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Review

The efficacy of fascia iliaca compartment block for pain control after hip arthroplasty: A meta-analysis

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ABSTRACT

Purpose: To assess the effect of fascia iliaca compartment block (FICB) on pain control and morphine consumption in patients with total hip arthroplasty (THA).

Methods: We searched databases (PubMed, Embase, Cochrane Library) for eligible randomized controlled trials (RCTs) published prior to September 12, 2018. We only included THA patients who received FICB versus placebo for pain control. Risk ratios (RRs), standard mean differences (SMD) and 95% confidence intervals (CI) were determined. Stata 12.0 was used for the meta-analysis.

Results: A total of 326 THA patients from 7 RCTs were subjected to meta-analysis. Overall, FICB was associated with lower VAS scores at 1–8 h and 12 h compared with placebo ($P < 0.05$). However, there was no significant difference between VAS at 24 h (SMD = -0.56, 95% CI [-1.42, 0.31], P = 0.206) and 48 h after THA (SMD = −0.82, 95% CI [-2.07, 0.44], P = 0.204). Compared with the control group, FICB significantly decreased the occurrence of nausea (RR = 0.41, 95% CI 0.25 to 0.69, P = 0.010; $I^2 = 0.0\%$). There was no significant difference in the risk of falls between the FICB and control groups ($P > 0.05$).

Conclusions: FICB has a beneficial role in reducing pain intensity and morphine consumption after THA. Moreover, FICB has morphine-sparing effects when compared with a control group. More high-quality RCTs are needed to identify the optimal technique and volume of injectate for FICB.

1. Introduction

Currently, total hip arthroplasty (THA) has been widely used in treatment for severe hip arthritis and femoral head necrosis [1,2]. Postoperative pain after THA is often intense and is always treated with opioids [2]. Unfortunately, the use of opioids can be associated with complications such as nausea, vomiting, urinary retention and respiratory depression [3]. These complications negatively affect patients' satisfaction and postoperative outcomes [4].

Peripheral nerve block techniques have been shown to improve pain scores and reduce morphine consumption in patients undergoing THA [5]. Fascia iliaca compartment block (FICB) is a peripheral nerve block that has been shown to decrease opioid use and pain scores after THA [6]. FICB was first introduced by Dalens et al. [7] in 1989. Dalens et al. [7] reported that FICB could be an alternative to the 3-in-1 nerve block for pain control in children. FICB is now one of the major methods of nerve block and is widely used in postoperative pain control in patients after THA. Several randomized controlled trials (RCTs) have compared FICB to no FICB. Many of these trials contained a relatively small number of patients and demonstrated inconsistent outcomes [8]. Shariat et al. [8] suggested that the difference in average pain intensity after FICB versus placebo was not significant.

This uncertainty leads to the determination of whether FICB is used for pain control after THA. Two relevant meta-analyses were published about FICB for pain control in orthopedic surgeries [9,10]. Fei et al. [10] reported that FICB shows no superiority over femoral nerve block regarding pain control and morphine consumption. Zhang et al. [9] found that FICB could significantly reduce pain scores and morphine consumption in patients undergoing total knee arthroplasty and THA. Nevertheless, these two meta-analyses included knee arthroplasty and THA, and thus their results should be viewed with caution. Moreover, three RCTs about FICB versus placebo for pain control in THA patients were not included in these two meta-analyses [8,11–13]. Considering all these issues, it is impossible to perform a meta-analysis and give clear advice on whether we should perform FICB for pain control after THA.

Thus, we undertook a further meta-analysis to evaluate whether FICB is superior to placebo with respect to (1) pain scores; (2) morphine

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consumption; (3) occurrence of nausea; and (4) occurrence of falls. We hypothesized that FICB results in lower pain scores and morphine consumption but without increasing the risk of falls.

2. Materials and methods

This work has been reported in line with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and AMSTAR (Assessing the methodological quality of systematic reviews) Guidelines.

2.1. Search strategy

This meta-analysis was designed on the basis of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines [14]. Several electronic databases were searched from inception to September 1, 2018, including PubMed, Embase, and the Cochrane library. No language or other limits were set. The search strategies were as follows: (((fascia iliaca block) OR fascia iliaca compartment block)) AND ((((("Arthroplasty, Replacement, Hip"[Mesh]) OR THR) OR THA) OR total hip replacement) OR total hip arthroplasty). To ensure the integrity of the search results, reference lists from related reviews were also screened. Before screening, the search task for each database was executed by 2 independent researchers to achieve agreement. A flow diagram is presented in Fig. 1.

2.2. Inclusion criteria and exclusion criteria

The following criteria must have been met for the eligible studies: (1) Study design: RCTs and prospective controlled studies; (2) Population: adults requiring THA without other comorbidities; (3) Intervention: use of FICB for pain control; (4) Comparison: placebo or no treatment; and (5) Main outcomes: visual analog scale (VAS) at 1–8 h, 12 h, 24 h, and 48 h; total morphine consumption; occurrence of nausea and occurrence of falls. At least two or three of the outcomes (VAS at 1–8 h, 12 h, 24 h, and 48 h, morphine, nausea/vomiting and fall) should be reported in all studies.

Ineligible studies contained the following features: (1) they were retrospective trials or other non-RCTs; (2) they included comparisons with other anesthesia protocols; and (3) they did not report outcomes.

2.3. Study inclusion

Articles found in the databases were imported into reference management software (Endnote X7), and the duplicate articles were removed. The inclusion criteria were applied to the screening of titles and abstracts by 2 independent researchers, and the retained articles were cross-checked. The 58 remaining articles were screened by reading the full articles, and 9 articles ultimately remained in the quantitative synthesis procedure. Agreement was reached by 3 independent researchers by discussion.

2.4. Quality assessment

The methodological quality of each individual study was assessed by 2 independent reviewers according to the Cochrane Handbook for Systematic Reviews of Interventions. The quality and bias assessment had to include the following items: randomization method, allocation

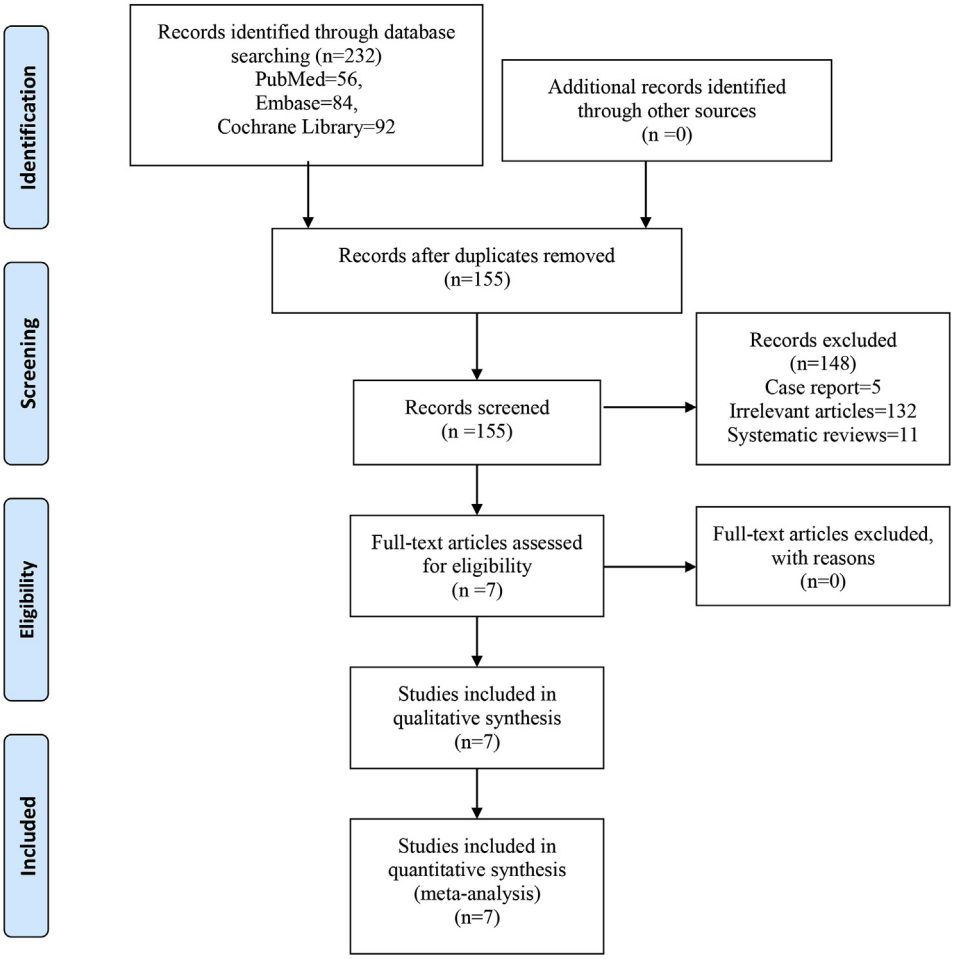

Fig. 1. Flow diagram of the study selection process.

concealment, blinding methods, incomplete outcome data, selective reporting and other bias.

2.5. Data extraction

Relevant data from the eligible articles were extracted independently by 2 reviewers, including the author; the data included publication year, country, intervention, size of each group, mean age, proportion of female patients, FICB, technique, anesthesia, outcomes and risk of bias. The corresponding authors of the included RCTs were contacted for the missing data to ensure the integrity of the review if necessary. Consensus was finally reached between 2 reviewers through discussion. When a numerical rating scale (NRS) score was used, it was converted to a VAS score [15]. The 10-point VAS score was converted to a 100-point VAS score [16]. In the absence of a standard deviation (SD), the median value of SDs from other studies of the same comparison were substituted [17]. For data described as the median and range, the mean and SD were estimated according to the previously described manner [18].

2.6. Data synthesis and statistical methods

Once adequate data were retrieved, weighted mean differences (WMD) were calculated for the following outcomes: visual analog scale (VAS) at 1–8 h, 12 h, 24 h, and 48 h; and total morphine consumption. For the dichotomous variables (occurrence of nausea and occurrence of falls), the risk ratio (RR) with a 95% CI was used. Separate statistics were combined using the inverse variance and Mantel-Haenszel methods. If the values were less than 0.05, the results were considered statistically significant. Study heterogeneity was estimated by the I^2 statistic test and Cochran's Q test in accordance with the values of I^2 and P. A fixed-effects model could be used if $I^2 < 50\%$ and $P > 0.1$. Otherwise, a random-effects model was used to pool the effects of the interventions. We performed subgroup analysis for VAS at 1–8 h according to the operative technique (probe parallel to the inguinal ligament or perpendicular to the inguinal ligament), risk of bias (low or unclear/high), volume of injectate (≤ 30 mL, > 30 ml) and anesthesia (general anesthesia or spinal anesthesia). A 2-sided P value of < 0.05 was considered significant. All statistical analyses were performed using Stata 12.0 (Stata Corp., College Station, TX). Publication bias across studies was examined visually using “funnel plots” and the more sensitive “Doi plots” and by formally using the Luis Furuya-Kanamori (LFK) index [19–21].

3. Results

3.1. Search results and general characteristics

A flow chart of the included studies is shown in Fig. 1. The primary database search yielded 232 relevant studies (PubMed = 56, Embase = 84, Cochrane Library = 92). After duplicates were removed, 155 studies were available for screening. After screening the titles, abstracts and full texts, 148 papers were excluded; 6 RCTs and 1 prospective controlled study met our inclusion criteria and were included for analyses [8,11–13,22–24]. The characteristics and demographics for the included studies are presented in Table 1.

The publication years ranged from 2007 to 2017. These 7 studies originated from 7 countries. The sample sizes in the included trials were from 11 to 43. The mean age of the included patients ranged from 54.2 to 85.2. All of the included studies performed FICB with ropivacaine and used ultrasound techniques. Only one study used spinal anesthesia, and the remaining studies used general anesthesia.

3.1.1. Risk of bias

Details of the risk of bias summary and risk of bias graph are presented in Fig. 2 and Fig. 3, **respectively**. Overall, 3 trials were

Table 1
General characteristic of the included studies. FICB, fascia iliaca compartment block, 2, GA, general anesthesia, 3, SA, spinal anesthesia, NS, not stated, 1, VAS at 6–8 h, 2 VAS at 12 h, 3 VAS at 24 h, 4 VAS at 48 h, 5 total morphine consumption, 6 the occurrence of nausea, 7 the occurrence of fall.

Author	Country	Intervention	Size(n)	Age (y)	Female (%)	FICB	Technique	Anesthesia	Outcomes	risk of bias
Shariat 2013	USA	FICB vs Control	16 vs 16	61.0	56.2	30 mL 0.5% ropivacaine	Ultrasound	GA	1,2,3,5,6,7	low
Cucereanu Badica 2010	Romania	FICB vs Control	30 vs 32	71.0	35.4	50 mL of ropivacaine 0.2% with epinephrine	Ultrasound	GA	1, 4,5	unclear
Stevens 2007	Australia	FICB vs Control	22 vs 22	54.2	50.0	40 mL mixture of 30 mL of 0.5% bupivacaine with 1:200000 epinephrine and 150 μg of clonidine	Ultrasound	SA	1,2,3,4,5,6	unclear
Desmet 2017	Belgium	FICB vs Control	43 vs 42	67.5	65.4	40 mL of ropivacaine 0.5%	Ultrasound	GA	1,2,3,5,6	unclear
Bang 2016	Korea	FICB vs Control	11 vs 11	81.6	85.2	40 mL of ropivacaine 0.2% with epinephrine 5 mg/mL	Ultrasound	GA	1,2,5,7	low
Goitia 2009	Spanish	FICB vs Control	21 vs 20	55.6	55.0	40 ml of 5% bupivacaine	Ultrasound	NS	1,2,3,4,5	low
Deniz 2014	Turkey	FICB vs Control	20 vs 20	59.1	56.5	2% prilocaine, 30 ml of 0.25% bupivacaine (1 mg/kg)	Ultrasound	GA	2,3,4,5,7	high

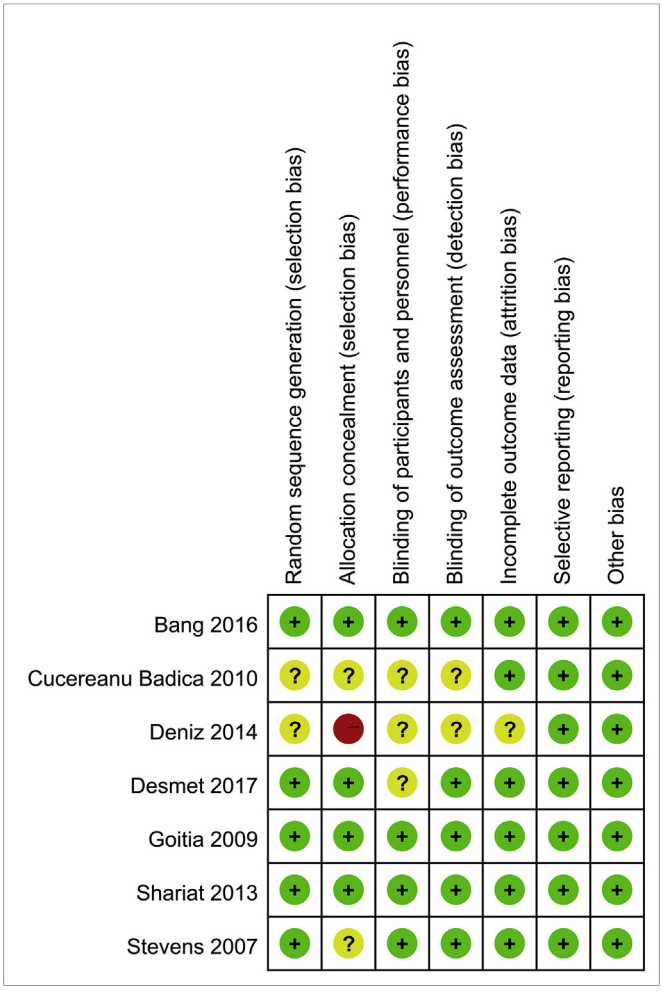

Fig. 2. Risk of bias summary.

categorized as being at low risk of bias, 3 as being unclear and 1 as being at high risk of bias.

3.1.2. Results of meta-analysis

3.1.2.1. VAS at 1–8 h. Five studies totaling 223 participants reported the VAS at 1–8 h. Compared with the control group, FICB significantly reduced VAS at 1–8 h with low heterogeneity (SMD = -0.64, 95% CI [-1.17, −0.11], P = 0.017, I^2 = 70.7%, Fig. 4).

3.1.2.2. VAS at 12 h. Four trials totaling 223 patients provided data on VAS at 12 h. Compared with the control group, FICB significantly reduced VAS at 12 h with high heterogeneity (SMD = -0.89, 95% CI [-1.49, −0.29], P = 0.004, I^2 = 71.5%, Fig. 5).

3.1.2.3. VAS at 24 h. Five studies totaling 264 THAs reported the VAS at 24 h. There was high heterogeneity among the included studies (I^2 = 83.4%, P = 0.008). FICB had no effect on VAS reduction at 24 h after THA when compared with the control group (SMD = -0.56, 95% CI [-1.42, 0.31], P = 0.206, Fig. 6).

3.1.2.4. VAS at 48 h. Three trials involving 169 patients reported VAS at 48 h. There was high heterogeneity among the included studies (I^2 = 94.8%, P = 0.000). Compared with the control group, FICB had no benefit on VAS at 48 h (SMD = −0.82, 95% CI [-2.07, 0.44], P = 0.204, Fig. 7) with high heterogeneity (I^2 = 91.9%, P = 0.000).

3.1.3. Total morphine consumption

A random-effects model was used to pool the total morphine consumption data, since the heterogeneity across the four studies was high (I^2 = 84.5%, P = 0.000). Pooled analysis demonstrated clinical inferiority of the efficacy of FICB compared with placebo for total morphine consumption (SMD = −1.00, 95% CI [-1.76, −0.23], P = 0.011, Fig. 8).

3.1.4. The occurrence of nausea

Five studies involving 224 THAs were available for analysis of the occurrence of nausea. FICB led to significantly less occurrence of nausea than in the control group (RR = 0.41, 95% CI 0.25 to 0.69, P = 0.010; I^2 = 0.0%, P = 0.979, Fig. 9). Thus, we used a fixed-effects model to pool the relevant data.

3.1.5. The occurrence of falls

Five studies involving 179 THAs were available for analysis of the occurrence of falls. FICB was not associated with an increase in the occurrence of falls (RR = 0.85, 95% CI 0.53 to 1.34, P = 0.478 Fig. 10). There was no heterogeneity among the included studies (I^2 = 0.0%, P = 0.979); thus, we used a fixed-effects model to pool the relevant data.

3.1.6. Publication bias, sensitivity analysis and subgroup analysis

To address publication bias, we created funnel plots for VAS at 1–8 h. No asymmetric patterns were observed (Fig. 11). The LFK index revealed no significant asymmetry (LFK index: 0.872). This indicates that heterogeneity in outcomes between studies may not be due to publication or reporting bias but to other factors. Sensitivity analysis was performed by excluding one trial at a time and recalculating the pooled WMD for the remaining trials, which showed that none of the studies affected the results (Fig. 12). We then performed sensitivity

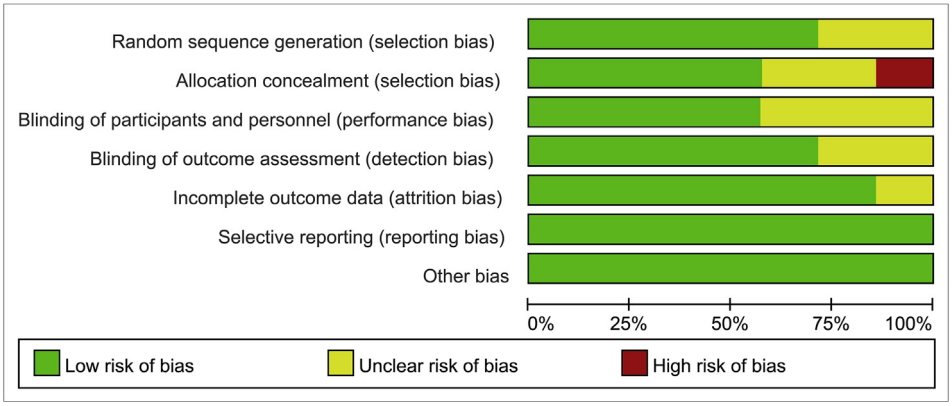

Fig. 3. Risk of bias graph.

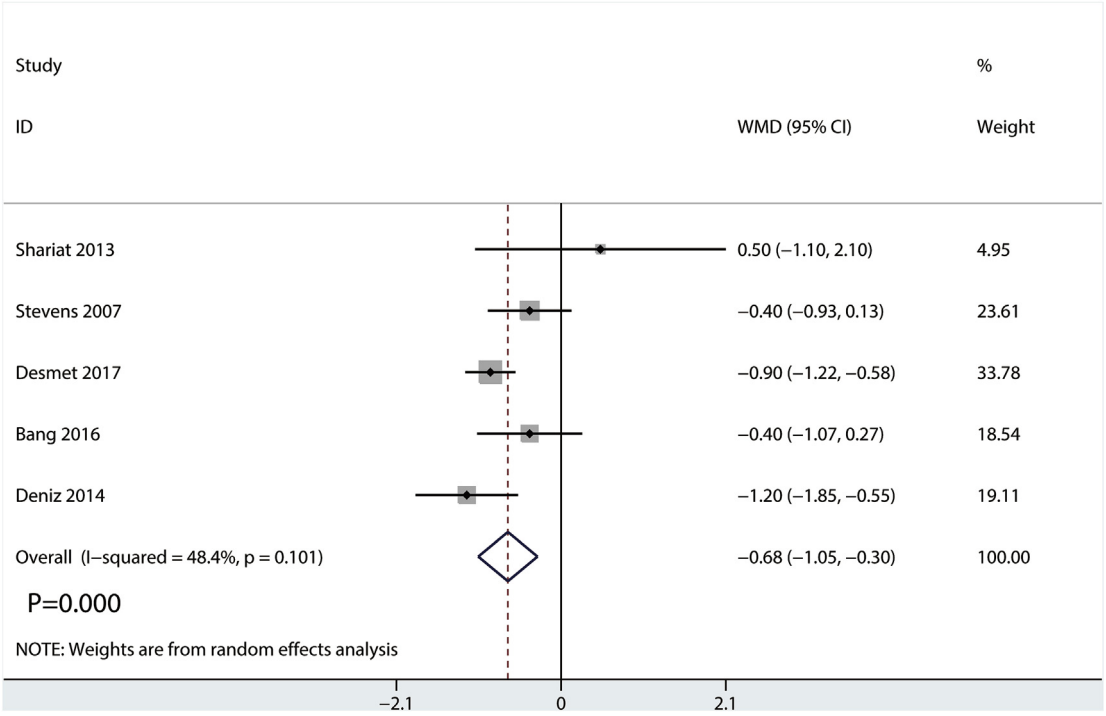

Fig. 4. Forest plot for the comparison of VAS at 1–8 h between the FICB group and control group.

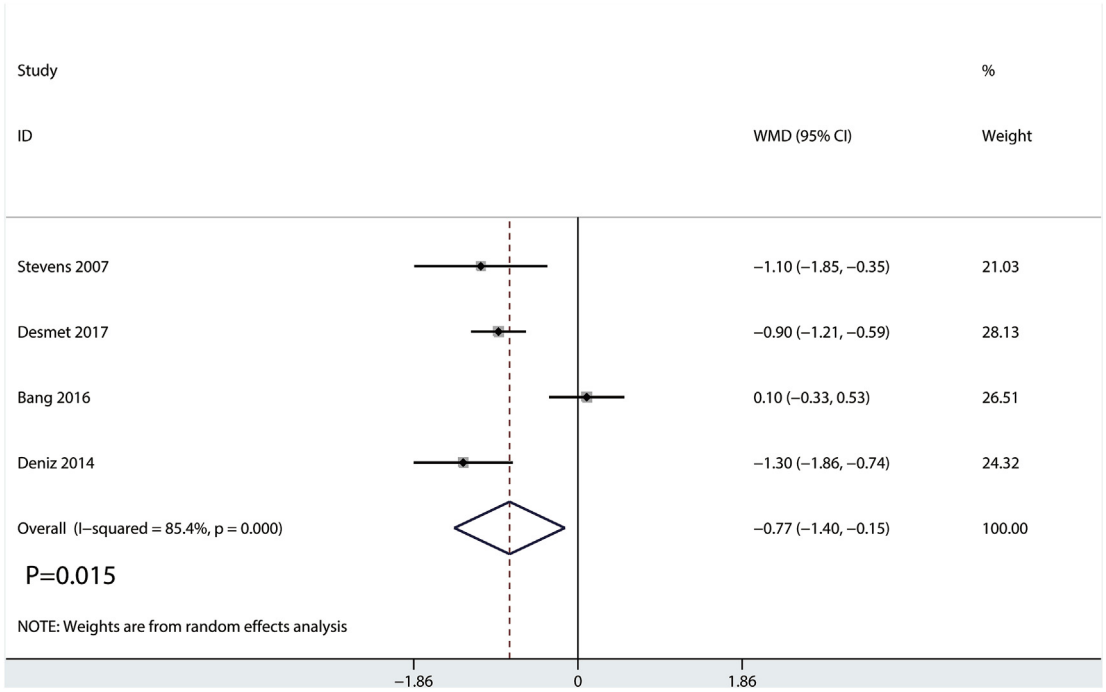

Fig. 5. Forest plot for the comparison of VAS at 12 h between the FICB group and control group.

analysis after removing the study of Bang et al. Results were listed in Supplement file 1. Results were consistent except for VAS at 48 h, FICB has a beneficial role in reducing VAS at 48 h when compared with control group (SMD = −1.55, 95% CI = −1.96, −1.15, P = 0.000). Subgroup analysis results can be seen in Table 2. The findings of the VAS at 1–8 h were not consistent in all subgroup analyses.

4. Discussion

4.1. Principal findings

Compared with placebo, FICB was shown to decrease postoperative pain at 1–8 h, 12 h and 24 h after THA but did not reach significance in those patients at postoperative 48 h. Moreover, FICB was associated with a reduction in total morphine consumption and the occurrence of nausea. FICB was not associated with an increase in the risk of falls after THA when compared with placebo.

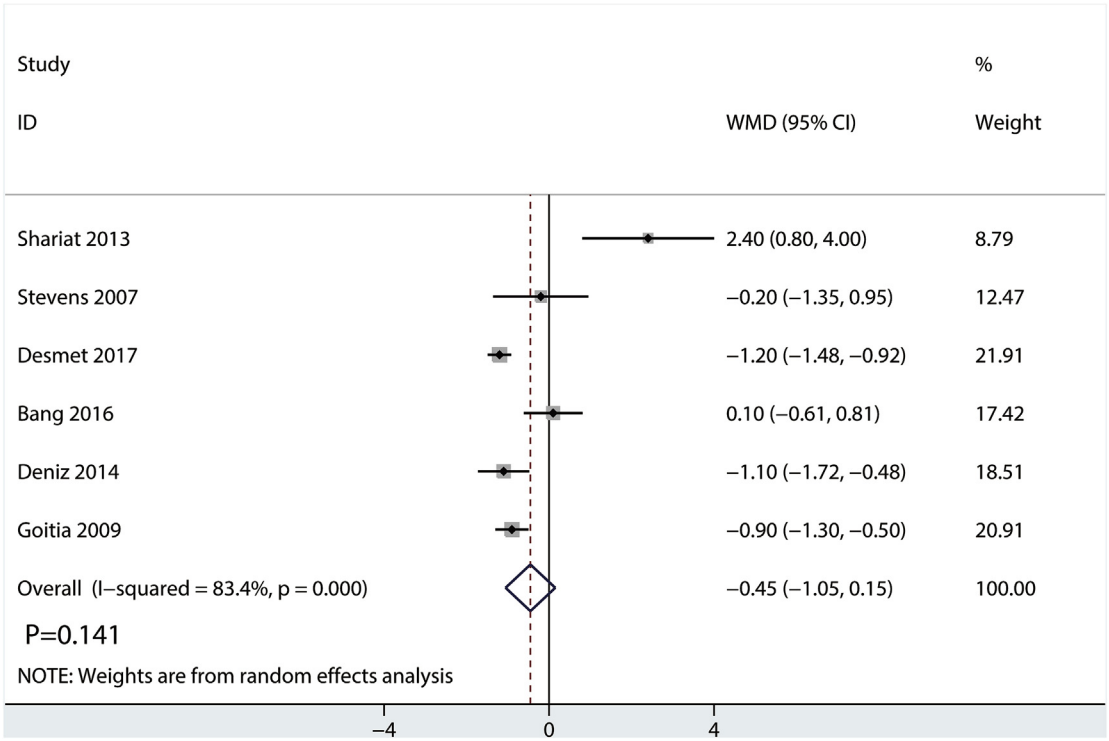

Fig. 6. Forest plot for the comparison of VAS at 24 h between the FICB group and control group.

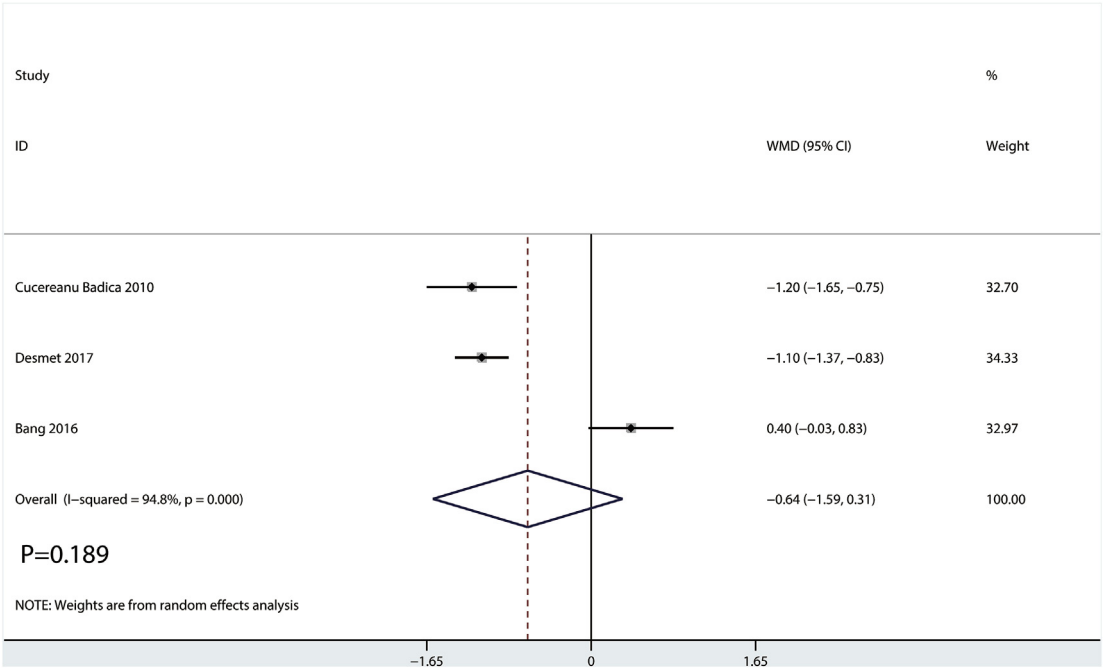

Fig. 7. Forest plot for the comparison of VAS at 48 h between the FICB group and control group.

4.2. Relationship to other systematic reviews

Two previous systematic reviews comparing FICB and placebo have been published [9,10]. A meta-analysis performed by Zhang et al. [9] showed a decrease in postoperative pain in the FICB group for patients undergoing total knee arthroplasty and total hip arthroplasty. Another meta-analysis [10] revealed that FICB is an effective and safe method for alleviating pain after lower limb surgery. Although the principal finding of our meta-analysis was consistent with previous meta-analyses, differences between our study and previous studies should be considered. First, these two meta-analyses included mixed surgeries (total knee arthroplasty, total hip arthroplasty and lower limb surgery). Thus, the clinical heterogeneity was high in these two meta-analyses. Second, these previous meta-analyses included no more than three trials and 112 THAs. In contrast, the current meta-analysis included 7 RCTs involving 326 patients and only focused on THAs. With the added statistical power of at least 214 cases, our current meta-analysis was the latest and most comprehensive meta-analysis.

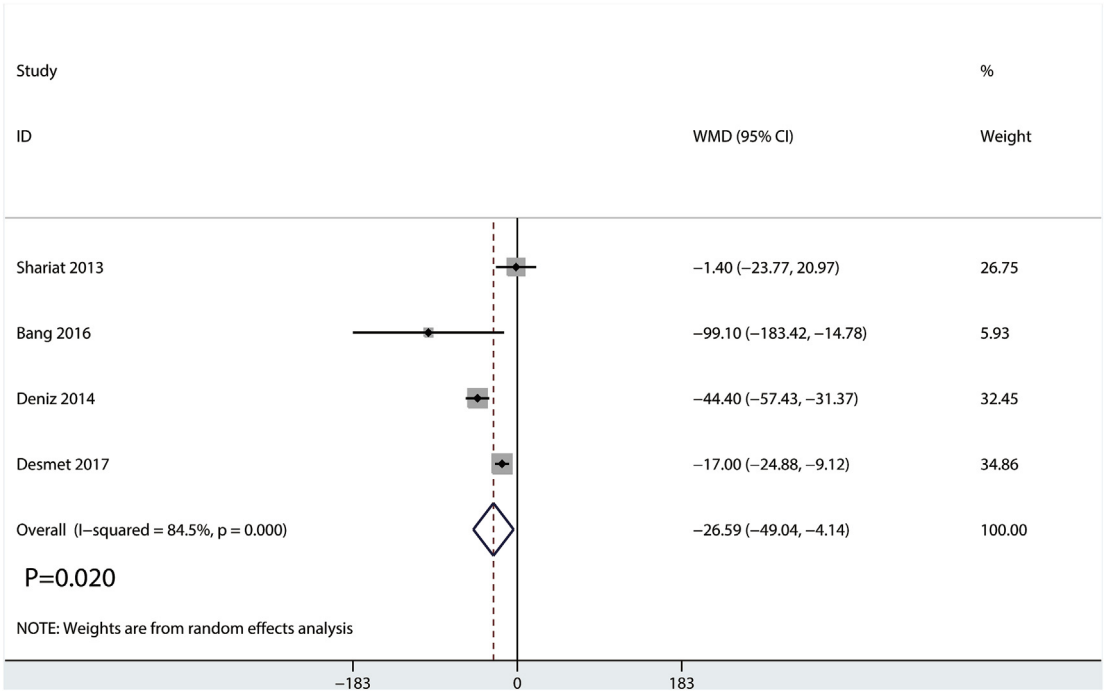

Fig. 8. Forest plot for the comparison of total morphine consumption between the FICB group and control group.

4.3. Implications for clinical practice

Our meta-analysis showed that acute anesthesia and morphine-sparing effects existed in the FICB group. The femoral nerve, lateral femoral cutaneous nerve, obturator nerve, and reproductive nerve traverse along the iliac fascia. Thus, FICB can result in a statistically significant increase in the incidence of femoral, lateral femoral cutaneous, and obturator nerve block.

Our primary outcome was pain scores after THA. Our results showed that FICB has a beneficial role in reducing pain scores at 1–8 h, 12 h and 24 h. There was no significant difference between the FICB and control groups in terms of the VAS at 24 h. Deniz et al. [13] compared the postoperative analgesic efficiency of FICB, 3-in-1 block and control groups in patients with THA. The results showed that both FICB and 3-in-1 block have a beneficial role in reducing acute pain after THA. The difference was statistically significant. Shariat et al. [8] assessed the efficacy of FICB (30 ml 0.5% bupivacaine) for THA patients. The evidence suggested that the average pain intensity in FICB and controls was not significant. Yang et al. [25] conducted a meta-analysis that compared the analgesic efficacy of FICB versus placebo for lower

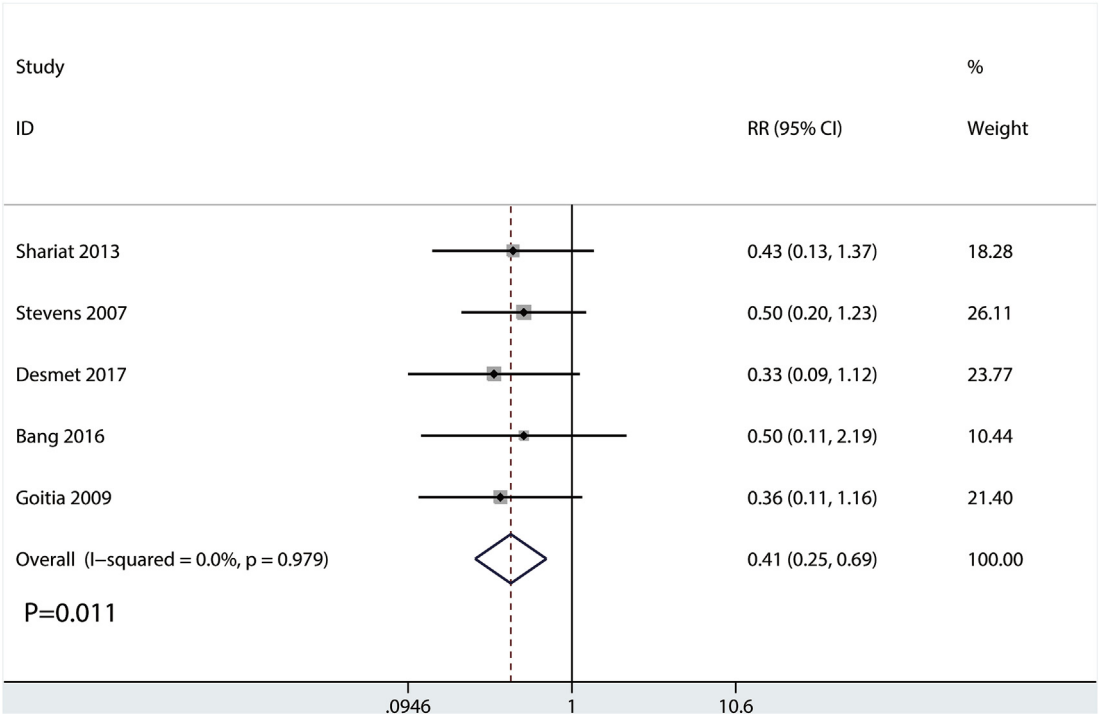

Fig. 9. Forest plot for the comparison of the occurrence of nausea between the FICB group and control group.

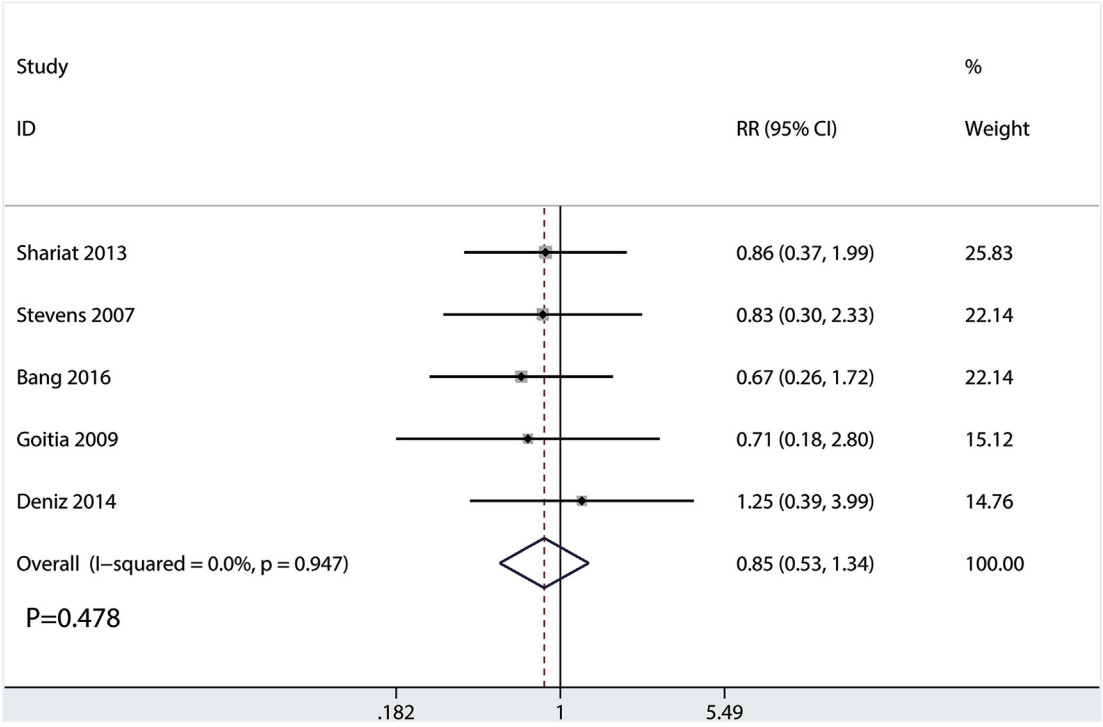

Fig. 10. Forest plot for the comparison of the occurrence of falls between the FICB group and control group.

limb surgery. The results showed that FICB is an effective and safe method for alleviating pain after lower limb surgery. We performed subgroup analysis for VAS with rest at 1–8 h. The findings of the VAS at 1–8 h were not consistent in all subgroup analyses. When assessing the VAS at 48 h, when removing the study of Bang et al., FICB was associated with a reduction of the pain scores than control group.

Next, we measured total morphine consumption in the FICB group and control group. The results showed that FICB could significantly reduce morphine consumption compared with the control group. Stevens et al. [22] assessed whether a modified FICB in unilateral total hip arthroplasty provides a morphine-sparing effect in the first 24 h. The results showed that a modified FICB has a significant morphine-sparing effect in unilateral THA.

Comparing the risk of falls, the meta-analysis did not demonstrate any difference. The major concern with peripheral nerve block was the risk of falls. When performing a peripheral nerve block, patients may suffer from motor weakness and subsequently may fall from their beds. We found no increased risk of falls with regard to administration of FICB.

In addition, FICB is easy and safe to administer for surgeons and

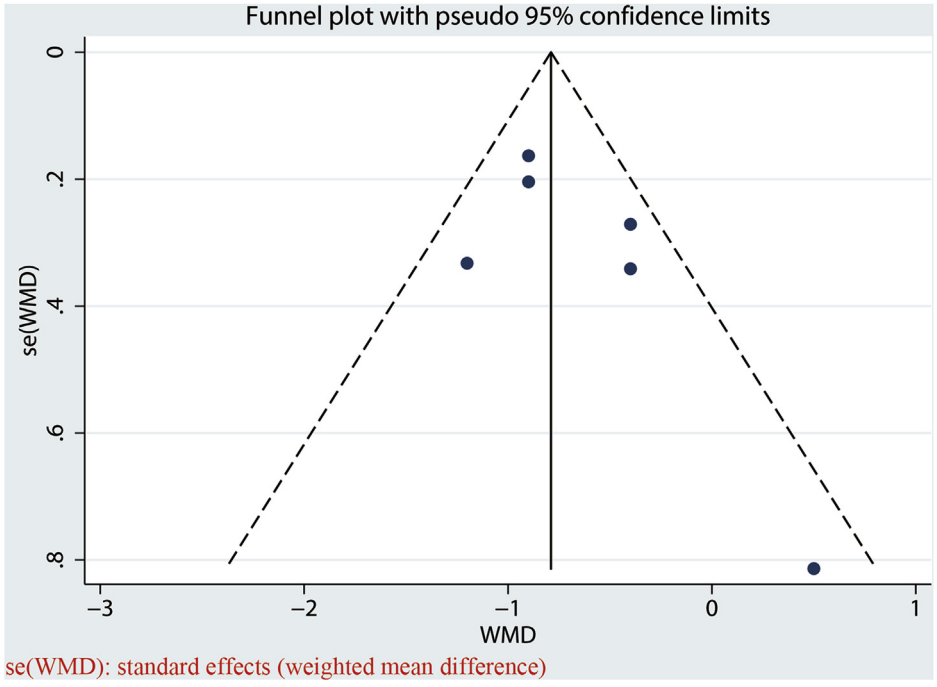

Fig. 11. Funnel plot for the comparison of the VAS at 6–8 h between the FICB group and control group.

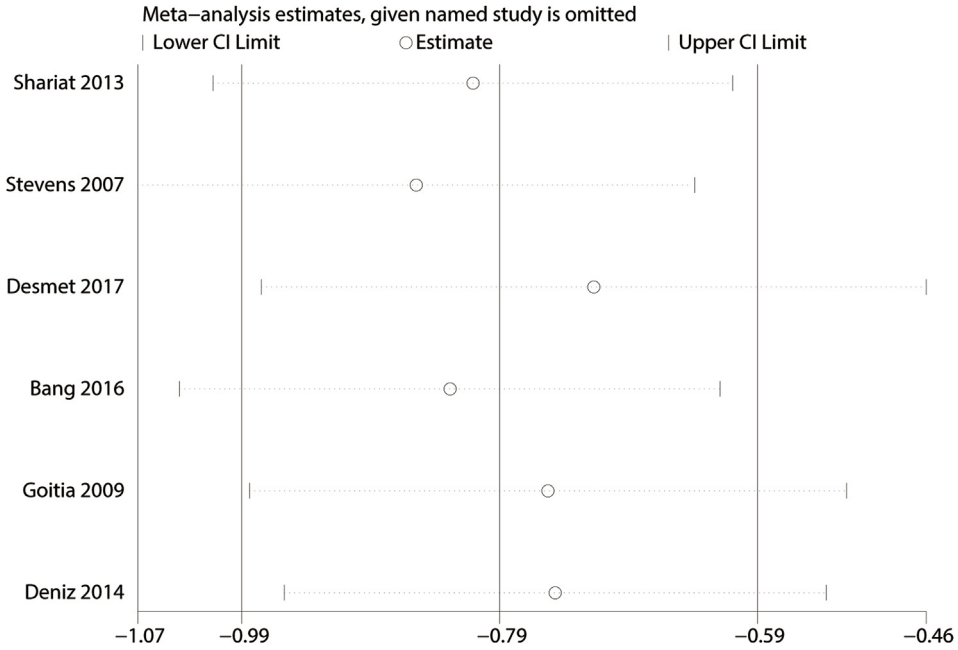

Fig. 12. Sensitivity analysis of the VAS at 1–8 h between the FICB group and control group.

Table 2
Subgroup analysis for the VAS at 6–8 h.

Subgroup	No. Trials	Standard mean difference (95% CI)	P Value	I^2 (%)	Test of Interaction, P
Total	6	−0.64 (−1.17,-0.11)	0.017	70.7	
Operative technique					
parallel	3	−0.10(-0.80,0.60)	0.783	39.0	0.013
perpendicular	3	−0.94(-1.42,-0.47)	0.000	51.6	
Risk of bias					
Low	3	−0.10(-0.80,0.60)	0.002	39.0	0.013
Unclear/high	3	−0.94(-1.42,-0.47)	0.000	51.6	
Volume					
≤30 ml	3	−0.46(-1.20,0.28)	0.220	73.7	0.025
> 30 ml	3	−0.94(-1.60,-0.29)	0.005	49.7	
Anesthesia					
GA	5	−0.69(-1.35,-0.02)	0.044	76.0	0.005
SA	1	−0.44(-1.04,0.15)	0.146	0.0	
Sample size					
≤40	3	−0.48(-1.30,0.35)	0.258	73.7	0.012
> 40	2	−0.85(-1.58,-0.11)	0.024	73.7	

anesthetists. FICB only requires ultrasound guidance for cathetering. Reports have shown that FICB can generally be performed with minimal training [26–28] and by nonmedical practitioners [29]. The fascia iliaca compartment is located away from the femoral nerve, femoral artery, and femoral vein.

4.4. Limitations

Our study has several limitations. The number of subjects in each of the 7 RCTs was different and ranged from 11 to 43. The reliability of the statistical results might be affected by these small sample sizes ($n < 100$). Second, the FICB technique (probe parallel to the inguinal ligament or perpendicular to the inguinal ligament) and volume of injectate varied between the included trials, which may result in clinical heterogeneity. One study was classified as having a high risk of bias, and 3 studies were classified as having an unclear risk of bias. Thus, the quality of evidence for the main outcomes should be viewed with caution.

5. Conclusion

Compared with placebo, FICB is a safe and effective method to reduce postoperative pain scores, morphine consumption, and the occurrence of nausea in patients after THA. Furthermore, more RCTs concerning FICB are needed to identify the optimal technique and volume of injectate for FICB.

Ethical approval

None.

Sources of funding

None.

Author contribution

Liyang Cai and Yutang Song: data collections, data analysis and writing.

Zhan Wang and Wei She: data collections and data analysis.

Xiangli Luo and Yuxin Song: data analysis and writing.

Yuxin Song: study design, data collectionsAll contributions were made by Ali Naki Yücesoy MD.

Conflicts of interest

None.

Research registry number

Reviewregistry630.

Guarantor

Yuxin Song.

Data statement

None.

Provenance and peer review

Not commissioned, externally peer reviewed.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijsu.2018.12.012.

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