture surgery.

Keywords

Elderly, Hip Fracture Surgery, Anesthesia Method

Introduction

Hip fractures are relatively common in clinical orthopedics. Studies indicate that they affect the daily lives of approximately 6% of men and 18% of women globally [1]. It is projected that the number of hip fractures worldwide will reach 2.6 million and 4.5 million by 2025 and 2050, respectively [2]. The main types of hip fractures include femoral neck fractures, intertrochanteric fractures, and pertrochanteric fractures. Due to factors such as physiological calcium loss and reduced mobility, elderly individuals are prone to osteoporosis and falls, making them the primary population affected by hip fractures [3]. Typical clinical manifestations in elderly patients with hip fractures include hip deformity, impaired function of the affected limb, and severe pain. Surgical intervention should be performed as early as possible when indications are met [4].

Anesthesia, as a critical component of hip fracture surgery, not only determines the feasibility of the procedure but also significantly influences postoperative recovery. However, the impact of different anesthetic techniques on patient outcomes varies [5]. This is particularly relevant for elderly patients, who often have diminished functional reserve of vital organs, multiple comorbidities, and an American Society of Anesthesiologists (ASA) physical status

classification of III or IV. These factors reduce their tolerance to anesthetic agents and increase the complexity of perioperative risk management [6]. Consequently, the optimal choice of anesthesia for elderly patients undergoing hip fracture surgery remains a significant clinical concern.

Currently, common anesthetic techniques for these patients include regional anesthesia and general anesthesia. Regional anesthesia primarily encompasses neuraxial techniques (such as epidural and spinal anesthesia) and peripheral nerve blocks. However, no consensus exists regarding the superiority of any single anesthetic technique [7]. Therefore, this article aims to review the selection of anesthesia methods for elderly patients undergoing hip fracture surgery based on available literature.

Basis for Selecting Anesthesia Methods

For elderly patients undergoing hip fracture surgery, the rational selection of an anesthesia method is primarily based on the following aspects:

Surgical Site and Type:

Different surgical sites and surgical types may require different anesthesia methods. For patients with hip fractures, open reduction and internal fixation are often performed intraoperatively. The anesthesia method should provide adequate muscle relaxation and nerve conduction blockade; therefore, neuraxial anesthesia and general anesthesia are common choices [8].

Patient Response to Surgical Stress:

Due to disease-related factors and physiological degenerative changes, elderly patients may have limited tolerance to intense surgical stimulation, which can result in poor intraoperative cooperation, difficulty in effective blood pressure control, increased intraoperative blood loss, and the occurrence of adverse events. Therefore, when selecting an appropriate anesthesia method, general anesthesia, which can alleviate negative emotional responses and stabilize hemodynamics, should be given priority [9].

Optimal Analgesia with Fewer Complications:

For patients with stable perioperative emotional status and no specific history of adverse reactions to anesthetic drugs, priority should be given to anesthesia methods that provide effective analgesia to ensure smooth surgical progression, while minimizing physiological interference (such as effects on cognition and hemodynamics) and facilitating rapid postoperative recovery of physiological functions [10].

In addition to these criteria, other factors should be considered, including the patient's comorbid organ dysfunction, the comprehensive capabilities of the hospital's anesthesiology department, the anesthesiologist's proficiency with anesthetic drugs and techniques, and patient preference. Therefore, no single anesthesia method is absolutely safe. When selecting the optimal anesthesia approach, anesthesiologists should comprehensively evaluate the patient's physical condition, disease severity, expected surgical duration, their own technical skill and experience, and the hospital's facilities in order to minimize anesthetic risk.

Selection and Application of Anesthesia Methods for Elderly Hip Fracture Patients Domestically and Internationally

At present, the proportion of the aging population in China continues to increase. As a common fracture type in elderly individuals, the incidence of hip fractures is also rising steadily. Anesthesia, as an integral part of the entire surgical process, is a prerequisite and a key factor for successful surgery; therefore, the selection of an appropriate anesthesia method is particularly important [12]. Currently, commonly used anesthesia methods for elderly patients undergoing hip fracture surgery include general anesthesia, neuraxial anesthesia, nerve blocks, and combined anesthesia techniques.

General Anesthesia:

General anesthesia is achieved by administering anesthetic agents through intravenous infusion, intramuscular injection, or inhalation, resulting in systemic loss of pain sensation, transient loss of consciousness, and suppression of reflexes, thereby effectively eliminating intraoperative anxiety and tension [13]. General anesthesia provides higher intraoperative comfort, alleviates postoperative pain, and allows the depth of anesthesia to be adjusted by regulating drug concentrations in the blood, thus improving controllability and safety. However, because

patients are unconscious under general anesthesia, early complications may not be detected promptly, potentially missing the optimal window for intervention [14]. In addition, there is ongoing debate regarding the effects of general anesthesia on postoperative delirium and recovery.

In a study by Li T et al. [15], involving 950 elderly patients with hip fractures (941 included after exclusions), the incidence of postoperative delirium was 6.2% in the regional anesthesia group and 5.1% in the general anesthesia group, with no statistically significant difference (P = 0.48), suggesting that general anesthesia did not significantly increase the risk of postoperative delirium. In a retrospective study by Wang Xiaowei et al. [16] of 1,001 elderly patients undergoing hip fracture surgery, which analyzed risk factors for perioperative hyponatremia, male sex and elevated white blood cell count were identified as independent risk factors, while general anesthesia was found to be a protective factor (OR = 0.614, P = 0.044), indicating that general anesthesia may help reduce the risk of hyponatremia.

However, Li Suihua et al. [17] randomly assigned 146 elderly patients with hip fractures into a control group receiving general anesthesia (fentanyl + sevoflurane + rocuronium) and an observation group receiving lumbosacral plexus block with ropivacaine. The results demonstrated that patients in the general anesthesia group had significantly lower Mini-Mental State Examination (MMSE) scores at 12 h, 24 h, 7 d, and 28 d postoperatively, as well as significantly higher incidences of delirium, hypotension, urinary retention, and increased mortality risk (P < 0.05), suggesting that general anesthesia may adversely affect postoperative prognosis. Wang H et al. [18] retrospectively analyzed 240 elderly patients undergoing hip fracture surgery (120 in the general anesthesia group and 120 in the non-general anesthesia group) and found that the incidence of cerebrovascular accidents was significantly higher in the general anesthesia group (P < 0.05). In addition, Chen Liang et al. [19] compared 53 patients receiving general anesthesia with 172 patients receiving neuraxial anesthesia and reported that general anesthesia was associated with prolonged preoperative waiting time and longer postoperative hospital stay.

These findings indicate that elderly patients with hip fractures undergoing general anesthesia require heightened vigilance regarding postoperative cognitive dysfunction and cerebrovascular events, underscoring the importance of comprehensive preoperative evaluation and close postoperative monitoring.

Neuraxial Anesthesia:

Neuraxial anesthesia refers to the injection of local anesthetics into the epidural or subarachnoid space to block spinal nerve roots and provide effective anesthesia. According to the puncture level, it mainly includes epidural anesthesia and spinal anesthesia [20]. Its advantages include minimal effects on the respiratory and circulatory systems at low doses, preservation of patient consciousness allowing intraoperative neurological monitoring, and a potential role in promoting postoperative recovery [21]. However, due to technical difficulty and the risk of local complications, there are differing views regarding its clinical value.

Song Ya'nan et al. [22] compared patients undergoing different anesthesia methods and found that those receiving epidural anesthesia had higher sleep quality scores, fewer nocturnal awakenings, and lower pain scores on the night of surgery compared with patients receiving general anesthesia (P < 0.05). Zheng Ruyi et al. [23] studied 72 patients undergoing hip fracture surgery (37 receiving general anesthesia and 35 receiving neuraxial anesthesia) and reported that the rates of inability to walk independently or death within 60 days, as well as total complications (including pneumonia, pulmonary embolism, and unplanned reintubation), were similar between the two groups (P > 0.05). Similarly, Vail EA et al. [24] followed 795 patients who received spinal anesthesia and 805 patients who received general anesthesia for 365 days and found no significant difference in mortality between the two groups (P > 0.05).

Thus, for patients undergoing routine hip fracture surgery, neuraxial anesthesia offers clinical outcomes comparable to those of general anesthesia. For patients with sleep disorders or low pain tolerance, neuraxial

anesthesia may offer distinct advantages; however, it requires a higher level of technical expertise from the anesthesiologist.

Peripheral Nerve Block:

With advancements in ultrasound technology, ultrasound-guided peripheral nerve blocks have been increasingly applied in clinical practice. This technique involves injecting local anesthetics near peripheral nerves under ultrasound guidance to block nerve impulse transmission and achieve regional anesthesia [25]. It can effectively reduce intraoperative and postoperative pain, attenuate perioperative stress responses, improve hemodynamic stability, and decrease the incidence of complications, demonstrating substantial value in enhancing postoperative recovery [26]. Meng Lingchao et al. [26] reported that this technique is particularly beneficial in patients older than 80 years, as it can reduce complications and intraoperative blood loss. However, challenges remain due to anatomical variability and technical difficulty in elderly patients with osteoporosis and soft tissue atrophy. Commonly used techniques include fascia iliaca compartment block (FICB) and lumbosacral plexus block.

Fascia Iliaca Compartment Block (FICB):

FICB involves the injection of local anesthetics, such as ropivacaine or dexmedetomidine, into the fascia iliaca compartment above the inguinal region [27]. Huang YY et al. [28] studied high-risk patients (ASA physical status IV) and compared FICB combined with general anesthesia with general anesthesia alone. Although 30-day and 1-year mortality rates were similar between the two groups, the FICB group had shorter ICU stays and total hospital stays and required significantly less postoperative opioid or morphine use ($P < 0.05$). Wang Qionghua et al. [29] compared single-shot FICB, continuous FICB, and oral tramadol in 120 patients and found that both FICB groups had lower postoperative pain scores and inflammatory marker levels (IL-6, CRP) than the tramadol group, with lower complication rates and no occurrences of respiratory depression or nerve injury. Nidgundi N et al. [30] also confirmed the effectiveness of FICB in reducing pain and facilitating positioning for spinal anesthesia.

Lumbosacral Plexus Block:

Lumbosacral plexus block combines lumbar plexus block, which targets nerves supplying the posterior hip region, and sacral plexus block, which targets nerves supplying the anterior and medial hip regions [31]. Tang L et al. [32] compared lumbosacral plexus block combined with general anesthesia with unilateral spinal anesthesia in 124 elderly patients. Although postoperative pain and complication rates were similar between the two groups, the lumbosacral plexus block group demonstrated significantly higher Activities of Daily Living (ADL) scores at 30 days postoperatively ($P < 0.05$). Du Rui et al. [33] studied 60 elderly patients receiving laryngeal mask airway ventilation and compared ultrasound-guided lumbosacral plexus block combined with general anesthesia with intravenous anesthesia alone. The block group required less fentanyl, had lower patient-controlled analgesia usage, shorter hospital stays, lower pain scores, and reduced incidences of delirium and postoperative cognitive dysfunction ($P < 0.05$).

Combined Anesthesia:

Combined anesthesia integrates the advantages of different anesthesia techniques to enhance perioperative safety and efficacy. Wei Youqin et al. [34] studied 86 elderly patients undergoing hip fracture surgery and compared combined spinal-epidural anesthesia (CSEA) combined with pericapsular nerve group (PENG) block with CSEA alone. The combined group exhibited lower levels of inflammatory markers, greater postoperative hip flexion, and fewer patient-controlled analgesia requirements ($P < 0.05$), while complication rates were comparable between groups. Zhao Huayu et al. [9] compared intravenous anesthesia combined with local infiltration anesthesia, CSEA, and laryngeal mask general anesthesia. The intravenous anesthesia combined with local infiltration group demonstrated shorter emergence and anesthesia preparation times, reduced anesthetic drug consumption, fewer adverse reactions, more stable hemodynamics, and higher Montreal Cognitive Assessment (MoCA) and Mini-Mental State Examination (MMSE) scores ($P < 0.05$).

Summary and Outlook

Elderly patients undergoing hip fracture surgery

often present with impaired organ function, multiple comorbidities, and high American Society of Anesthesiologists (ASA) physical status classifications, which significantly increase anesthetic risk. Therefore, the selection of anesthesia methods should comprehensively consider the patient's overall condition, disease severity, and technical factors, with particular emphasis on perioperative safety management to maximize clinical benefit.

At present, anesthetic techniques and clinical experience in China continue to evolve. Combined anesthesia techniques, owing to their advantages of effective sedation and analgesia, minimal physiological disturbance, and lower incidence of adverse effects, demonstrate considerable potential and may represent a mainstream direction for anesthesia management in elderly patients undergoing hip fracture surgery in the future.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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