Original Article

Comparative Supra-Inguinal Fascia Iliaca Compartment Block and Continuous Lumbar Epidural Analgesia for Total Hip Replacement: A Retrospective Study

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Background: Optimal pain control is one of the major concerns in total hip arthroplasty (THA). Lumbar epidural analgesia (LEA) is considered a common modality for pain relief following THA. However, the benefits must be weighed against the possibility of adverse effects and complications. Supra-inguinal fascia iliaca compartment block (S-FICB) is an alternative to neuraxial analgesia and provides adequate analgesia with fewer adverse effects.

Objective: To compare the efficacy of postoperative analgesia between S-FICB and LEA in THA patients.

Material and Methods: The present study was a retrospective cohort study that included 58 patients who underwent THA. Thirty-nine patients received LEA and 19 patients received S-FICB. Numeric rating score (NRS) at rest and movement, morphine (MO) consumption, complications/side-effects, and satisfaction score were collected at 24 and 48 hours postoperative.

Results: Twenty-four hours NRS at rest was lower in LEA group (median resting NRS: 0 (0, 1) versus 4 (2, 4), p=0.0003). Twenty-four hours MO equivalent consumption was also lower in LEA group (MO equivalent consumption (mg): 0 (0, 5) versus 3 (0, 6), p=0.027). However, intraoperative blood loss was higher in LEA group compared with S-FICB group (median BL: 600 mL (500, 1,000) versus 400 mL (250, 700), p=0.02). The incidence of itching was higher in LEA group. However, the satisfaction score, the incidence of hypotension, nausea/vomiting, and dizziness were not statistically different.

Conclusion: LEA provided superior analgesic efficacy than S-FICB. However, LEA is associated with higher incidence of blood loss and itching. The length of hospital stays and level of patient satisfaction with the analgesic treatment were comparable between the two groups.

Keywords: Total hip arthroplasty; Epidural; Fascia iliaca; Postoperative analgesia

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Total hip arthroplasty (THA) is a common operative procedure for hip disease, including advanced hip osteoarthritis and neck of femur fracture[1]. Due to the broader indications and increased awareness to improve mobility and quality of life, the number of THA has been increased over the past decades, with about 2.5 million THA performed annually in the United States[2]. To enhance recovery after surgery, the key to early recovery, ambulation, and initiation of physiotherapy is ensuring that postoperative pain is well controlled with minimal side effects[3].

Lumbar epidural analgesia (LEA) is a common modality for pain relief in THA patients. A meta-analysis study by Choi et al showed that epidural analgesia (EA) was a good pain relief technique for THA surgery[4]. However, the magnitude of pain relief must be weighed against the frequency of adverse events such as hypotension, nausea/vomiting, and respiratory depression from local anesthetic and opioids in epidural infusion[4]. Moreover, LEA is associated with lower limb weakness especially in patients who received a high concentration of local anesthetic, which may induce quadricep muscle weakness and prevent the patient from early mobilization.

Supra-inguinal fascia iliaca compartment block

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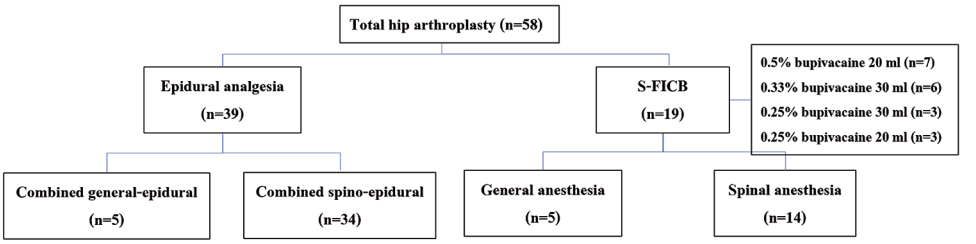

Figure 1. Flow diagram of total hip arthroplasty patients for the comparison between group.

(S-FICB) is a regional anesthetic technique that involves injecting local anesthetic under fascia iliaca superior to the groin region, to block the femoral and lateral cutaneous nerve of thigh[5]. It is an alternative technique to neuraxial analgesia and provides adequate unilateral analgesia with fewer side-effects than the EA[6]. Compared to a placebo group, fascia iliaca compartment block (FICB) has been shown to reduce both pain and opioid consumption in studies[7-9]. A recent meta-analysis also showed that FICB could be used to effectively reduce pain intensity up to 24 hours as well as total morphine consumption in THA patients[10]. Therefore, the PROSPECT guideline recommended a single shot FICB as a regional anesthetic of choice for THA[11]. However posterior part of the hip joint is innervated by the sacral plexus that is not covered by S-FICB. This is a reason that the patients who underwent THA with a single-shot S-FICB with multimodal oral analgesic drugs still required morphine for breakthrough pain. Moreover, S-FICB is a special technique. It needs trained anesthesiologists and special equipment such as ultrasound (US). Therefore, epidural is still an alternative technique that is versatile, easy, safe, and inexpensive. Furthermore, general anesthesiologists can do epidural without special equipment in rural hospitals.

The present study primary aim was to assess the efficacy of postoperative analgesia compared between S-FICB and EA in 24 hours, and the secondary aim was to assess postoperative analgesia in 48 hours and the side effects.

Material and Methods

Patient population

The present study was a retrospective cohort study that included 58 patients. The study was approved by the Ramathibodi Hospital Research Ethics Board (MURA 2021/686) and was registered in the Thai Clinical Trial Registry, TCTR 20210825003 (https://www.thaiclinicaltrials.org). Inclusion criteria were patients that underwent total hip arthroplasty under general or neuraxial anesthesia either with LEA (n=39) or with S-FICB (n=19). Patients who had chronic pain or chronic use of opioid drugs, had neurological deficits in the lower extremities, or unable to communicate such as postoperative cognitive impairment, on mechanical ventilation, were excluded.

The reporting of the present study was performed by adhering to the statement for reporting observational studies (STROBE).

The primary objective was to compare the 24 hours numeric rating scale (NRS) at rest and on movement in patients received LEA or S-FICB in THA patients. The secondary objective was to identify the 48 hours NRS at rest and on movement, postoperative morphine equivalent consumption as 1 mg intravenous tramadol equal to 0.1 mg intravenous morphine, adverse effect/complications such as hypotension seen as systolic blood pressure of less than 90 mmHg or diastolic blood pressure of less than 60 mmHg, dizziness, itching, nausea/vomiting, respiratory depression with a respiratory rate of less than 8 to 10 per minute, length of hospital stay, and satisfaction score related with analgesic treatment with 0 as unsatisfied to 10 as very satisfied. All the data were collected from acute pain service and electronic medical records (EMR) between January 2018 and December 2020.

Anesthesia protocol

Fifty-eight patients were divided into two groups, epidural anesthesia for 39 patients and S-FICB for 19 patients. For the epidural anesthesia group, five out of 39 patients underwent combined general-epidural anesthesia, while the rest of 34 patients underwent combined spino-epidural anesthesia. For the S-FICB group, five out of 19 patients underwent general anesthesia, while the rest of 14 patients underwent spinal anesthesia (Figure 1). No analgesic pre-medications were given to the patients before the

operation. All patients received standard monitoring included blood pressure, pulse oximetry, and electrocardiogram in the operation room. The patients that underwent general anesthesia were monitored with end-tidal carbon dioxide (ETCO2).

Spinal anesthesia was induced using a standard technique as 0.5% isobaric bupivacaine was administered 3 mL using a 27-G cutting needle at the L3-4 or L4-5. The combined spinal-epidural technique was conducted by inserting an epidural catheter at L2-3 or L3-4 and the catheter was threaded in space 3 to 5 cm. Spinal anesthesia was induced 1 level below the epidural catheter. Then, 0.5% hyperbaric bupivacaine was administered 3 mL using a 27-G cutting needle.

The general anesthesia was conducted using propofol 1 to 2 mg/kg, atracurium 0.5 mg/kg, or cisatracurium 0.2 mg/kg. After intubation, anesthesia was maintained using air, oxygen, sevoflurane/desflurane, and intravenous fentanyl as needed. The EA was not used during the intraoperative period. Neostigmine 0.05 mg/kg and atropine 0.02 mg/kg were administered to reverse residual muscle relaxation at the end of surgery.

Ultrasound-guided Supra-inguinal longitudinal FICB technique was done before general or spinal anesthesia. Patients were placed in the supine position. Linear US transducer was positioned longitudinally at the level of the ASIS as described by Desmet et al[7]. Iliacus muscle (IM), fascia iliaca (FI), deep circumflex iliac artery (DCIA), and "bow tie" sign was identified by sliding the US transducer in a medial and caudal direction. The needle was inserted in the plane from caudal to cranial direction. The injection point was under the FI at the level of the DCIA. The regional analgesic regimen can be divided into four groups as seven patients received 0.5% bupivacaine 20 mL, six patients received 0.33% bupivacaine 30 mL, three patients received 0.25% bupivacaine 30 mL, and three patients received 0.25% bupivacaine 20 mL.

Postoperative analgesia protocol for EA and S-FICB after total hip surgery

For all patients in LEA group, 0.08% bupivacaine with fentanyl 1 mcg/mL was infused at 5 mL/hour via the epidural catheter. Oral analgesics including acetaminophen 500 mg every six hours and etoricoxib 90 mg orally once daily, were given to every patient. Intravenous tramadol 50 mg was given every four to six hours for breakthrough pain.

For patients in S-FICB group, Oral analgesics that included acetaminophen 500 mg every six hours and etoricoxib 90 mg orally once daily, were given to every patient. Morphine intravenous 3 mg was given every four hours for breakthrough pain.

Statistical analysis

Statistical analyses were done by using Stata Statistical Software, version 16.0 (StataCorp LLC, College Station, TX, USA). Continuous variables were presented as mean ± standard deviation or median (interquartile range). Categorical variables were presented as frequency and percentage. For pair-wise relationship, a two-sample t-test or Mann-Whitney test was used to compare continuous variables and the chi-square test or Fisher's exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

Fifty-eight THA patients were included in the present study. Thirty-nine patients received LEA and 19 patients received S-FICB for their postoperative pain control. The baseline demographic data are summarized in Table 1. There was no statistical difference between the two groups with respect to gender, age, American society of anesthesiologists (ASA) physical status, and operative time. However, intraoperative blood loss was higher in LEA group with a median blood loss of 600 (500, 1000) versus 400 (250, 700), p=0.02).

NRS at 24 and 48 hours in both at rest and on movement were significantly lower in LEA group compared with S-FICB. Twenty-four hours MO equivalent consumption was also significantly lower in LEA group but there was no statistical difference in 48 hours after surgery (Table 2).

Patients who received LEA had a higher incidence of itching. However, other side-effects that included hypotension, nausea, vomiting, and dizziness were comparable between both groups. Hospital length of stay was not statistically significant different between the two groups. All patients had rated their satisfaction related to analgesic treatment as high level (Table 3).

Discussion

The present study compared the analgesic efficacy between patients that received LEA and S-FICB in THA patients. The present study results suggested that single shot S-FICB may have inferior analgesic efficacy compared with LEA. However, patients in LEA group had a higher incidence of intraoperative blood loss and incidence of itching.

In comparing the present study results to the other

Table 1. Demographic and perioperative characteristics of the two groups

	Lumbar epidural analgesia (n=39)	Supra inguinal fascia iliaca compartment block (n=19)	p-value
Age (years); mean±SD	57.94±17.89	60±15.40	0.670
Sex; n (%)			1.000
Male	11 (28.2)	6 (31.6)	
Female	28 (71.8)	13 (68.4)	
BMI; mean±SD	24.03±4.77	23.48±2.95	0.640
ASA physical status; n (%)			0.480
2	14 (35.9)	6 (31.6)	
3	25 (64.1)	12 (63.2)	
4	0 (0.0)	1 (5.2)	
Anesthetic technique (GA/SA); n (%)	5 (12.8)/34 (87.2)	5 (26.3)/14 (73.7)	0.270
Operative time (minutes); mean±SD	139.82±40.93	127.73±43.78	0.300
Blood loss (mL); median (IQR)	600 (500, 1,000)	450 (250, 700)	0.020*

ASA=American Society of Anesthesiologists; BMI=body mass index; EA=epidural analgesia; GA=general anesthesia; IQR=interquartile range; SA=spinal anesthesia; SD=standard deviation; S-FICB=supra inguinal fascia iliaca compartment block

* p<0.05 is statistically significant

Table 2. Pain numeric rating scale and morphine equivalent consumption between the two groups

	Lumbar epidural analgesia (n=39); median (IQR)	Supra inguinal fascia iliaca compartment block (n=19); median (IQR)	p-value
NRS at resting			
0 to 24 hours	0 (0, 1)	4 (2, 4)	0.000*
25 to 48 hours	0 (0, 0)	2 (0, 3)	0.005*
NRS at on movement			
0 to 24 hours	3 (0, 6)	6 (5, 8)	0.002*
25 to 48 hours	3 (0, 5)	5 (4, 8)	0.002*
Morphine equivalent consumption (mg)			
0 to 24 hours	0 (0, 5)	3 (0, 6)	0.027*
25 to 48 hours	0 (0, 0)	0 (0, 3)	0.370

IQR=interquartile range; NRS=numeric rating scale

* p<0.05 is statistically significant

Table 3. Side-effects regarding analgesic technique

	Lumbar epidural analgesia (n=39)	Supra inguinal fascia iliaca compartment block (n=19)	p-value
Adverse effects; n (%)			
Respiratory depression	0 (0.0)	0 (0.0)	-
Hypotension	2 (5.1)	0 (0.0)	1.000
Nausea/vomit	13 (33.3)	8 (42.1)	0.560
Dizziness	5 (12.8)	0 (0.0)	0.160
Itching	11 (28.2)	0 (0.0)	0.011*
Hospital length of stay (days); mean±SD	5.30±2.73	7.57±7.27	0.080
Patient satisfaction; mean±SD	9.11±0.93	8.76±1.14	0.240

SD=standard deviation

* p<0.05 is statistically significant

studies, Azizoğlu et al[12] showed that 24 and 48 hours visual analog scale were lower in the epidural group than the S-FICB. However, postoperative morphine consumption was comparable between both groups. These results can be explained by the hip joint innervation that originates from the lumbar plexus and

sacral plexus. An anterior hip joint capsule is proposed to be innervated by sensory articular branches of the femoral nerve and articular branches of the obturator nerve[13,14]. However, the posterior hip joint capsule is innervated by articular branches of the sacral plexus in terms of the sciatic nerve, nerves to the quadratus femoris, and superior gluteal nerve[13,14]. Therefore, LEA can provide analgesia in both sides of the hip capsule, but the posterior hip joint is not covered by S-FICB. EA may provide better analgesia but may associate with hypotension, urinary retention, and lower limb weakness. Therefore, a low concentration of local anesthetic with a combination of low-dose opioids are recommended.

FICB is an anterior approach to the lumbar plexus that anesthetizes the femoral nerve and lateral cutaneous nerve of thigh. However, a large volume of local anesthetic drugs can also anesthetize the obturator nerve. Studies have evaluated the minimal effective volume of FICB. Yamada et al[15] conducted a study in hip fracture patients using 0.25% ropivacaine for S-FICB under US. An effective block was defined as loss of sensation of pinprick in the territory of the femoral nerve and lateral cutaneous nerve of the thigh 30 minutes after the injection. The result showed that 95% effective volume (EV95) of 0.25% ropivacaine was 26.99 mL (95% CI 20.54 to 84.09). Vermeylen et al[16] conducted a study in healthy volunteers and assessed S-FICB with 40 mL of 1% lidocaine. Details of the sensory and motor block and spread of local anesthetics by MRI were evaluated. The results showed that 40 mL of local anesthetics with S-FICB provided more reliably spreads to the anatomical location of the three target nerves of the lumbar plexus[16]. Kantakam et al[17] conducted a cadaveric dose-finding study to investigate the minimum effective volume of dye in 90% of cases (MEV90) required to stain the femoral, lateral femoral cutaneous, and obturator nerves for ultrasound-guided S-FICB. The MEV90 in the present study was 62.5 mL. As a result, the local anesthetic dose in the present study is in the range of the previous studies. However, the effective volume of S-FICB is still inconclusive as it is from 26.7 to 62.5 mL, and further study may need to find the best effective volume for S-FICB. Another reason for improving analgesic quality in S-FICB besides local anesthetic volume is multimodal analgesic drugs that should be combined with S-FICB such as paracetamol, non-steroidal anti-inflammatory drug/cyclo-oxygenase-2-selective inhibitor perioperative, and intraoperative dexamethasone. Nonetheless, the present study was conducted with various multimodal analgesic drugs that might impact the effectiveness of S-FICB.

S-FICB has been proved in its analgesic efficacy and opioid-sparing effect in hip surgery compared with a control group[7,9,10]. Even though S-FICB had an inferior analgesic effect than LEA, it is associated with less incidence of hypotension, urinary retention, and lower limb weakness. Therefore, S-FICB combined with multimodal analgesic drugs is an alternative pain control of choice for hip replacement patients such as patients who are contraindicated for neuraxial anesthesia.

A meta-analysis by Richman et al demonstrated that neuraxial anesthesia is associated with decreased blood loss in abdominal, pelvic, and lower extremity surgery compared with GA[18] due to an increase in venous capacitance because of the sympathetic blockage. Thus, there is decreased blood volume in the arterial circulation and therefore less blood loss. Although intraoperative anesthetic techniques in the present study were mostly spinal anesthesia with normal coagulation profiles, stop antiplatelet and anticoagulant use before surgery to prevent hemorrhagic complications of neuraxial techniques, other risks of why the bleeding in LEA was more than in S-FICB could not be studied and might be one of the limitations.

The limitations in the present study are the author's retrospective and single institutional design, which significant information such as motor power and patient's recovery function were not recorded. Secondly, there was no standard postoperative analgesia management in the present study and the authors' patients in S-FICB group received various doses of local anesthetic regimen, which may impede the positive results of S-FICB. Lastly, the authors evaluated pain score up to 48 hours postoperative as well as morphine equivalent consumption, which a single shot PNB might be insufficient up to 48 hours after the blockade.

Conclusion

LEA provides better analgesia than S-FICB in THA patients. However, patients in LEA had a greater incidence of higher blood loss and incidence of itching.

What is already known on this topic?

LEA is considered a common modality for pain relief following THA. However, this benefit must be weighed against the possibility of adverse effects and complications.

What this study adds?

LEA provided superior analgesic efficacy than S-FICB. This technique is still quite easy, safe, inexpensive, and practical for anesthesiologists. However, LEA is associated with a higher incidence of blood loss and itching. S-FICB could be an alternative postoperative analgesia for THA in high-risk patients.

Conflicts of interest

The authors declare no conflict of interest.

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