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Original Article

Use of ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia in elderly patients undergoing total hip arthroplasty

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Abstract: Objectives: To evaluate the effects of ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia in elderly patients undergoing total hip arthroplasty (THA). Methods: This retrospective study involved 84 elderly patients, divided into two groups based on anesthesia method: control group (n=40) and observation group (n=44). Hemodynamics, including mean arterial pressure (MAP), heart rate (HR), and oxygen saturation (SpO_2) were compared between the two groups before anesthesia (T0), after induction of anesthesia (T1), immediately after skin incision (T2), and immediately after the end of surgery (T3). Preoperative and postoperative (1 day after surgery) levels of cortisol, blood glucose, norepinephrine, and adrenaline were compared between the two groups. Postoperative recovery time, laryngeal mask removal time, observer's assessment of alertness/sedation (OAA/S) score, and incidence of postoperative complications were also recorded. Results: From T1-T3, the MAP, HR, and SpO_2 were significantly higher in the observation group than those of the control group (all $P<0.05$). The anesthetic effect in the observation group was better than that of the control group ($P<0.05$). At 1d after surgery, levels of cortisol, blood glucose, norepinephrine, and adrenaline increased in both groups, but they were lower in the observation groups than in the control group. The OAA/S score was lower in the observation group, and both postoperative recovery time and laryngeal mask removal time were shorter than those of the control group (all $P<0.05$). Patients were further categorized into an orthostatic intolerance (OI) group (n=38) and a non-OI group (n=46) after THA. Factors influencing OI in elderly patients included BMI, decreased hemoglobin levels, and MFES score. Conclusion: Ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia provides a superior anesthesia effect and reduces postoperative complications in elderly patients undergoing THA.

Keywords: Ultrasound guidance, total hip arthroplasty, lumbar plexus block, sacral plexus block, laryngeal mask general anesthesia

Introduction

The proportion of hip fractures in elderly people over 65 years in China accounts for 23.8% of all fracture patients [1]. With advancements in medical technology, total hip arthroplasty (THA) has become an effective treatment for end-stage hip disorders in elderly patients. It plays a crucial role in reducing joint dysfunction and restoring walking ability in this population [2]. As a common orthopedic surgery for treating various middle- and late-stage hip diseases [3], the volume of THA surgeries in China has reached 650,000 cases in 2018, with continued annual increases [4].

Surgical trauma and systemic inflammatory reactions often result in neuroendocrine metabolic changes, causing a significant stress response in patients [5]. In the elderly, immune system aging or immune senescence contribute to progressive dysregulation of immune function [6], while perioperative stress and anesthesia further weaken cellular immunity, increasing the risk of postoperative infections and even death [7]. Despite the routine use of perioperative antibiotics in the last two decades, postoperative infections still occur in more than 30% of elderly patients [8]. Joint prosthesis infection following arthroplasty is particularly concerning, with 30-day morbidity

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Table 1. General information of the two groups

Group	Observation group	Control group	χ^2/t	*P*
n	44	40		
Gender (Male/Female, n)	11/33	13/27	0.578	0.447
Age (year)	82.20±8.64	81.38±5.98	0.501	0.618
Weight (kg)	64.51±7.23	63.14±6.72	0.897	0.372
ASA (n)			0.024	0.877
II	29	27		
III	15	13		
Hypertension	18	15	0.102	0.749
Diabetes	15	11	0.426	0.514

Note: ASA: American Society of Anesthesiologists.

and mortality rates as high as 18%, and a 1-year morbidity and mortality rate reaching 27% [9]. Therefore, identifying anesthesia modalities that minimize perioperative stress and protect body function is essential for improving the prognosis of elderly patients undergoing THA.

The out-of-bed activity rate at 1 to 3 days after THA is only 13.13%, and symptoms of orthostatic intolerance (OI), such as dizziness, nausea, and even fainting, can be significant barriers to early mobilization in these patients [10]. Current domestic research on OI primarily focuses on children with cardiovascular disease and postoperative patients [11]. However, as the largest weight-bearing joint in the human body, the effect on the hip of OI in elderly patients after THA remains underexplored, particularly regarding the factors influencing OI when patients attempt to leave the bed for the first time [12]. Hence, this study aimed to investigate the effect of ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia in elderly patients following THA, as well as the factors influencing OI when elderly patients first attempt to leave the bed after surgery, in order to provide a basis for clinical practice.

Materials and methods

Subjects

This retrospective study was approved by the Ethics Committee of Lanxi People's Hospital. A total of 84 elderly patients who underwent THA at Lanxi People's Hospital from April 2022 to April 2023 were selected. They were divided into two groups based on different anesthesia methods: the control group (n=40; laryngeal mask general anesthesia) and the observation group (n=44; ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block in addition to laryngeal mask general anesthesia).

Inclusion criteria: (1) All patients underwent unilateral THA; (2) Patients aged ≥65 years old. Exclusion criteria: (1) Patients with gastroesophageal reflux; (2) Patients with spinal deformities or previous hip surgeries; (3) Patients with mental or cognitive dysfunction prior to surgery; (4) Patients with hepatic, renal, or coagulation dysfunction; (5) Patients unable to tolerate surgery; (6) Patients allergic to the study medication; (7) Patients with skin infection at the block site. There were no significant differences between the general characteristics of the two groups (P>0.05). See **Table 1**.

Methods

All subjects underwent routine preoperative checkups and fasted for 6 h before surgery. They were then positioned supine for the procedure, during which all vital signs were monitored, and intravenous access was established.

In the control group, laryngeal mask general anesthesia was used. The anesthetic regimen included intravenous injections of 0.1 μg/kg sufentanil (No. 24026015; China National Pharmaceutical Industry Co., Ltd.), 0.15 mg/kg cis-atracurium (No. 24102211; Hangzhou Ausia Biological Technology Co., LTD.), and 0.3

mg/kg etomidate (No. TYT24G45; Jiangsu Nhwa Pharmaceutical Co., Ltd.). Fifteen minutes after successful induction, a multifunctional laryngeal mask was inserted to for mechanical ventilation, with relevant parameters adjusted as necessary. Intraoperative anesthesia was maintained with intermittent injections of cis-atracurium, and the depth of anesthesia was further maintained with either propofol or fentanyl.

In the observation group, ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block was performed in addition to the anesthesia regimen used in the control group. For the first ultrasound-guided block, the patient was placed on the non-operative side. The skin was marked, and the puncture point was located approximately 4-5 cm lateral to the lumbar vertebrae, adjacent to the L3 and L4 vertebrae. The puncture point was infiltrated with 1% lignocaine (No. R24060502; Hunan Kelun Pharmaceutical Co. LTD.). An ultrasound probe was placed over the corresponding lumbar vertebral segments (L3, L4, and L5) to identify the transverse processes and the lumbar plexus muscle. Using the in-plane technique, the needle was inserted, and 20 mL of 0.5% ropivacaine (No. 4C0023C71; Qilu Pharmaceutical Co., Ltd.) was injected. Next, the ultrasound probe was moved 5-6 cm from the posterior superior iliac spine, where an image of the sacrum and ilium appeared on the ultrasound. The needle was carefully advanced toward the sacral plexus location, and then advanced until contraction of the broad fascia tensor muscle was observed. At this point, 15 mL of 0.5% ropivacaine was injected to complete the sacral plexus block. Fifteen minutes after successful block, laryngeal mask general anesthesia was performed in the same manner as in the control group. Total hip arthroplasty (THA) was then carried out in both groups by the same surgical team.

Observational indicators

Hemodynamics: Mean arterial pressure (MAP), heart rate (HR), and pulse oximetry (SpO_2) levels were recorded for all subjects at the following time points: before anesthesia (T1), after induction of anesthesia (T2), immediately after skin incision (T3), and immediately after the end of surgery (T4).

Anesthesia effect: The anesthesia effect [6] was assessed postoperatively. Postoperative resting and motor visual analogue scale (VAS) scores were used to classify the anesthesia outcome: an excellent effect was defined as a resting VAS score <4 and a motor VAS score <4; a good effect was defined as a resting VAS score <4 and a motor VAS score ≥4; and a poor effect was defined as both resting VAS score and motor VAS score ≥4.

Stress reaction indicators: Before and 1 d after the operation, venous blood samples were collected from all subjects. After centrifugation (4000 r/min, 10 min) using a TD6M desktop low-speed centrifuge (Yancheng Kite Experimental Instrumentation and Equipment Co., Ltd.), the supernatant was obtained. Levels of adrenaline, cortisol, and norepinephrine were measured by radioimmunoassay, and blood glucose levels were measured using a Roche Glucose meter.

Quality of wakefulness: postoperative awakening time and laryngeal mask removal time were recorded. The patients' level of wakefulness at 30 minutes postoperatively was assessed using the Observer's Assessment of Alertness/Sedation (OAA/S) score [13], with scores ranging from 0 to 5 (higher scores indicating greater alertness).

The diagnostic criteria used were based on the guidelines from the American Academy of Autonomic Neuroscience and the American Academy of Neurology. Orthostatic intolerance (OI) is defined as a clinical syndrome where systolic blood pressure falls by ≥30 mmHg (1 mmHg =0.133 kPa) within 3 min of transitioning from a prone to an upright position, accompanied by symptoms of hypoperfusion such as dizziness, visual blackout, or even syncope [14]. OI diagnosis was performed by measuring blood pressure in the prone and standing positions when patients first attempted to leave the bed after surgery. Patients were encouraged to attempt standing 24-48 hours postoperatively, using the time of their return to the ward after hip surgery as the reference point. Before standing, prone blood pressure was measured after the patient had been lying down for at least 5 min. If the patients could tolerate standing for 3 min, standing blood pressure was measured for 3 min; if the patient could not tol-

erate standing, immediate blood pressure was measured. Patient safety was ensured during the measurement, and bed rest was provided if the patient experienced discomfort. A decrease in systolic blood pressure of ≥30 mmHg in the standing position compared to the prone position was used to confirm the diagnosis of OI.

The Numerical Rating Scale (NRS) [15] is the most commonly used pain rating scale in clinical practice. It evaluates a patient's pain on a scale from 0 to 10, with higher numbers indicating more severe pain. A score of 0 indicates no pain, 1 to 3 represents mild pain, 4 to 6 indicates moderate pain, 7 to 9 represents severe pain, and 10 denotes the most severe pain. The number of dots on the scale indicates the severity of pain. Patients were fully informed about the scale, asked to rate their pain, and either recorded their score or marked the number that best represented their pain level.

The Modified Fall Efficacy Scale (MFES) was proposed by Bandura based on self-efficacy theory [16] and later adapted into Chinese by Hao Yanping et al. to assess the confidence of older adults in avoiding falls in daily life. The MFES includes two dimensions: indoor and outdoor activities. It consists of 14 items, each scored from 0 to 10, with 0 representing no confidence, 5 representing average confidence, and 10 representing full confidence. The final score is the average of all item scores. Lower scores indicate greater fear of falling and lower confidence in preventing falls, while scores below 8 suggest the presence of fall efficacy concerns, and scores above 8 indicate the absence of such concerns. The MFES has demonstrated strong reliability and validity, with a Cronbach's alpha coefficient of 0.968 and a content validity index ranging from 0.647 to 0.915 in the elderly population [17].

Statistical analysis

SPSS 25.0 was used for statistical analysis. Continuous data were expressed as ($\overline{x}$±s), and t-test was used for between group comparison. Categorical data were presented rate (%) and analyzed using the χ^2 test. For ranked data, the rank-sum test was applied. A *P*-value of <0.05 was considered significant. Multivariate logistic regression analysis was applied to identify factors influencing OI in elderly patients.

Results

General information

The general characteristics of the observation and control groups are summarized in **Table 1**. The gender distribution was similar between the two groups, with 11 males and 33 females in the observation group, and 13 males and 27 females in the control group (χ^2=0.578, *P*=0.447). The mean age in the observation group was 82.20±8.64 years, and in the control group, it was 81.38±5.98 years (t=0.501, *P*=0.618). The average weight was 64.51±7.23 kg in the observation group and 63.14±6.72 kg in the control group (t=0.897, *P*=0.372). In terms of American Society of Anesthesiologists (ASA) classification, 29 participants in the observation group and 27 in the control group were classified as ASA II, while 15 and 13 participants were classified as ASA III (χ^2=0.024, *P*=0.877) respectively. The prevalence of hypertension was 18 in the observation group and 15 in the control group (χ^2=0.102, *P*=0.749), and the prevalence of diabetes was 15 and 11, respectively (χ^2=0.426, *P*=0.514). No significant differences were found between the two groups in terms of gender, age, weight, ASA classification, hypertension, or diabetes (*P*>0.05).

Hemodynamics

From T0 to T3, the MAP, HR, and SpO_2 levels in both groups showed a trend of initially decreasing and then increasing. At the times of T1-T3, the MAP (T1: *P*=0.001; T2: *P*=0.002; T3: *P*=0.013), HR (T1: *P*=0.038; T2: *P*<0.001; T3: *P*=0.002), and SpO_2 (T1: *P*=0.034; T2: *P*=0.001; T3: *P*<0.001) levels in the observation group were significantly higher than those of the control group. See **Table 2**.

Anesthetic effect

The anesthetic effect in the observation group was significantly better than that in the control group (*P*=0.029). See **Table 3**.

Stress response

At 1 d postoperatively, cortisol, blood glucose, norepinephrine, and adrenaline levels in both groups were higher than preoperative levels.

Table 2. Comparison of hemodynamics between the two groups ($\bar{x}\pm s$)

Indicators	Group	T0	T1	T2	T3
MAP (mmHg)	Observation group (n=44)	84.15±8.24	79.53±7.18[a]	73.22±6.21[a,b]	78.16±6.47[a,c]
	Control group (n=40)	83.71±7.39	74.12±7.65[a]	68.46±7.13[a,b]	74.85±5.39[a,c]
t/P		0.257/0.798	3.343/0.001	3.270/0.002	2.533/0.013
HR (times/min)	Observation group (n=44)	79.45±6.26	75.03±7.54[a]	71.48±6.65[a,b]	74.12±5.47[a,c]
	Control group (n=40)	79.12±7.39	71.81±6.36[a]	64.06±5.71[a,b]	70.14±6.08[a,c]
t/P		0.221/0.825	2.105/0.038	5.460/<0.001	3.158/0.002
SpO_2 (%)	Observation group (n=44)	131.05±9.81	124.71±9.62[a]	117.42±7.11[a,b]	123.81±5.43[a,c]
	Control group (n=40)	130.28±8.36	120.64±7.25[a]	112.18±7.34[a,b]	118.56±6.42[a,c]
t/P		0.385/0.701	2.173/0.034	3.322/0.001	4.058/<0.001

Note: Compared with T0, [a]*P*<0.05; compared with T1, [b]*P*<0.05; compared with T2, [c]*P*<0.05. MAP: Mean arterial pressure; HR: Heart rate.

Table 3. Comparison of anesthetic effect between the two groups (*n*, %)

Group	N	Excellent	Good	Poor
Observation group	44	23	17	4
Control group	40	12	20	8
Z			4.79	
P			0.029	

However, the observation group showed significantly lower levels of cortisol (*P*<0.001), blood glucose (*P*<0.001), norepinephrine (*P*=0.003), and adrenaline (*P*<0.001) compared to the control group. See **Table 4**.

Recovery quality

The OAA/S score of the observation group was significantly lower than that of the control group (*P*<0.001), indicating better sedation. Additionally, the postoperative awakening time and the time to laryngeal mask removal were significantly shorter in the observation group compared to the control group (both *P*<0.001). See **Table 5**.

Univariate analysis of OI

A total of 84 patients were categorized as an orthostatic intolerance (OI) group (n=38) and the non-OI group (n=46) based on whether OI occurred during the first attempt to leave the bed after THA. As shown in **Table 6**, significant differences were observed in BMI (t=4.589, *P*<0.001), anesthesia method (χ^2=7.158, *P*=0.008), decreased hemoglobin levels (t=4.112, *P*<0.001), NRS (t=2.589, *P*=0.012), and MFES (t=-4.408, *P*<0.001) between the two groups.

Logistic regression analysis of OI risk factors

Logistic regression analysis demonstrated that BMI [OR (95% CI): 1.460 (1.144-1.864), *P*=0.002] and decreased levels of hemoglobin [OR (95% CI): 1.153 (1.040-1.279), *P*=0.007] were risk factors for OI in elderly patients after THA. In contrast, the MFES score [OR (95% CI): 0.558 (0.366-0.853), *P*=0.007] was found to be a protective factor against OI (**Table 7**).

Discussion

This study showed that the anesthesia effect in the observation group was superior to that of the control group. From T0 to T3, the MAP, HR, and SpO_2 levels in both groups showed a trend of initially decreasing and then increasing. However, the MAP, HR, and SpO_2 levels in the observation group were consistently higher than those of the control group from T1 to T3. Additionally, the cortisol, blood glucose, norepinephrine, and adrenaline levels were lower in the observation group compared to the control group. These findings suggest that ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia results in more stable anesthetic depth, a better anesthetic effect, reduced stress response, and lesser impact on the hemodynamics of elderly patients undergoing THA.

The lumbar plexus primarily innervates the lateral, anterior, and medial thighs, while the sacral plexus mainly innervates the posterior thighs and buttocks. Under ultrasound guidance, the location and direction of the lumbosacral plexus can be clearly visualized, allowing

Table 4. Comparison of stress response ($\bar{x}\pm s$)

Group		Observation group (n=44)	Control group (n=40)	*t*	*P*
Cortisol (pg/mL)	Pre-operation	222.54±29.01	217.43±33.26	0.752	0.454
	1 d post-operation	273.16±30.42[a]	302.25±36.18[a]	4.001	<0.001
Blood glucose (mmol/L)	Pre-operation	4.37±0.65	4.42±0.71	0.337	0.737
	1 d post-operation	5.41±0.73[a]	6.83±0.62[a]	9.560	<0.001
Norepinephrine (pg/mL)	Pre-operation	166.42±20.19	168.31±21.46	0.416	0.679
	1 d post-operation	175.51±18.37[a]	189.28±23.15[a]	3.033	0.003
Adrenaline (pg/mL)	Pre-operation	51.18±6.63	52.09±5.17	0.697	0.488
	1 d post-operation	61.53±6.08[a]	74.72±5.14[a]	10.681	<0.001

Note: Compared with pre-operation, [a]*P*<0.05.

Table 5. Comparison of recovery quality between the two groups ($\bar{x}\pm s$)

Group	Observation group (n=44)	Control group (n=40)	*t*	*P*
Postoperative awakening time (min)	28.15±4.29	36.32±5.08	7.987	<0.001
Time to laryngeal mask removal (min)	9.26±1.51	12.43±2.27	7.599	<0.001
Observer's assessment of alertness/sedation score (OAA/S)	2.21±0.54	2.87±0.49	5.845	<0.001

local anesthetics to more effectively block sensation in the targeted areas. This approach also helps avoid nerve damage and prevents dilation of the visceral blood vessels [18]. The combination of laryngeal mask general anesthesia can achieve a more stable depth of anesthesia and can improve the overall anesthesia effect. It reduces the afferent surgical stimuli, greatly lowering the patient's stress response while maintaining hemodynamic stability, thus ensuring the smooth progress of the operation [19]. Previous research [20] showed that the ultrasound-guided lumbosacral nerve block can enhance anesthetic efficacy, mitigate the inflammatory and stress responses in elderly patients, and reduce the risk of postoperative cognitive dysfunction. These findings are consistent with the results of this study, indicating that the combined anesthesia method in this study may work through similar mechanisms. By clearly visualizing the lumbosacral plexus and allowing for more precise administration of local anesthetics, this method effectively blocks sensation in the targeted areas, avoids nerve damage, and prevents visceral blood vessel dilation. When combined with laryngeal mask general anesthesia, it provides a more stable depth of anesthesia, reduces surgical stimuli, minimized the stress response, and effectively maintains hemodynamic stability throughout the procedure.

The results of this study showed that the BMI of the OI group was significantly higher than that of the non-OI group. Obese patients often have comorbidities such as hypertension, diabetes mellitus, hyperlipidemia, and other multisystem disorders, along with metabolic and vascular abnormalities, including atherosclerosis, impaired vascular diastolic and contractile function, and damaged vascular pressure receptors [21, 22]. These factors may contribute to the higher prevalence of OI in obese patients. Therefore, patients with high BMI should be advised to control their weight appropriately to enhance mobility and physical fitness.

As an important indicator of the body's nutritional status, a decrease in hemoglobin levels is associated with poorer nutritional status and reduced adaptive capacity. The more pronounced the decrease in hemoglobin, the higher the likelihood of OI [23]. After THA, patients often experience significant blood loss and a notable decline in hemoglobin levels, making it essential to monitor for OI during the postoperative period. This highlights the importance for healthcare professionals not only to focus on preoperative and postoperative physiological and psychological care but also closely monitor intraoperative conditions in order to guide postoperative management [24].

Table 6. Univariate analysis of OI in elderly patients after THA

	OI (n=38)	Non-OI (n=46)	t/χ^2	*P*
Age, year	82.66±8.36	81.07±6.54	0.980	0.330
Gender, n (%)			0.231	0.631
Male	17 (44.7)	23 (50.0)		
Female	21 (55.3)	23 (50.0)		
BMI (kg/m^2)	25.79±3.11	23.04±2.36	4.589	<0.001
Smoking history, n (%)			0.001	0.981
Yes	10 (26.3)	12 (26.1)		
No	28 (73.7)	34 (73.9)		
Alcohol consumption history, n (%)			1.901	0.168
Yes	18 (47.4)	15 (32.6)		
No	20 (52.6)	31 (67.4)		
Hypertension, n (%)			1.901	0.168
Yes	18 (47.4)	15 (32.6)		
No	20 (52.6)	31 (67.4)		
Diabetes, n (%)			0.690	0.404
Yes	10 (26.3)	16 (34.8)		
No	28 (73.7)	30 (65.2)		
Anesthesia method, n (%)			7.158	0.008
Observational	12 (42.1)	28 (60.9)		
Control	26 (57.9)	18 (39.1)		
Decreased levels of hemoglobin (g/L)	32.52±6.09	26.54±7.05	4.112	<0.001
Surgery duration (h)	78.63±18.01	80.93±17.57	-0.591	0.556
NRS	4.74±1.43	4.02±1.02	2.589	0.012
MFES	6.55±1.31	7.85±1.37	-4.408	<0.001
Time to first attempt to leave bed	40.13±9.83	41.24±10.03	-0.508	0.613

Note: BMI: Body mass index; NRS: Numerical Rating Scale; MFES: Modified Fall Efficacy Scale; OI: orthostatic intolerance.

Table 7. Logistic regression analysis of OI in elderly patients after THA

	β	SE	Wald	*P*	OR	95% CI
BMI	0.379	0.125	9.235	0.002	1.460	1.144-1.864
Anesthesia method	0.408	0.613	0.443	0.506	1.504	0.452-4.997
Decreased levels of hemoglobin	0.142	0.053	7.250	0.007	1.153	1.040-1.279
NRS	0.155	0.246	0.397	0.529	1.168	0.721-1.892
MFES	-0.583	0.216	7.278	0.007	0.558	0.366-0.853

Note: BMI: Body mass index; NRS: Numerical Rating Scale; MFES: Modified Fall Efficacy Scale; OI: orthostatic intolerance.

The results of this study showed that fall efficacy score was lower in the OI group compared to the non-OI group, suggesting that patients in the OI group had less confidence in leaving the bed without experiencing a fall and exhibited greater fear of falling. Fall efficacy and postoperative pain are closely related, and they may interact to increase OI risk [25]. In this study, we found that fall efficacy significantly affected the occurrence of OI in elderly patients after THA, indicating that the elderly may experience increased psychological vulnerability post-surgery, which may be related to reduced physical activity during the postoperative period [26].

There were some shortcomings in this study, including its single-center design and relatively small sample size. Further research with larger, multi-center samples is needed to strengthen the findings and provide more detailed insights.

Conclusion

Ultrasound-guided anterior lumbar plexus block combined with rapid sacral plexus block and laryngeal mask general anesthesia provided stable anesthesia depth, better anesthesia effect, reduced stress response, and improved hemodynamic stability in elderly patients undergoing THA. This approach also enhanced the quality of awakening and reduced the incidence of complications. Additionally, BMI, decreased hemoglobin levels, and the MFES were identified as factors influencing OI in elderly patients.

Disclosure of conflict of interest

None.

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