

Fascia iliaca compartment block versus no block for pain control after lower limb surgery: a meta-analysis

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Background: The analgesic effect of fascia iliaca compartment block (FICB) versus no block (NB) after lower limb surgery (LLS) is still controversial, so we performed this meta-analysis.

Materials and methods: By searching the PubMed, Embase and the Cochrane Library (last update by July 20, 2017), randomized controlled trials comparing the analgesic effect of FICB versus NB in patients receiving LLS were identified. The primary outcome was the pain scores at 4, 12, and 24 h after LLS. The dosage of morphine at 24 h was also collected. The side effect of anesthesia was assessed according to the occurrence rate of postoperative nausea and vomiting.

Results: Data from 7 clinical trials that included 508 patients were summarized. The results showed that patients receiving FICB had lower pain scores at 4 h (mean difference [MD]=−1.17; 95% CI=−2.30 to −0.05; $P=0.041$), 12 h (MD=−0.41; 95% CI=−0.76 to −0.05; $P=0.026$) and 24 h (MD=−0.96; 95% CI=−1.77 to −0.15; $P=0.020$) after LLS. Besides, FICB could reduce the dosage of morphine at 24 h (MD=−2.06; 95% CI=−3.82 to −0.30; $P=0.022$) and the incidence of postoperative nausea and vomiting (relative risk rate=0.44, 95% CI=0.24–0.80, $P=0.008$).

Conclusion: Compared with NB, FICB is an effective and safe method for alleviating the pain after LLS. More high-quality randomized controlled trials are needed to confirm this finding.

Keywords: fascia iliaca compartment block, lower limb surgery, meta-analysis, RCTs

Introduction

Lower limb surgery (LLS), especially in the region of medial thigh, and front and lateral and knee, is usually performed to relieve joint pain, correct deformity, and improve motor function of the joint.¹ For patient to receive LLS, postoperative pain is the first symptom. Due to the physical symptoms and psychological pressure, patients focus on pain, which aggravates the degree of pain. Severe pain after LLS can affect a patient's mood and result in failure to complete the postoperative exercise, which may limit functional recovery.² Some studies have revealed that the fascia iliaca compartment block (FICB) could provide an analgesic effect in patients with femur fractures.^{3–5} They concluded that the FICB is an effective and easily learned procedure to decrease postoperative pain score and dosage of opioid.

FICB is a peripheral nerve block, which has become an important part of post-operative multimodal analgesic strategies. FICB was first reported by Dalens et al.⁶ As an alternative to the 3-in-1 nerve block, it is now one of the major methods of lower limb nerve block and is widely used in postoperative analgesia in patients after LLS.⁶ More specifically, the femoral, lateral femoral cutaneous, and obturator nerves of the thigh are blocked by local anesthetic (LA) injected under the fascia of iliacus

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muscle (Figure 1).^{6–8} The pain block can persist up to 24 h.^{9,10} However, the pop technique using fascial click had a low success rate of 35%–47%.¹¹ When FICB was performed under real-time ultrasound guidance, the success rate increased to 82%–87%, which led to an increased interest in FICB as a postoperative analgesia option for hip and knee surgeries.¹²

However, some studies have showed that FICB is inefficient in reducing pain scores and dosage of opioid in patients after hip arthroplasty.¹³ Therefore, it is necessary to conduct a meta-analysis to evaluate the efficacy and safety of FICB in alleviating pain after LLS, which is helpful for postoperative rehabilitation.

Materials and methods

This meta-analysis was carried out in accordance with the Systematic Reviews and Meta-Analyses (PRISMA) guidelines¹⁴ and the Observational Studies in Epidemiology (MOOSE) guidelines.¹⁵ The data included in our study did not require informed patient consent, and our study was approved by the Ethical Committee and Institutional Review Board of Soochow University.

Search strategy

Literature was searched through PubMed, Embase and the Cochrane Library (last update on July 20, 2017). Keywords used in the search strategy were “fascia iliaca OR fascia iliaca compartment block” (all fields) AND “randomized OR randomised” (all fields) AND “surgery” (all fields). The language was limited to English only. We did not impose any advanced limitations in the database searching process. Besides title, abstract and full text, all the reference lists of identified articles were also screened to further identify

potential studies. The comprehensive database search and availability evaluation were carried out independently by 2 authors (LY and ML). Disagreement from 2 reviewers was resolved via a third reviewer.

Inclusion and exclusion criteria

To be eligible for inclusion in this meta-analysis, literature was required to meet the following criteria: 1) randomized controlled trials (RCTs) comparing methods of nerve block in patients undergoing LLS; 2) FICB versus no block (NB); and 3) the primary outcome measure was postoperative pain scores. The exclusion criteria were as follows: 1) when multiple studies were targeted at the same patient cohort, only the most recent or complete study was selected; 2) case reports, letters, reviews, conference abstracts and animal trials were excluded; 3) studies without comparable groups; and 4) data couldn't be extracted.

Data extraction and quality assessment

The required parameters from all eligible studies were collected by 2 researchers independently, which included first author's surname, publication year, country, study characteristics (number of patients and percent of female patients), and participant characteristics (i.e., mean age, body mass index, technique of FICB, complication of FICB, nature of study, type of standard care, operative type, and LA). The main outcome was the postoperative pain score. If additional information and original data were needed for the meta-analysis, we sent e-mail to the corresponding authors of eligible articles. Data in other forms (i.e., median, interquartile range, and mean \pm 95% CI) were converted to mean \pm SD, as described in the Cochrane handbook.¹⁶ If the data were not reported

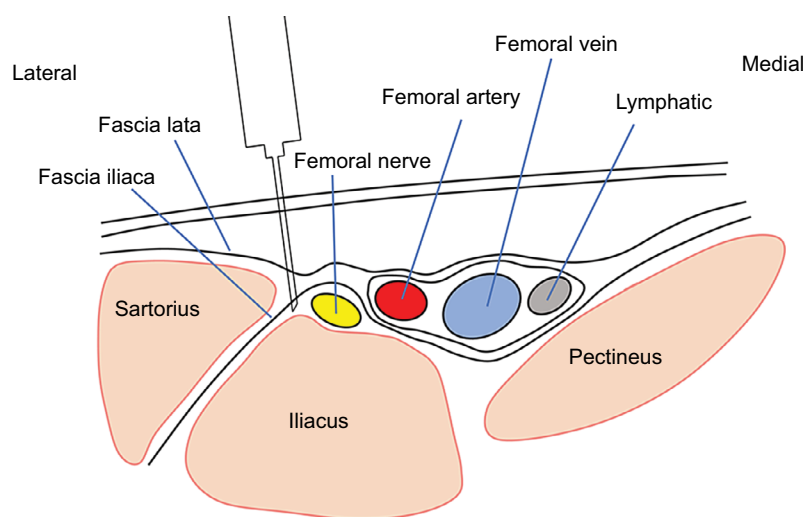


Figure 1 Anatomy of the fascia iliaca compartment block.

numerically, we extracted them from the published figures using the “Get Data Graph Digitizer” software.¹⁷

The quality of individual studies was evaluated using the Downs and Black quality assessment method, which is a list of 27 criteria to evaluate both randomized and nonrandomized trials.¹⁸ This quality assessment scale (QAS) assesses study reporting, external validity, and internal validity (i.e., bias and confounding), and has been ranked in the top 6 QAS’ suitable for use in systematic reviews.^{19,20} As has been done in other reviews using the Downs and Black scale,^{21,22} the tool was modified slightly for use in this review. Specifically, the scoring for question 27 dealing with statistical power was simplified to a choice of awarding either 1 or 0 point depending on whether there was sufficient power to detect a clinically important effect. Downs and Black score ranges were grouped into the following 4 quality levels: excellent (26–28), good (20–25), fair (15–19), and poor (<14).

Two reviewers (LY and ML) independently assessed the quality of the included studies. A consensus method was used to resolve disagreement.

Statistical analysis

Continuous outcomes, such as the postoperative pain scores at 4, 12, and 24 h, dosage of morphine at 24 h, and surgery time, were expressed as the mean difference (MD) with the respective 95% CIs. Discontinuous outcome (the rate of postoperative nausea and vomiting [PONV]) was expressed as the relative risk (RR) with 95% CIs. Statistical heterogeneity was assessed by visual inspection of forest plots, by performing the Chi-square test (assessing the *P*-value), and by calculating the *I*² statistic.^{23,24} If the *P*-value was <0.05 and/or *I*² exceeded 50%, indicating the presence of heterogeneity, a random-effects model (the DerSimonian–Laird method) was used. Otherwise, the fixed-effects model (the Mantel–Haenszel method) was used. Publication bias was estimated using Egger’s and Begg’s tests. If publication bias was observed, we adjusted for the effect by using the Duval and Tweedie trim-and-fill method.²⁵ Sensitivity analysis was conducted to further identify potential sources of heterogeneity. For all analyses, STATA version 12.0 (Stata Corporation, College Station, TX, USA) was used with significance defined as a *P*-value <0.05 except where otherwise specified.

Results

Study characteristics

A total of 60 studies were initially enrolled based on the search strategy. After viewing the contents of each article, 15 studies compared the effects of different types of nerve

blocks. Among these, 8 articles that only compared FICB with other types of nerve blocks were excluded. Finally, 7 articles were found eligible for review (Figure 2).^{4,13,26,27,29–31}

Of the 7 articles, 1 study each was carried out in Australia,¹³ China,²⁶ Thailand,²⁷ Korea,²⁹ Belgium,³⁰ Greece,³¹ and Ethiopia.⁴ Our present study involved 252 cases with FICB and 256 cases with NB. These studies were all prospective. According to the type of probe, that is, parallel to the inguinal ligament or perpendicular to the inguinal ligament, the FICB technique was categorized into 2 classes: the parallel approach and the perpendicular approach. Four studies used the parallel approach, whereas other studies used the perpendicular approach. The types of LA administered in these studies was either bupivacaine (*n*=4) or ropivacaine (*n*=3). The volumes of the mixture could be divided into 3 categories: 40 mL (*n*=4), 30 mL (*n*=2), and weight related (*n*=1). The major characteristics of the eligible publications are reported in Table 1.

Quality assessment

The mean score of QAS for the 7 studies was 20.9. Among them, 3 studies were ranked “fair” and 4 were ranked “good”. The insufficient clinical outcomes is the main item limiting the quality. Because none of the studies was ranked “poor”, all the studies were enrolled in the subsequent analysis.

Pain score at 4, 12, and 24 h after surgery

The results of subgroup analysis are shown in Table 2. The pooled analysis of 4 trials, which included 217 patients, showed that the patients receiving FICB had a lower pain score at 4 h after surgery (MD=−1.17; 95% CI=−2.30 to −0.05; *P*=0.041, Figure 3) with an obvious heterogeneity (*P*=0.000, *I*²=92.3%). The pooled analysis of 5 trials, which included 359 patients, showed that patients receiving FICB

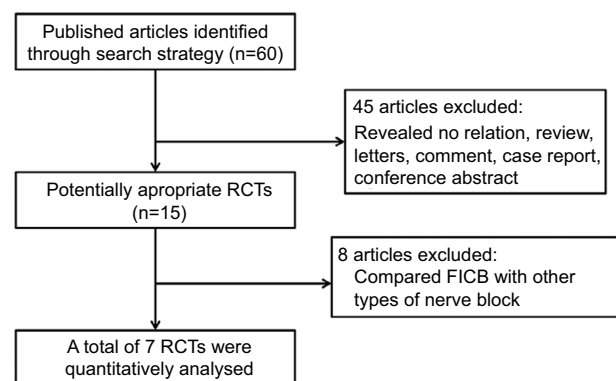


Figure 2 Flow diagram of the study selection process.

Abbreviations: FICB, fascia iliaca compartment block; RCTs, randomized controlled trials.

Table 1 The general characteristic of the included studies

Author and year	Country	No of patients (FICB:NB)	Gender male/female	Age (mean, FICB:NB)	BMI (mean, FICB:NB)	Technique	Complication	Nature of study	Surgery type	Standard care	FICB	Quality assessment score
Stevens et al ¹³ 2007	Australia	22/22	26/18	66.8/68.7	NS	Parallel	NS	Prospective	Total hip arthroplasty	Intravenous morphine	30 mL of 0.5% bupivacaine with 1:200,000 adrenaline, 150 µg clonidine and 9 mL of 0.9% saline (total volume 40 mL)	22, Good
Wang et al ²⁶ 2011	China	32/32	NS	4.9/4.4	NS	Parallel	None	Prospective	Development dislocation of the hip	General anesthesia	Ropivacaine 0.2%, 1 mL/kg, max 30 mL	19, Fair
Wongswadiwat et al ²⁷ 2012	Thailand	23/24	45/2	30/27	24/23	Perpendicular	None	Prospective	Arthroscopic anterior cruciate ligament reconstruction	Subarachnoid block	40 mL of 0.25% bupivacaine with adrenaline 1:200,000	18, Fair
Bang et al ²⁹ 2016	Korea	10/11	11/10	14/7	21/23	Parallel	None	Prospective	Femur fractures	Spinal anesthesia	40 mL of ropivacaine 0.2% with epinephrine 5 µg/mL	18, Fair
Desmet et al ³⁰ 2017	Belgium	43/42	52/33	60.4/66.5	27/27	Perpendicular	NS	Prospective	Total hip arthroplasty	General anesthesia	40 mL ropivacaine 0.5%	24, Good
Mouzopoulos et al ³¹ 2009	Greece	102/105	154/53	72.3/73.1	NS	Perpendicular	Hematoma (2.9%)	Prospective	Hip fracture	Epidural anesthesia	0.25 mg dose of 0.3 mL/kg bupivacaine	22, Good
Kurmie et al ⁴ 2015	Ethiopia	20/20	34/6	28/29	20/19	Parallel	None	Prospective	Femur fractures	Spinal anesthesia	30 mL of 0.25% bupivacaine	23, Good

Abbreviations: BMI, body mass index; FICB, fascia iliaca compartment block; NB, no block; NS, not stated.

Table 2 Pooled results according to subgroup analysis

Variables	Studies (n)	Patients (n)	P-value	Incidence			Egger's test	Begg's test
				MD or RR (95% CI)	Heterogeneity P-value (I_2)	Model		
Pain score								
4 h	4	217	0.041	-1.17 (-2.30 to -0.05)	0.000 (92.3)	Random	0.487	0.734
12 h	5	359	0.026	-0.41 (-0.76 to -0.05)	0.078 (52.5)	Random	0.404	0.806
24 h	6	301	0.020	-0.96 (-1.77 to -0.15)	0.000 (90.1)	Random	0.701	0.452
Morphine consumption	3	176	0.022	-2.06 (-3.82 to -0.30)	0.000 (95.3)	Random	0.093	1.000
PONV	5	261	0.008	0.44 (0.24 to 0.80)	0.538 (0)	Fixed	0.976	0.806

Abbreviations: MD, mean difference; PONV, postoperative nausea and vomiting; RR, relative risk.

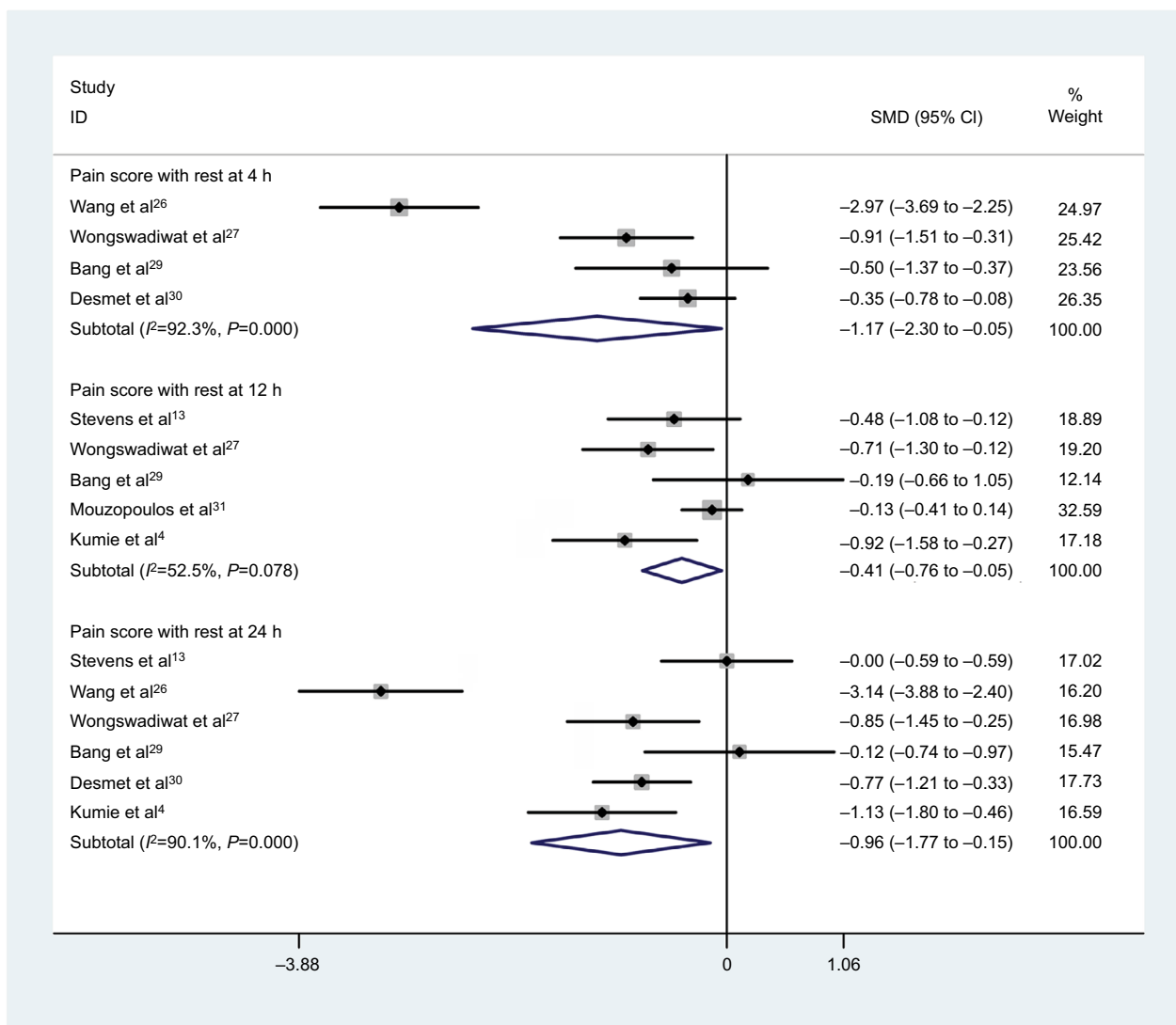


Figure 3 Forest plots of studies comparing FICB and NB for pain score after LLS.

Note: Weights are from random effects analysis.

Abbreviations: FICB, fascia iliaca compartment block; LLS, lower limb surgery; NB, no block; SMD, standard mean difference.

had a lower pain score at 12 h after surgery (MD=-0.41; 95% CI=-0.76 to -0.05; $P=0.026$, Figure 3) with no heterogeneity ($P=0.078$, $I^2=52.5\%$). Besides, the pooled analysis of 6 trials, which included 301 patients, showed that patients receiving FICB had a lower pain score at 24 h after surgery (MD=-0.96; 95% CI=-1.77 to -0.15; $P=0.020$, Figure 3) with a significant heterogeneity ($P=0.000$, $I^2=90.1\%$).

The publication bias was not found in this study because the P -values of Egger's and Begg's tests were all greater than 0.05 (Table 2). Because of the significant heterogeneity among the studies, we performed a sensitivity analysis and the result pattern was not obviously impacted by any single study (Figure 4).

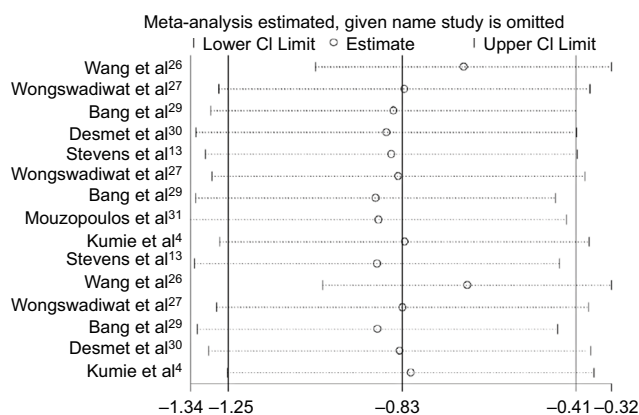


Figure 4 Sensitivity analysis for the pain score after LLS. **Abbreviation:** LLS, lower limb surgery.

Dosage of morphine at 24 h after surgery

The pooled analysis of 3 trials, which included 176 patients, showed that the patients receiving FICB had a lower dosage of morphine at 24 h after surgery (MD=-2.06; 95% CI=-3.82 to -0.30; $P=0.022$, Figure 5). Moreover, a significant heterogeneity was observed ($P=0.000$, $I^2=95.3\%$).

Postoperative nausea and vomiting

The occurrence rate of PONV was reported in 5 trials, which included 261 patients. The pooled result showed that FICB helped to reduce the incidence of PONV after LLS (RR=0.44, 95% CI=0.24-0.80, $P=0.008$, Figure 6) and there was no obvious statistical heterogeneity ($P=0.538$, $I^2=0\%$).

Discussion

Pain is a stress response of the body to damage, and is not only a physiological response but also a psychological reaction. Different people have varying susceptibilities to pain. Severe pain can cause patients to experience psychological burden, stress, a restless mood, and affect postoperative exercise and recovery.³² LLS usually results in moderate-to-severe pain for the first 24-48 h. Extensive bony and soft tissue damage may be one of the common causes of this pain. Inadequate pain control affects the success of patients' rehabilitation program, and postoperative pain is one of the discharge criteria. The better the pain control is, the more accelerated and satisfactory the rehabilitation program can be.

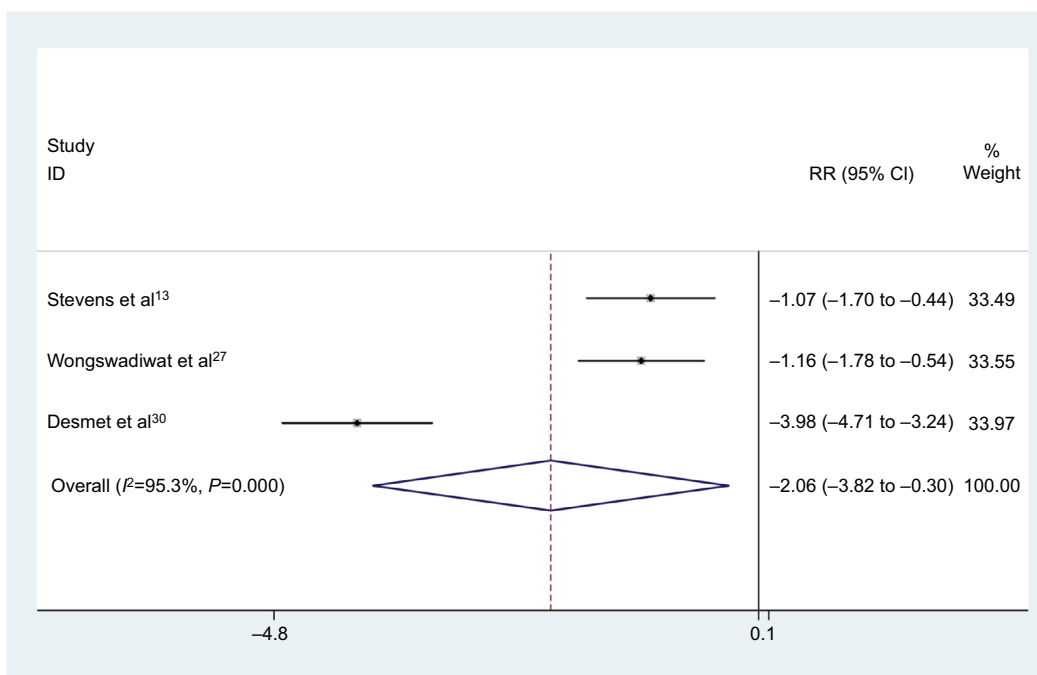


Figure 5 Forest plots of studies comparing fascia iliaca compartment block and no block in terms of morphine consumption at 24 h after lower limb surgery. **Note:** Weights are from random effects analysis. **Abbreviation:** RR, relative risk.

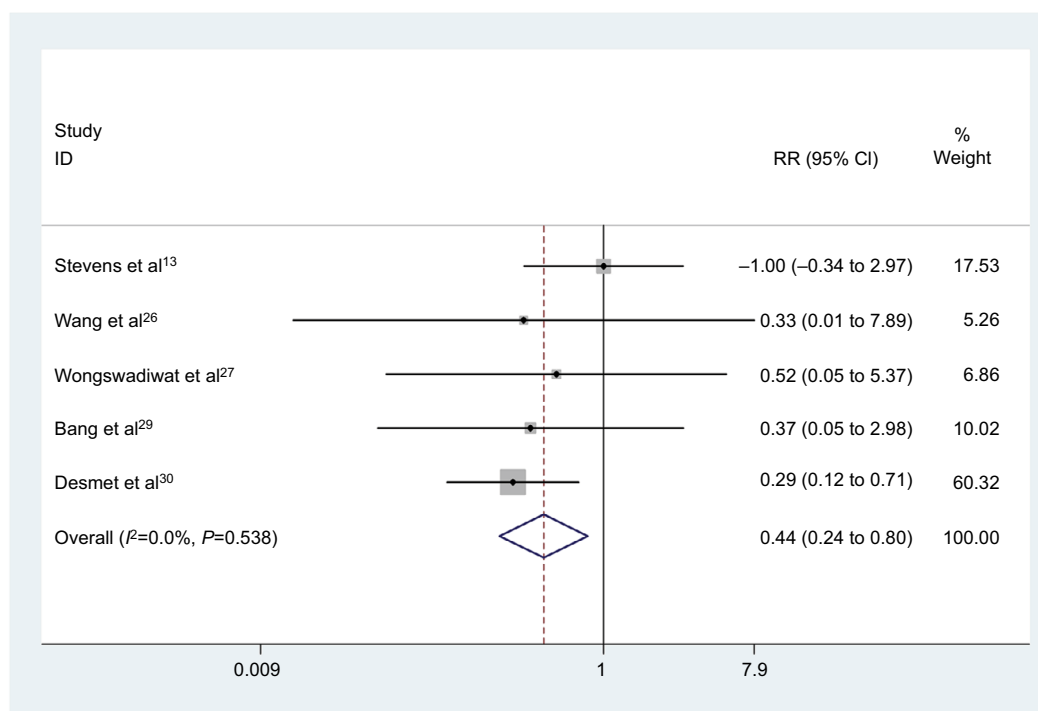


Figure 6 Forest plots of studies comparing postoperative nausea and vomiting between the fascia iliaca compartment block and no block groups.

Abbreviation: RR, relative risk.

Many methods can provide effective postoperative analgesia for patients receiving LLS, including spinal morphine,³³ intravenous patient control analgesia,³⁴ intra-articular injection of LA or opioid,³⁵ femoral nerve block both single shot or continuous infusion via catheter,³⁶ ultrasound-guided FICB,³⁷ and oral analgesic medication (i.e., nonsteroidal anti-inflammatory drugs [NSAIDs], acetaminophen) as multimodal analgesia.³⁸ Among these, FICB is injected through the iliac fascia cavity, which is constructed with the fascia as prezone and the iliopsoas as posterior. To a certain extent, the femoral nerve, lateral femoral cutaneous nerve, obturator nerve, and reproductive nerve traverse along the iliac fascia. FICB can result in a statistically significant increase in the incidence of femoral, lateral femoral cutaneous, and obturator nerve block.^{8,9} Besides, FICB is easy to administer, as it only requires ultrasound guidance. And FICB is a relatively safe anesthesia technique because the needle point is away from the femoral nerve, femoral artery, and femoral vein.³⁹ Nevertheless, FICB may also occasionally lead to complications such as hematoma, emphysema, bladder puncture, and nerve damage. Puncture site hematoma and retroperitoneal emphysema of the FICB were reported in few studies, but without any direct adverse effects.^{4,40} Only 1 literature reported a case of bladder puncture caused by FICB, but this patient had a significant hip flexion contracture.⁴¹ Atchabahian and

Brown⁴² reported the postoperative nerve damage from FICB, but this damage was not persistent. In general, FICB is safe and seems to have few clinical risks. Remarkably, FICB may cause a reflexive knee flexion; therefore, assistive devices such as crutches and temporary knee arthroplasty were recommended to reduce the postoperative risk.⁴³

To our knowledge, we are the first to compare the analgesic effect of FICB and NB after LLS using meta-analysis. According to the results of pooled analysis, compared with patients receiving NB, patients receiving FICB suffer less pain at 4, 12, and 24 h after LLS ($P=0.041$, $P=0.026$, and $P=0.020$, respectively). This reduction is of clinical importance. At 24 h after LLS, morphine consumption and incidence of nausea or vomiting in patients receiving FICB were found to be significantly reduced. Ritcey et al⁴⁴ conducted a systematic review to determine whether regional nerve blocks could reduce pain, the need for parenteral opiates, and complications, compared with standard pain management with opiates, acetaminophen, or NSAIDs. Three studies about FICB were included in their review.^{3,45,46} However, it is difficult to draw a firm conclusion regarding postoperative analgesic effect or other outcomes because of significant bias from the retrospective study and small sample size. Compared with their review, this study included 7 high-quality RCTs and had a larger sample size. Besides, we quantitatively analyzed

the postoperative analgesic effect and other outcomes of FICB using statistical methods. Therefore, our results might be of more clinical significance.

There are still some limitations in our meta-analysis: First, because of only 7 clinical trials that enrolled 508 patients, the reliability of statistical results might be affected by the small sample size. Second, the pain scoring criteria and the type of LLS in different studies were not uniform, which might also influence the results. Third, there was variability in FICB techniques (probe parallel to the inguinal ligament or perpendicular to the inguinal ligament). Fourth, the type and volume of LA administered in different studies were different.

Compared with NB, FICB is a safe and effective method to reduce the postoperative pain scores, morphine consumption, and the occurrence of PONV in patients after LLS. Furthermore, more RCTs about FICB are needed to identify the optimal technique of FICB.

Disclosure

The authors report no conflicts of interest in this work.

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