

## Original Article

# Comparative analysis of analgesic effect of iliac fascial block with vertical and horizontal inguinal approach for total hip arthroplasty

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**Abstract:** Objective: To compare and analyze the analgesic effect of iliac fascial block with vertical and horizontal inguinal approach after total hip arthroplasty. Methods: 78 patients who admitted to our hospital and underwent unilateral total hip replacement from January 2019 to June 2020 were enrolled and randomly divided into Group A (n=40) and Group B (n=38). 30 min before surgery, the group A received ultrasound-guided iliac fascial block by vertical inguinal approach, and group B underwent ultrasound-guided iliac fascial block with horizontal inguinal approach. Both groups received patient-controlled intravenous analgesia (PCA) postoperatively. Subsequently, the postoperative VAS scores, the cumulative postoperative PCA dosage of Sufentanil, the occurrence of postoperative adverse reactions, and the overall satisfaction scores of patients with anesthesia 24 h after surgery were compared accordingly. Results: The VAS score of Group A at 4 h, 8 h, 12 h, 24 h after surgery was remarkably lower than that of Group-B ( $P<0.05$ ). The cumulative Sufentanil dosage of PCA in Group A was substantially less than that in Group B ( $P<0.05$ ). The incidence of adverse reactions between the two groups of patients was statistically insignificant ( $P>0.05$ ). The satisfaction degree with anesthesia 24 h after surgery in Group A was notably higher than that in Group B ( $P<0.05$ ). Conclusion: Compared with the horizontal inguinal approach, patients received iliac fascial block by vertical inguinal approach can achieve better postoperative analgesic effect for hip replacement. It helps to reduce Sufentanil dosage and improve the patient's satisfaction with analgesia, and thus safe for clinical application.

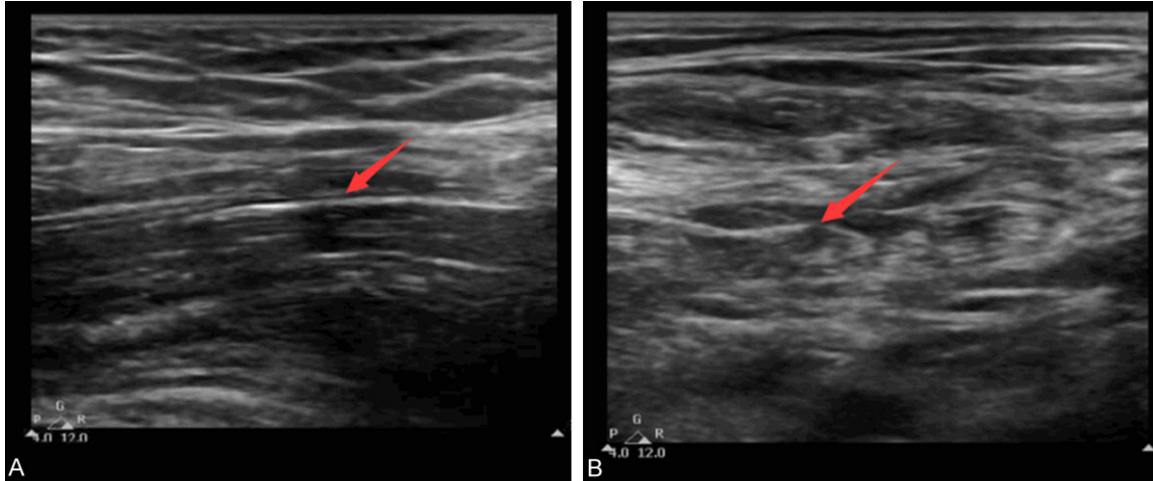
**Keywords:** Vertical inguinal approach, horizontal inguinal approach, iliac fascia block, total hip replacement, post-operative analgesia

## Introduction

Total hip replacement is usually performed in elderly patients. Most patients are complicated with cardiovascular and cerebrovascular diseases, and the postoperative pain caused by the surgical trauma will cause adverse cardiac events, and affect the postoperative functional exercise of patients [1, 2]. In recent years, ultrasound-guided nerve block has been widely applied in anesthesia and analgesia. This application can reduce patients' postoperative pain, reduce the dosage of opioids, increase patients' satisfaction and promote their postoperative recovery. Therefore, the pain block for total hip arthroplasty is of great significance to improve the clinical prognosis of patients. Iliac fascia block is one of the ef-

fective ways of postoperative analgesia in patients with total hip arthroplasty, which can effectually relieve the postoperative pain [3]. In addition, with the development of ultrasound technology in recent years, the application of ultrasound in clinical anesthesia has resulted in a higher success rate of Iliac fascia block. However, analgesic effect under traditional approach still has some deficiency [4, 5]. Some scholars have explored and analyzed the ultrasound-guided vertical inguinal approach for iliac fascial block, which achieved good results [6, 7]. This study aimed to further analyze the influence of different approaches on iliac fascia block, and to investigate the analgesic effect of iliac fascia block with vertical and horizontal inguinal approach for total hip arthroplasty.

## Analgesic effect of different approaches of iliac fascia block



**Figure 1.** Vertical and horizontal inguinal approach of ultrasound-guided iliac fascia block. A: Group A; B: Group B. (The arrow shows the location of the iliac fascia block).

### Materials and methods

#### Research objects

During January 2019 to June 2020, 78 patients underwent unilateral total hip replacement in our hospital were enrolled and randomly divided into Group A (n=40) and Group B (n=38). The study was carried out after the approval of the ethics committee of our hospital.

#### Inclusive and exclusive criteria

Inclusive criteria: (1) Patients who received unilateral total hip arthroplasty; (2) Patients with classification of grade II-III by the American Society of Anesthesiologists (ASA); (3) Age  $\geq 60$  years old; (4) The patients voluntarily signed the informed consent forms.

Exclusive criteria: (1) Patients with dysfunction of coagulation; (2) Patients with diabetes and peripheral neuropathy; (3) Patients experienced with mental illness; (4) Patients with malignant tumors; or (5) Patients with systemic and infectious diseases.

#### Methods

30 min before surgery, the patient was placed in supine position, with lower limbs abducted and externally rotated by  $15^\circ$ . Guided by a two-dimensional ultrasound system and a high-frequency probe, the Group A underwent iliac fascial block with vertical inguinal approach, and Group B received iliac fascia block with hori-

zontal inguinal approach. Both groups received 30 ml of 0.25% ropivacaine.

For patients in Group A: We placed the probe, which 2 cm below the outer 1/3 of the inguinal ligament, and in the parasagittal position, to observe the morphology and deformation of the iliopsoas muscle. The 22 G puncture needle was inserted at a level of  $30^\circ$  inward, upward and backward with the skin along the ultrasound imaging plane, and its tip reached the surface of iliopsoas muscle to iliopsoas lance. After withdrawing without gas or blood, we injected 2 ml of saline and observed the expansion status. If the normal saline was in good diffusion, 30 ml of 0.25% ropivacaine would be injected to expand the space around the iliac fascia through “water separation” technique. Subsequently, we rotated the probe to the lateral position, and observed the diffusion of the patient’s local anesthetic. According to ultrasound imaging, the fluid was distributed in the lateral iliac fascia space and diffused towards the anterior, and a small amount of which diffused around the femoral nerve inwardly (**Figure 1A**).

For patients in Group B: We placed the ultrasonic probe 2 cm below the midpoint of the inguinal ligament horizontally to observe the iliopubic arch fascia. According to the ultrasonic display, the femoral nerve with deep hyperechoic triangular structure could be seen. We applied the in-plane technique to insert the puncture needle along the ultrasound beam at

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**Table 1.** Comparison of clinical data between the two groups

Clinical data	Group A (n=40)	Group B (n=38)	t/ $\chi^2$	P
Gender				
Male	22	23	0.244	0.622
Female	18	15		
Age (years old, $\bar{x} \pm s$ )	69.72 $\pm$ 5.64	68.94 $\pm$ 6.33	0.575	0.567
BMI (kg/m <sup>2</sup> , $\bar{x} \pm s$ )	23.16 $\pm$ 4.39	23.31 $\pm$ 3.78	0.161	0.872
Operation time (min, $\bar{x} \pm s$ )	145.27 $\pm$ 46.57	150.22 $\pm$ 40.86	0.498	0.620
ASA Grading				
Grade II	29	30	0.440	0.507
Grade III	11	8		

30° from the skin to the lateral femoral nerve below the iliac fascia. After withdrawing without gas or blood, 2 ml saline was injected to observe the expansion status. If the fluid was in normal diffusion, 30 ml of 0.25% ropivacaine would be injected slowly (**Figure 1B**).

Intravenous inhalation combined with general anesthesia was performed during the surgery. The anesthesia induction was formulated by 0.05 mg/kg midazolam, 0.7  $\mu$ g/kg Sufentanil, 0.1 mg/kg vecuronium, and 2 mg/kg propofol; The maintenance of anesthesia was carried as follows: patient was inhaled with 2-3% sevoflurane and received intermittent intravenous injection of vecuronium and sufentanil as required, with the total amount of Sufentanil approximately 1  $\mu$ g/kg; 5 mg Tropisetron was routinely applied to prevent nausea and emesis before patient resuscitated. Patients were treated with intravenous controlled analgesia (PCA) after surgery: 2  $\mu$ g/kg Sufentanil was added with normal saline to 100 ml; the background dose-rate was at 2 ml/h, the time was locked by 15 min, and each single shot was set by 0.5 ml for compression.

### Observation of indexes

(1) The postoperative pain degree at 4 h, 8 h, 12 h, 24 h and 36 h were compared for the two groups of patients by Visual Analogue Scale (VAS). The score was ranged between 0-10 points, with 0 referred to no pain and 10 referred to severe pain. (2) The cumulative dosage of Sufentanil in PCA was compared between the two groups. (3) The occurrence of adverse reactions, including nausea, emesis, pruritus, hypotension (systolic pressure <90 mmHg), and hypoxia (blood oxygen saturation

<90%), were observed and compared between the two groups. (4) The overall sfaction score of anesthesia 24 h after operation was compared between the two groups. The score was from 0-3 points, with 0 was very dissatisfied, 1 represented basically satisfied, 2 represented satisfied, and 3 referred to very satisfied.

### Statistical analysis

We used Statistical software SPSS 22.0 for data processing and analysis. The comparison of measurement data was performed by *t*-test, and the comparison of enumeration data was performed by  $\chi^2$  test. The difference was considered as statistically significant if *P*<0.05.

## Results

### Clinical material

The comparison of gender, age, BMI, operation time and ASA grading between the two groups of patients was conducted, and the difference was statistically insignificant (*P*>0.05) (**Table 1**).

### Comparison of postoperative VAS scores between the two groups

The VAS score of Group A at 4 h, 8 h, 12 h, 24 h after surgery was remarkably lower than that of Group-B (*P*<0.05), and the difference in VAS scores between the two groups of patients 36 h after surgery was no statistically significant (*P*>0.05) (**Table 2; Figure 2**).

### Comparison of cumulative Sufentanil dosage of PCA between the two groups

The cumulative Sufentanil dosage of PCA in Group A was substantially less than that in Group B (*P*<0.05) [(53.13 $\pm$ 5.29)  $\mu$ g vs. (56.27 $\pm$ 6.12)  $\mu$ g] (**Table 3**).

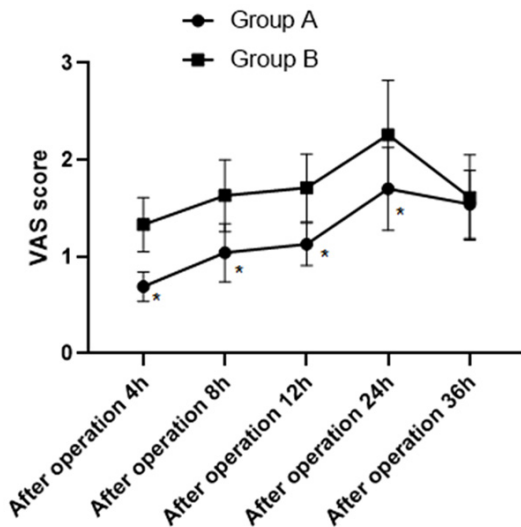
### Comparison of postoperative adverse reactions between the two groups

The incidence of postoperative adverse reaction was 25.00% in Group A and 26.32% in Group B. There was no significant difference in the incidence of postoperative adverse reac-

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**Table 2.** Comparison of postoperative VAS scores between the two groups (points,  $\bar{x} \pm s$ )

Group	Number of cases	4 h postoperatively	8 h postoperatively	12 h postoperatively	24 h postoperatively	36 h postoperatively
Group-A	40	0.69±0.15	1.04±0.30	1.13±0.22	1.77±0.43	1.54±0.35
Group-B	38	1.33±0.28	1.63±0.37	1.71±0.35	2.26±0.56	1.61±0.44
t	-	12.671	7.745	8.809	4.347	0.780
P	-	0.000	0.000	0.000	0.000	0.438



**Figure 2.** Postoperative VAS scores between the two groups.

tions between the two groups ( $P > 0.05$ ) (Table 4).

*The overall satisfaction score of patients with anesthesia 24 h after surgery*

The satisfaction degree with anesthesia 24 h after surgery in Group A was notably higher than that in Group B [(2.84±0.42) vs. (2.41±0.39)] ( $P < 0.05$ ) (Table 5).

### Discussion

For the elderly patients, the severe postoperative pain after total hip replacement often leads to delays in their rehabilitation activities and causes contractures and adhesions around the hip joint, which seriously affects the surgery effect. Furthermore, for parts of patients who complicated with basic diseases, may lead to multiple complications such as heart, brain and lung [8, 9]. The improvement of perioperative pain management in elderly patients with total hip replacement can effectively promote their rapid recovery. Peripheral nerve tissue, as an

important component of multi-mode analgesia, has achieved good results in perioperative analgesia of total hip replacement by combining with intravenous patient-controlled analgesia [10, 11]. The innervation of the hip joint is complex, with sensory nerves coming from the femoral and obturator nerves in the front and the superior gluteal nerves and part of the sciatic nerves in the rear. For complete hip analgesia, the application of large doses of local anesthetics were needed to block all lumbosacral plexus nerves, which increases the risk of local anesthetic intoxication and puncture injury [12, 13]. Ultrasound-guided iliac fascia block is a new analgesia commonly used in recent years. This method can provide analgesia in the anterior and lateral areas of the thigh, and has received certain effects on the pain caused by acetabular formation and osteotomy [14, 15].

Anatomically, the potential space between the iliac fascia and the iliopsoas muscles is called the iliac fascia chamber, which runs along the lateral femoral cutaneous nerve, femoral nerve, and obturator nerve [16]. Compared with femoral nerve block, the Iliac fascial block is more superior for blocking the lateral femoral cutaneous nerves. However, the traditional horizontal approach is limited due to the direction and volume of injection. Most drugs usually diffuse to the medial side to block the femoral nerve, while less spread to the proximal end of the lumbar plexus, resulting in insufficiency of analgesia in hip surgery [17, 18]. Since the incision is often located behind the lateral thigh, the complete block of the lateral femoral nerve plays a vital role in alleviating the postoperative pain of patient; The lateral femoral cutaneous nerve descends from the medial inguinal ligament of the anterior superior iliac spine to the anterolateral thigh, and there is a great variant in the course of nerve. As some patients may have premature branches, the injection in the horizontal direction of groin may cause incomplete block of the mutated branches and thus influencing the blocking effect [19, 20]. Scho-

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**Table 3.** The cumulative Sufentanil dosage of PCA between the two groups ( $\mu\text{g}$ ,  $\bar{x}\pm s$ )

Group	Number of cases	Cumulative dosage of Sufentanil in PCA	t	P
Group-A	40	53.13 $\pm$ 5.29	2.428	0.018
Group-B	38	56.27 $\pm$ 6.12		

**Table 4.** Comparison of the postoperative adverse reactions between the two groups [n (%)]

Group	Number of cases	Nausea	Emesia	Pruritus	Hypotension	Hypooxia	Total
Group-A	40	5	3	2	0	0	10 (25.00)
Group-B	38	7	1	2	0	0	10 (26.32)
$\chi^2$	-	-	-	-	-	-	0.018
P	-	-	-	-	-	-	0.894

**Table 5.** The overall satisfaction score of the two groups of patients with anesthesia 24 h after surgery (points,  $\bar{x}\pm s$ )

Group	Number of cases	Overall satisfaction score of patients with anesthesia	t	P
Group-A	40	2.84 $\pm$ 0.42	4.679	0.000
Group-B	38	2.41 $\pm$ 0.39		

lars in recent years reported that as the new approach, iliac fascial block with vertical inguinal approach can fully anesthetize the lateral femoral cutaneous nerve and its branches, and remarkably reduce the dosage of opioids in total hip replacement [21, 22].

In this study, we compared and analyzed the analgesic effect of iliac fascial block under vertical and horizontal inguinal approaches in total hip arthroplasty. The results showed that the VAS score of Group A at 4 h, 8 h, 12 h, 24 h after surgery was remarkably lower than that of Group-B, the cumulative Sufentanil dosage of PCA in Group A was substantially less than that in Group B, and the satisfaction degree with anesthesia 24 h after surgery in Group A was notably higher than that in Group B. The results, which consisted with those of scholars' [23-26], suggested that the application of improved vertical inguinal approach for iliac fascial block can achieve more ideal postoperative analgesic effect. It is conducive to reduce Sufentanil analgesic drugs at the same time, and improve the patients' satisfaction with analgesia. Besides, there was insignificant difference in the incidence of postoperative adverse reactions between the two groups, and indifference in the incidence of adverse reactions between the two groups of patients when low-dose Sufentanil was used as a drug for intravenous analgesia. Therefore, we con-

sidered the multi-mode analgesia has high safety.

However, as the sample size included in this study was limited, the results may have certain deviation. In addition, although good analgesic effect has achieved in the study by 30 ml

local anesthetic drug applied, the optimal volume of the local anesthetic remains to be further explored.

In conclusion, compared with the horizontal inguinal approach, the iliac fascial block with vertical inguinal approach can achieve better postoperative analgesic effect after hip replacement. It helps to reduce the dosage of Sufentanil and improve the patient's satisfaction with analgesia, which is safe and worthy of clinical promotion.

### Disclosure of conflict of interest

None.

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