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Original Article

Application of Hip Pericapsular Nerve Block Combined With Spinal Anesthesia in the Treatment of Elderly Patients With Femoral Intertrochanteric Fracture

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Abstract

Objective: To investigate the effect of pericapsular nerve group (PENG) block combined with spinal anesthesia in the treatment of elderly patients with intertrochanteric fractures through "rapid diagnosis and treatment channel" PFNA internal fixation. **Methods**: 52 elderly patients were randomly divided into the observation group (26 patients, PENG block combined with spinal anesthesia) and the control group (26 patients, spinal anesthesia alone). The general health, mean arterial pressure (MAP), and heart rate (HR) of both groups were compared at various stages: immediately before the administration of pain analgesia, during the positioning of spinal epidural anesthesia, at the beginning and end of the surgery, and 2 hours after surgery. Additionally, VAS scores at rest and during passive straight leg elevation by 15° were evaluated at 12 hours, 24 hours, 48 hours, 72 hours, and 7 days after surgery. **Results**: The MAP and HR in the observation group under spinal anesthesia in the lateral position were lower than those in the control group ($P < 0.05$). Additionally, the VAS scores of the observation group during positioning and at 12 hours and 24 hours after surgery were lower than those in the control group under spinal epidural anesthesia (both $P < 0.05$). **Conclusion**: The application of ultrasound-guided PENG block combined with lumbar anesthesia can reduce pain when in lateral position, stabilize perioperative vital signs, and result in high satisfaction.

Keywords: Internal Fixation, Intertrochanteric Fracture, Pericapsular Nerve Group Block, Rapid Diagnosis And Treatment Channel, Spinal Epidural Anesthesia

Introduction

Intertrochanteric fractures have an enormous impact on elderly people, including increased mortality, reduced activity level and ability, and decreased quality of life, with a high 1-year mortality rate after the fracture[1]. Elderly patients have a decline in body functions, take a long time to discharge anesthetics and have a greater stress response to surgery[2]. Additionally, the use of sedatives and analgesics, along with postoperative opioid analgesics, is prone to lead to postoperative neurocognitive disorder, nausea, and vomiting, resulting in an increased risk of anesthesia-related complications[3].

Previous fascia ilica compartment block (FICB) has been proven to have a good effect on improving the pain of patients with hip fracture[4]; this block can desensitize the obturator, femoral nerve and lateral femoral cutaneous nerve. It can last up to 48 h, but the onset of effect is slow, the effect of

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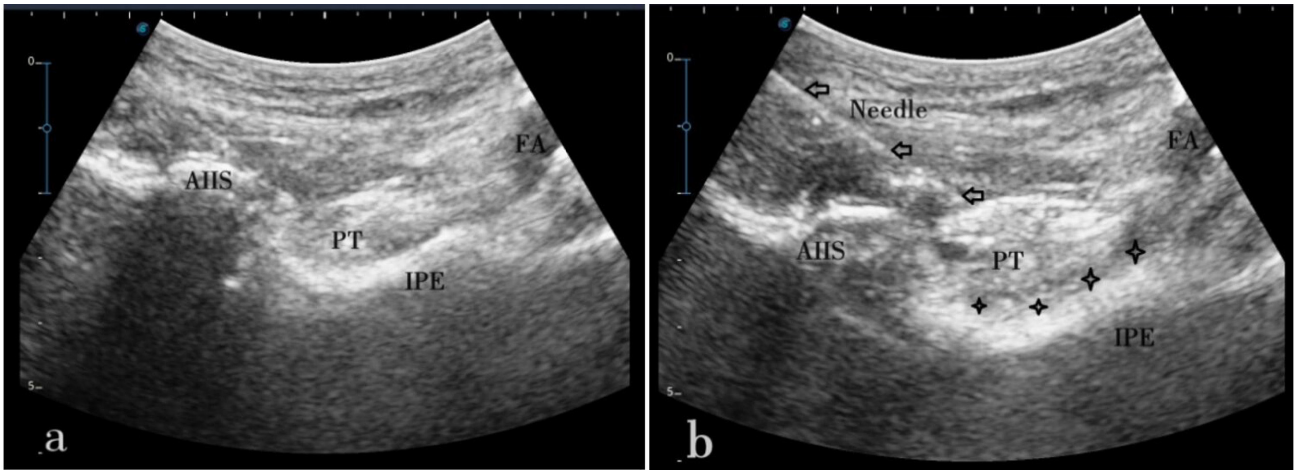

Figure 1. Ultrasound image of the PENG block. (a) Ultrasonic anatomy of the PENG block; (b)The needle path and the diffusion of local anesthetics. ASIS, anterior inferior iliac spine; FA, femoral artery; PT, psoas tendon; IPE, iliopectal eminence; Needle, puncture needle pathway.

obturator nerve block is poor, and it can lead to a decrease in quadriceps muscle strength. Giron-Arango L[5,6] proposed a new nerve block method: pericapsular nerve group (PENG) block, which can simultaneously block the femoral nerve, obturator nerve and accessory obturator nerve of the anterior capsule of the hip joint. It acts rapidly, effectively reduces the influence on quadriceps strength and has a better analgesic effect for hip surgery.

Proximal Femoral Nail Antirotation (PFNA) internal fixation is an effective surgical treatment for intertrochanteric fractures[7]. One deliberate investigation reported that early surgery in elderly patients with intertrochanteric fractures has a positive effect on improving function, reducing mortality and improving quality of life after hip fractures[8]. In recent years, with the rapid rise and popularization of the concept of rapid surgical rehabilitation, our hospital has established the rapid diagnosis and treatment channel of the ERAS concept[9] under the multidisciplinary collaboration model for the treatment of elderly intertrochanteric fractures to improve the lives of patients through early surgery[10]. Therefore, the application of multimodal analgesia to patients during the perioperative period can enable them to perform early functional exercise[11]. This study aims to investigate the effect of pericapsular nerve block combined with spinal anesthesia in the treatment of elderly patients with intertrochanteric fractures in the "rapid diagnosis and treatment channel" PFNA internal fixation and to provide a clinical reference.

Materials and methods

Participants

Patients with intertrochanteric fractures who underwent PFNA internal fixation within the 'rapid diagnosis and treatment channel' at our hospital between January 2021 and December 2023, aged 60-99 years, weighing 42-81 kg, and classified as ASA II-III, were included in the study. Exclusion criteria were as follows: 1) patients with concomitant fractures or other associated injuries; 2) patients with contraindications for spinal anesthesia; 3) patients with mental disorders, poor compliance, or inability to cooperate; and 4) patients who declined participation in the clinical research.

A total of 52 eligible patients (mean age: 79.5 ± 9.5 years) were included in the study. They were randomly allocated into two groups: the observation group (26 patients) receiving pericapsular nerve block combined with spinal anesthesia, and the control group (26 patients) receiving lumbar epidural block alone (Table 1).

Treatment methods

The emergency department conducted thorough preoperative imaging examinations, including chest X-ray and CT reconstruction of the hip joint. Emergency-related blood tests and ECG examinations were also performed. Upon direct admission to the trauma ward, patients' previous medical comorbidities and examination results were considered. Based on these findings, perioperative medications, blood

Table 1. General information of the patients in the two groups.

Group	Cases	Gender		Age (years)	Weight (kg)	BMI	Height (cm)	ASA classification		Duration of operation (hours)	Surgical bleeding volume (ml)
		Male	Female					I	II		
Observation	26	10	16	71.4±28.2	62.2±10.5	22.6±4.52	168.6±9.8	15	11	30.5±12.5	100.2±20.6
Control	26	11	15	70.4±27.6	64.1±11.8	23.8±4.38	167.4±8.8	14	12	30.8±13.6	110.5± 18.4
T value / X^2		0.092	1.382	0.424	-0.364	1.028	0.822			0.524	0.686
P score		0.762	0.274	0.728	0.628	0.804	0.648			0.606	0.546

Note: American society of Anesthesiologists (ASA).

pressure adjustments, blood glucose control, and other symptomatic and supportive treatments were administered. If surgical contraindications were excluded, the patient proceeded to the operating room as quickly as possible, in line with the formulated surgical plan. Surgical treatment was initiated within 24 hours of admission to the operating room. During admission to the operating room, the patient received oxygen inhalation, and continuous monitoring included ECG, invasive arterial blood pressure after radial artery puncture, percutaneous oxygen saturation, and heart rate. All nerve block procedures were performed by the same group of experienced anesthesiologists.

Methods of anesthesia

In the Observation group, hip joint capsule nerve block was initiated after routine skin disinfection, utilizing a SonoScape ultrasound system (Shenzhen Kaili Biomedical Technology Co., Ltd.). The low-frequency ultrasound probe was positioned at the anterior inferior iliac spine, aligned with the pubic rami to identify key anatomical landmarks such as the iliopectal eminence, femoral artery, pubic muscle, and psoas major tendon. The needle was inserted from lateral to medial, and its tip was positioned on the myofascial plane between the posterior tendon of the psoas major and the dorsal rami of the pubic bone. A single injection mixture of 0.5% ropivacaine hydrochloride (Lot No. 23051852, Shijiazhuang Fourth Drug Co., Ltd., China) and 3.3 mg dexamethasone (20 mL) was administered. After the completion and evaluation of the nerve block, the affected limb was positioned laterally (with assistance from an anesthesiologist, as the patient experienced significantly less pain). Following the routine block procedure, a single dose of spinal anesthesia (L3/4, ropivacaine, Shijiazhuang Siyao Co., Ltd., China, 100 mg/10 ml) was administered. The patient was then placed in the supine position after the epidural catheter was fixed. Surgical preparation commenced upon detecting the anesthesia level. For the Control group, after patient positioning, a single session of spinal anesthesia was performed along with the placement of an epidural catheter as a precaution. At the conclusion of the surgery, patients received intravenous patient-controlled analgesia (PCIA) consisting of sufentanil 100 μg, butorphanol 5 mg, and ondansetron 8 mg, diluted to 100 mL with normal saline. The background infusion rate was set at 2 mL/h, with a patient-controlled analgesia (PCA) dose of 1.5 mL, combined with intravenous ketorolac tromethamine injection, to maintain the pain score below 4 points.

Surgical methods

The patient was positioned supine on the traction bed, with the lower limb of the healthy side flexed and abducted. Simultaneously, the affected limb was distracted and assisted in adduction and internal and external rotation. Using C-arm fluoroscopy to ensure satisfactory reduction of the fracture, a longitudinal incision was made above the greater trochanter. Subsequently, a guide wire was inserted along the direction of the medullary canal, and after reaming, the main nail was inserted. Adjusting the anteversion, a guide wire was driven into the femoral neck through the collimator. This was positioned in the middle and lower 1/3 and the center under anteroposterior and lateral fluoroscopy, respectively. A helical blade of appropriate length was driven in, followed by the insertion of the distal locking screw and the installation of the tail cap. After confirming satisfactory reduction through C-type fluoroscopy, the incision was closed.

Observation indicators

1) The mean arterial pressure (MAP) and heart rate (HR) of patients in both groups were recorded at various stages: immediately before analgesia, during positioning for combined spinal-epidural block anesthesia, 10 minutes after analgesia, at the start and end of the surgery, and 2 hours after surgery. 2) Anesthesia Visual Analog Scale (VAS) scores were recorded at specific intervals: immediately before pain, during positioning for spinal-epidural anesthesia, 10 minutes after analgesia, at the beginning and end of the surgery, 2 hours after surgery, and at 12 hours, 24 hours, 48 hours, 72 hours, and 7 days after surgery. VAS scores were assessed for patients under static and dynamic pain conditions. 3) Data at 6 hours, 12 hours, 24

Table 2. Comparison of mean arterial pressure (mmHg) between the two groups at different time points.

Group	Cases	Immediately before analgesia	When in lateral position	Operation commences	Operation ends	Post-operation 2h
Observation	26	120.6±12.8	110.5±8.9*	102.8±7.2	105.4±7.2	102.6±8.4
Control	26	118.2±14.4	132.4±7.6	104.2±6.8	104.8±6.6	103.2±5.6
T value / X^2		0.206	5.986	0.348	0.526	0.089
P score		0.902	0.001	0.824	0.956	0.726
*Note: Compared with the control group: *P<0.05.*						

Table 3. Comparison of heart rate (beats/min) between the two groups at different time points.

Group	Cases	Immediately before analgesia	When in lateral position	Operation commences	Operation ends	Post-operation 2h
Observation	26	90.6±9.8	78.6±8.2*	72.4±6.6	76.2±5.8	75.6±4.6
Control	26	89.4±8.8	102.8±10.4	73.8±9.2	78.9±6.6	76.4±8.2
T value / X^2		0.206	5.986	0.348	0.526	0.089
P score		0.782	0.001	0.068	0.437	0.364
*Note: Compared with the control group: *P<0.05.*						

Table 4. Static VAS scores of the patients in the two groups after surgery (x±s).

Group	Cases	Post-operation 12h	Post-operation 24h	Post-operation 48h	Post-operation 72h	Post-operation 7 days
Observation	26	2.2±0.4	2.8±0.6	2.2±0.2	1.6±0.4	1.2±0.3
Control	26	2.4±0.2	3.0±0.4	2.4±0.3	1.5±0.3	1.3±0.4
T value / X^2		4.026	2.036	3.086	1.088	1.076
P score		0.001	0.03	0.024	0.364	0.525

Table 5. Postoperative dynamic VAS scores of the patients in the two groups (x±s).

Group	Cases	Post-operation 12h	Post-operation 24h	Post-operation 48h	Post-operation 72h	Post-operation 7 days
Observation	26	6.2±0.2	4.2±0.2	3.2±0.3	2.0±0.2	1.4±0.2
Control	26	8.2±0.3	6.2±0.2	5.4±0.2	3.2±0.4	1.6±0.4
T value / X^2		4.026	2.036	3.086	1.088	1.076
P score		0.001	0.03	0.024	0.364	0.525

Table 6. Patients in the two groups after surgery Comparison of the cumulative dose of ketorolac tromethamine injection and the effective number of compressions with the analgesic pump (x±s).

Groups	Case	Post-operation 6h		Post-operation 12h		Post-operation 24h		Post-operation 48h	
		ADKT (mg)	NECAP (times)	ADKT (mg)	NECAP (times)	ADKT (mg)	NECAP (times)	ADKT (mg)	NECAP (times)
Observation	26	15.2±10.2	0.5±0.5	24.6±8.3	1.5±0.8	33.8±9.9	2.3±1.2	38.8±8.9	3.1±1.3
Control	26	30.9±14.3	1.3±0.9	43.8±9.7	2.6±1.3	56.5±10.8	4.1±1.5	61.2±9.8	6.5±1.6
T value / X^2	3.264	5.632	4.242	5.882	3.346	5.864	2.469	6.024	
P score	1.284	1.064	2.266	1.842	1.924	2.424	2.834	2.882	
Note: ADKT: Accumulated dosage of ketorolac tromethamine; NECAP: Number of effective compressions of analgesic pump.									

Table 7. Postoperative dynamic VAS scores of the patients in the two groups (x±s).

Groups	Cases	Satisfaction	General satisfaction	Unsatisfaction	Total satisfaction rate
Observation	26	20	5	1	96.15%
Control	26	12	8	6	76.92%

hours, and 48 hours post-surgery included the cumulative dose of ketorolac tromethamine injection and the effective number of compressions by the analgesic pump. 4) Incidence of anesthesia-related complications for patients in both groups was recorded. 5) Perioperative satisfaction levels of surgeons and patients were recorded using anesthesia satisfaction rating criteria. All data collection and processing were performed by another anesthesiologist not involved in the analgesia implementation.

Statistical analysis

SPSS 22.0 software was used for statistical analysis. The measurement data are expressed as the mean ± standard deviation (x ± s). The intergroup comparisons were performed using the two independent samples t test, and the comparisons at multiple time points were performed using repeated measures analysis of variance (ANOVA). Comparisons between groups were performed using the $\chi 2$ test. P <0.05 was considered statistically significant.

Results

General information of the patients in the two groups

The differences in sex, age, height, weight, BMI, ASA class, operative time, and intraoperative blood loss between the two groups were not statistically significant (P>0.05) (Table 1).

Comparison of hemodynamic indicators between the two groups at different time points

There were no significant differences in mean arterial pressure or heart rate between the two groups immediately before analgesia, during positioning for spinal epidural anesthesia, at the beginning and end of the surgery, or 2 hours after surgery (P > 0.05). However, at the time of treatment, the mean arterial pressure and heart rate in the observation group decreased compared to the pre-anesthesia values (P < 0.05), while in the control group, there was an increase in mean arterial pressure and heart rate compared to pre-anesthesia values (P < 0.05). The differences between the two groups were statistically significant (P < 0.05) (Tables 2 and 3).

Comparison of the VAS scores under static and dynamic conditions between the two groups at different time points after surgery

The static VAS score of the observation group at 12 h, 24 h, and 48 h after surgery was lower than that of the control group; the difference was statistically significant (P < 0.05). There was no significant difference in the static VAS score between the two groups at 72 h and 7 d after surgery (P > 0.05), as shown in Table 4. The dynamic VAS score of the observation group was lower than that of the control group at 12 h, 24 h, 48 h, and 72 h after surgery; the difference was statistically significant (P<0.05). However, the difference in the dynamic VAS score between the two groups at 7 d after surgery was not statistically significant (P>0.05), as indicated in Table 5.

Comparisons of the cumulative dosage of ketorolac tromethamine injection, the effective number of compressions of the analgesic pump, and the incidence of anesthesia-related complications between the two groups after surgery.

After surgery, the observation group exhibited significantly lower cumulative doses of ketorolac tromethamine injection and a lower effective number of compressions by the analgesic pump at 6 h, 12 h, and 24 h compared to the control group (P < 0.05). However, the difference between the two groups at 48 h after surgery was not statistically significant (P > 0.05), as presented in Table 6. No postoperative puncture site infections or nerve injuries were observed in either group of patients.

Comparison of the satisfaction degree of anesthesia between the two groups

The satisfaction degree of anesthesia in the observation group was 96.15%, which was higher than that of the control group (76.92%), and the difference was statistically significant ($\chi 2$=5.426, P=0.004<0.05), as shown in Table 7.

Discussion

The importance of the ERAS concept[11] as a "fast diagnosis and treatment channel" for elderly hip fractures has been confirmed by peer investigations[11,12]. Many hospitals have specifically established fast-track channels for elderly hip fractures. Through multidisciplinary collaboration, the

preoperative waiting time is shortened, and early surgical treatment can accelerate the recovery of patients and reduce the pain of patients[13]. Through the integration of in-hospital resources, our hospital integrated the management of pre-hospital first aid, emergency surgery and trauma surgery, from the reception of patients, the completion of various examinations, the completion of internal medicine consultation with "zero through time", and the preparation of patients for preoperative evaluation as soon as possible. Early surgical treatment, standardized and systematic treatment for elderly patients with femoral intertrochanteric fracture, has achieved good clinical efficacy.

As an intramedullary fixation system, proximal femoral nail antirotation (PFNA) improves the resistance to rotation, angular stability, and resistance to cut-out, reduces complications of long-term bed rest, and facilitates rehabilitation training[14]. Very good clinical efficacy has been achieved in improving the quality of life and reducing mortality[14]. Because elderly people have physiologically decreased heart and lung function and are often complicated with various basic diseases, such as hypertension, diabetes, and coronary heart disease, the selection of anesthesia methods for elderly patients undergoing intertrochanteric fracture surgery is very important. The induction of general anesthesia takes a relatively long time and cannot effectively suppress the body's stress response. It has a great impact on the respiratory system of elderly patients, is not conducive to the maintenance of stable vital signs of patients during surgery and is prone to increase the risk of adverse reactions. Despite these advantages, with the advent of Proximal Femur Bionic Nail (PFBN) technique, PFNA seems to have been overshadowed by PFBN with a recent piece of clinical observational study[7] supporting this. Additionally, there is evidence[15] suggesting that PFNA may have negative effects on patients with intertrochanteric fractures.

Spinal anesthesia is considered an ideal method for patients undergoing closed reduction and internal fixation of femoral fractures[16,17]. Its prolonged analgesic duration not only ensures satisfactory anesthesia effects but also enhances safety by minimizing drug usage. However, positioning the patient in the lateral position during spinal anesthesia surgery may exacerbate hip pain and elevate the stress response, potentially leading to hemodynamic fluctuations such as changes in blood pressure. This, in turn, increases the anesthesia-related risks, and in severe cases, may induce cardiovascular and cerebrovascular complications, impacting the prognosis of patients[18]. On the other hand, the fascia iliaca compartment block (FICB) can be performed with the patient in the supine position. Local anesthetic is injected through the junction of the sartorius and iliacus muscles into the fascia iliaca space. This procedure provides a simple and effective block of the femoral nerve and lateral femoral cutaneous nerve[19]. However, it's important to note that since the obturator nerve does not pass through the fascia iliaca space, there is a possibility of incomplete obturator nerve block when performing FICB[20].

In 2018, Giron-Arango[5,6] proposed a novel nerve block method: the pericapsular nerve block (PENG) of the hip joint[5,6]. This technique primarily targets the femoral nerve, obturator nerve, and accessory obturator nerve within the anterior capsule of the hip joint and its branches. It utilizes a smaller amount of anesthesia, provides rapid and effective pain relief, has a longer duration of action, and significantly reduces intraoperative movement-related pain without an increase in adverse reactions. In the observation group of this study, ultrasound-guided peripheral nerve block of the hip joint was performed before spinal anesthesia. After the onset of the effect, the patient was positioned for spinal anesthesia without experiencing significant pain, facilitating the completion of the spinal anesthesia operation.

The results of this study demonstrated that patients in the observation group who underwent PENG block exhibited lower VAS pain scores and more stable hemodynamics during positioning for spinal epidural anesthesia compared to the control group. This resulted in a reduced need for vasoactive drugs. PENG block analgesia showed a rapid onset of action, longer maintenance time, and significant reduction in intraoperative movement-related pain. This facilitated the smooth completion of surgery without an increase in adverse reactions.

Under static and dynamic conditions, the observation group experienced significantly lower pain levels at 12 hours, 24 hours, and 48 hours after surgery compared to the control group. This suggests that PENG block not only reduces pain during the combined spinal-epidural anesthesia operation but also provides continuous postoperative analgesia, contributing to a better surgical experience and enhanced rehabilitation.

Postoperatively, the observation group had significantly lower cumulative doses of ketorolac tromethamine injection and a reduced number of compressions on the analgesic pump at 6 hours, 12 hours, and 24 hours compared to the control group. This decreased use of intensive analgesics in the observation group effectively improved patient acceptance and satisfaction. Therefore, PENG block proves to be a favorable anesthesia method for elderly patients undergoing intertrochanteric fracture surgery.

In conclusion, for the treatment of elderly patients with intertrochanteric fractures within the 'rapid diagnosis and treatment channel,' ultrasound-guided pericapsular nerve block combined with spinal epidural anesthesia of the hip joint proves to be an easily performable technique. It effectively reduces pain during patient positioning under spinal anesthesia and ensures stable vital signs throughout the perioperative period. The postoperative analgesic effect is long-lasting, and the satisfaction level is high. This approach merits consideration for wider implementation in clinical practice. It's important to note that pericapsular nerve block (PENG) is a relatively new method. While the cases in this study show promising results, further investigation with a larger sample size is necessary to observe and validate its clinical efficacy thoroughly.

Ethics approval

This study was approved by the Medical Ethics Committee of Dongying People's Hospital (approval number: DYYY-2024-002).

Consent to participate

All individual participants or their authorized representatives provided written informed consent for inclusion in the study.

References

1. Parikh K, Kandemir U, Agarwal A. Intertrochanteric Hip Fractures: Pearls and Pitfalls in Managing Difficult Fractures. Instr Course Lect 2023;72:375-387.
2. Tang Y, Wang D, Wang L, et al. The PFNA in treatment of intertrochanteric fractures with or without lateral wall fracture in elderly patients: a retrospective cohort study. Eur J Med Res 2023;28(1):380.
3. Ren J, Wang L, Sun X. The effect of propofol combined with sufentanil on anesthetic effect, cognitive function, and hemodynamics in patients undergoing intertrochanteric fracture surgery evaluated by propensity score matching. Am J Transl Res 2023;15(5):3607-3615
4. Salottolo K, Meinig R, Fine L, et al. A multi-institutional prospective observational study to evaluate fascia iliaca compartment block (FICB) for preventing delirium in adults with hip fracture. Trauma Surg Acute Care Open 2022;7(1):e000904.
5. Giron-Arango L, Peng PWH, Chin KJ, Brull R, Perlas A. Pericapsular Nerve Group (PENG) Block for Hip Fracture. Reg Anesth Pain Med 2018;43(8):859-863.
6. Giron Arango L, Peng P. Reply to Dr Yu, et al. Inadvertent quadriceps weakness following the pericapsular nerve group (PENG) block. Reg Anesth Pain Med 2019; 44(5):613-614.
7. Wang Y, Chen W, Zhang L, et al. Finite Element Analysis of Proximal Femur Bionic Nail (PFBN) Compared with Proximal Femoral Nail Antirotation and InterTan in Treatment of Intertrochanteric Fractures. Orthop Surg 2022;14(9):2245-2255.
8. Xie Y, Zhou H. Primary cemented hemiarthroplasty for unstable intertrochanteric fractures in elderly severe osteoporotic patients. Injury 2020;51(3):670-673.
9. Zhu W, Yan Y, Sun Y, et al. Implementation of Enhanced Recovery After Surgery (ERAS) protocol for elderly patients receiving surgery for intertrochanteric fracture: a propensity score-matched analysis. J Orthop Surg Res 2021;16(1):469.
10. Yin M, Yan Y, Fan Z, et al. The efficacy of Enhanced Recovery after Surgery (ERAS) for elderly patients with intertrochanteric fractures who received surgery: study protocol for a randomized, blinded, controlled trial. J Orthop Surg Res 2020;15(1):91.
11. Sameer M, Muthu S, Vijayakumar PC. Enhanced Recovery After Surgery (ERAS) Protocol in Geriatric Hip Fractures: An Observational Study. Cureus 2023;15(7):e42073.
12. Li J, Zhao F, Gao J, et al. Enhanced recovery after surgery (ERAS) protocol in geriatric patients underwent unicompartmental knee arthroplasty: A retrospective cohort study. Medicine (Baltimore) 2023; 102(6):e32941.
13. Lan P, Zhang M, Liu H, Deng F, Zhang J. [Effect of enhanced recovery after surgery on postoperative function and pain in total hip arthroplasty patients with high comorbidity]. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2023;37(9):1081-1085.
14. Sahin EK, Imerci A, Kinik H, et al. Comparison of proximal femoral nail antirotation (PFNA) with AO dynamic condylar screws (DCS) for the treatment for unstable peritrochanteric femoral fractures. Eur J Orthop Surg Traumatol 2014;24(3):347-352.
15. Chang HM, Lu WY, Kuan FC, et al. Wound drainage after proximal femoral nail antirotation (PFNA) fixation may negatively affect the patients with intertrochanteric fractures: A prospective randomized controlled trial. Injury 2021;52(3):575-581.
16. Stengel D, Spranger N, Wirth S, Schmittner M. [Spinal anesthesia vs. general anesthesia for surgical stabilization of proximal femoral fractures : The REGAIN trial in context]. Unfallchirurg 2022;125(4):336-338.
17. Lee KH, Lee SJ, Park JH, et al. Analgesia for spinal anesthesia positioning in elderly patients with proximal femoral fractures: Dexmedetomidine-ketamine versus dexmedetomidine-fentanyl. Medicine (Baltimore) 2020; 99(20):e20001.
18. Xie PC, Zhang NN, Wu YM, Li ZF, Yang JL. Comparison between ultrasound-guided paravertebral nerve block and subarachnoid block for elderly male patients under unilateral-opened inguinal hernia repair operation: A randomised controlled trial. Int J Surg 2019;68:35-39.
19. Vermeylen K, Desmet M, Leunen I, et al. Supra-inguinal injection for fascia iliaca compartment block results in more consistent spread towards the lumbar plexus than an infra-inguinal injection: a volunteer study. Reg Anesth Pain Med 2019.
20. Bendtsen TF, Pedersen EM, Moriggl B, et al. Anatomical considerations for obturator nerve block with fascia iliaca compartment block. Reg Anesth Pain Med 2021; 46(9):806-812.