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Research Article

The analgesic efficacy of continuous fascia iliaca block vs. continuous psoas compartment block after hip surgery: A comparative study

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KEYWORDS

Fascia iliaca;
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Abstract *Background:* Both psoas compartment block and fascia iliaca compartment block have been shown to be reliable blocks for postoperative pain relief for procedures involving the hip joint. This study evaluated the efficacy of continuous psoas compartment block with continuous fascia iliaca block for postoperative analgesia after hip surgery.
Methods: In randomized blinded study Forty, ASA I–III patients aged 30–75 years, with BMI less than 40, scheduled for hip surgery, were divided to one of two groups. Group P: continuous psoas compartment block (n = 18) and group F: continuous fascia iliaca block (n = 19). Standard general anesthesia was induced after finishing the block technique. After recovery 30 ml of 0.125% levobupivacaine was injected through the catheter to all patients. Postoperative 24 h meperidine consumption, patient satisfaction, visual analogue scale pain scores at (1, 6, 12, 18, and 24 h) postoperative, postoperative hemodynamics (HR and MAp), evidence of sensory and motor blockades, and incidence of adverse effects were recorded.
Results: There was no significant difference between the two groups in 24 h postoperative meperidine requirements, postoperative VAS, patient satisfaction, postoperative hemodynamics, and distribution of sensory and motor block of (femoral, lateral femoral cutaneous, and obturator nerves). The epidural anesthesia occurred in two patients in psoas group (11%).

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Conclusion: Both continuous fascia iliaca block and continuous psoas compartment block were comparable in providing safe and effective analgesia after hip surgery.

1. Introduction

After total hip arthroplasty (THA), most of patients consider the postoperative pain as severe at rest and is exacerbated during physiotherapy. Postoperative analgesia can be achieved by epidural analgesia or by patient-controlled IV analgesia. But, these techniques are associated with related side effects and poor pain relief during physiotherapy. Peripheral nerve blocks are useful in providing anesthesia and postoperative analgesia [1].

Lumbar plexus block is a good choice for pain relief after hip arthroplasty because it is the most reliable method of blocking the femoral, lateral femoral cutaneous, and obturator nerves [2].

Psoas compartment block (PCB) is a peripheral block technique that blocks the main components of the lumbar plexus (the femoral, lateral femoral cutaneous (LFC), and obturator nerves) within the psoas major muscle. It is also known as the posterior lumbar plexus block which was first described by Winnie et al. [3].

Fascia iliaca compartment block was first described by Dalens for use in pediatric patients [4], the local anesthetic diffuse under the fascia iliaca to block femoral, lateral femoral cutaneous, and obturator nerves. It is used pre and post-operatively, for fractures of the hip, total hip and knee arthroplasties [5].

Both psoas compartment block and fascia iliaca compartment block have been shown to be reliable blocks for postoperative pain relief for procedures involving the hip joint. To our knowledge there was no literature that has compared these two approaches of the lumbar plexus block. This study was designed to compare continuous psoas compartment block with continuous fascia iliaca compartment block for post-operative pain relief after hip surgery.

2. Method

After approval of the ethical committee in Dar Alshifa hospital (State of Kuwait), a written informed consent obtained from 40, American Society of Anesthesiology (ASA) physical status I–III patients aged 30–75 years, with BMI less than 40, scheduled for hip surgery (fixation of fracture neck femur or total hip replacement) under general anesthesia from December 2010–October 2011.

Patients were excluded if they were allergic to amide local anesthetics, had a history of hepatic or renal failure, had a contraindication to regional anesthesia (patient refusal, acquired or congenital coagulopathy, systemic or local infection, neurological disease affecting the lower limbs), or BMI more than 40.

During the preoperative visit, the study protocol, the posterior lumbar plexus block, fascia iliaca block, and the Visual Analogue Scale (VAS) for pain were explained to each patient.

Preoperatively, all the patients were premedicated with oral midazolam 0.1 mg/kg 30–60 min before surgery. In the operating room, 18G intravenous cannula was inserted and 8 ml/kg lactated ringer was given IV and fentanyl 50–100 μg was given. Electrocardiogram (lead II and V with ST segment analysis), pulse oximetry, non-invasive arterial blood pressure recorded every 5 min, and skin temperature were monitored.

The patients were randomly assigned to two equal groups (20 each) using closed envelope technique for randomisation.

Group (P): the continuous psoas compartment block (CPCB), was performed under strict aseptic condition using the approach of Capdevila and colleagues [1], the patient was placed in the lateral position with the side to be blocked upper and 30° flexion of the hip on the side to be blocked. The skin was prepared with antiseptic solution. The site of needle insertion was 1 cm cephalad to the junction of the medial two thirds and lateral third of the intercrestal line between the spinous processes line and the line passing through the posterior superior iliac spine and parallel to the spinous processes line. The injection site was infilterated with 3 ml Lidocaine 1%, a 110-mm 18-gauge insulated Contiplex™ needle (B. Braun Melsungen AG, Melsungen, Germany) connected to nerve stimulator, (HNS11 Stimuplex™, B. Braun Melsungen AG); with a starting current of 1.5 mA and 2 Hz was inserted perpendicular to all planes and advanced until quadriceps twitches were noticed or transverse process of L4 was encountered where the needle was withdrawn and directed under the transverse process and advanced 1.5–2 cm, until contraction of the quadriceps muscles were noticed with a current 0.5 mA. The needle bevel was directed caudally and laterally, 5 ml saline was injected to distend the psoas compartment, and a 20G catheter was introduced through the needle and advanced 5 cm beyond the needle tip and secured (by tunneling though the skin). As catheter migration to the epidural and subarachinoid spaces can occur, therefore, a test dose of 3 ml lidocaine 1% with 1:200,000 adrenaline was administered to detect intravascular or intrathecal placement.

Group (F): the continuous fascia iliaca compartment block (CFICB) was performed under strict aseptic condition using the technique of Dalens and colleagues [4], the patient was placed in the supine position and the site of needle insertion approximately 1 cm below the junction between the lateral third and medial two thirds of the inguinal ligament, The injection site was infiltrated with 3 ml Lidocaine 1% then a 18G Tuohy needle and 20G catheter (PERIFIX, B.BRAUN, Melsungen, Germany) was introduced at a 75° angle. The first resistance break (pop) was felt when the tip of needle passed through the fascia lata. The needle was advanced in the same angle until the second resistance break, corresponding to the fascia iliaca. The angle with the skin was reduced to 30° and the needle was advanced 1 cm cephalad and the catheter was introduced 15 cm beyond the tip of the needle and secured (by tunneling though the skin).

After finishing of the nerve block technique, general anesthesia was induced in all patients with i.v. propofol 2 mg/kg, fentanyl 1 μg/kg, cisatracurim 0.15 mg/kg, oral cuffed endotracheal tube was inserted, anesthesia was maintained with O_2:NO_2, sevoflorane, and mechanical ventilation was initiated with maintenance of endtidal carbon dioxide 35–40 mmHg.

At the end of surgery neuromuscular blockade was reversed, the patients were extubated and were transferred to high dependant unit (HDU) where they were monitored and the psoas compartment block or fascia iliaca compartment block were activated (After negative aspiration, 30 ml of 0.125% levobupivacaine (Chirocaine, Abbott laboratories) was injected incrementally over 5 min.

Heart rate and blood pressure monitoring was continued for 30 min after block and bilateral sensory assessment from T8 to L1 and the sensory distribution of the femoral nerve, lateral femoral cutaneous nerve, and obturator nerve were assessed using cold perception test. After establishment of the block, an infusion of 10 ml h^{-1} of 0.125% levobupivacaine was continued for 24 h.

Postoperatively, the patients were asked to quantify their pain on the Visual Analogue Scale (VAS) where zero score corresponds to no pain and 10 to the worst pain. When pain scores were > 3, bolus doses of IV meperidine (pethedine) 25 mg as rescue analgesia were given till adequate analgesia was achieved.

The following parameters were evaluated in both groups by an anesthesiologist, who was blinded to the technique used:

1. Patient characteristics.
2. Hemodynamic parameters (HR and MAP) checked every 5 min, averaged and recorded every 15 min for 30 min and then checked every 30 min, averaged and recorded at 1, 6, 12, 18, and 24 h postoperatively.
3. The severity of postoperative pain for 24 h (checked every 2 h and recorded at 1, 6, 12, 18, and 24 h postoperatively) using (VAS).
4. The amount of meperedine consumption for 24 h.
5. Patients' satisfaction using satisfaction scores (0, not satisfied; 100, very satisfied).
6. Sensory blockade of the femoral nerve (anterior surface of the thigh), lateral femoral cutaneous nerve (lateral surface of the thigh), and obturator nerve (medial and posterior surface of the knee) were assessed at 1, 6, 12, 18, and 24 h using cold perception test.
7. Evidence of motor blockade of the femoral nerves (weakness in knee extension against resistance) and obturator nerves (weakness in hip adduction against resistance) were also assessed at 1, 6, 12, 18, and 24 h.
8. Adverse effects including epidural anesthesia (excluded from the study), local anesthetic toxicity, and nausea and vomiting (treated with ondansetron 4–8 mg).

3. Statistical analysis

We calculated the sample size of 16 patients in each group based on the data from Mannion et al. [6] regarding contralateral spread of sensory block. The α-error level was fixed at 0.05 and the power was set at 90%. Because we expected some exclusions and failures, we increased the number of the sample size to 20 patients per group.

Data values are presented as means (SD), median (range) or number (percentages). Numerical data were analyzed by using Student's unpaired *t*-test. Nonparametric data were analyzed by using the Mann Whitney *U*-test. A value of $P < 0.05$ was considered significant. All statistical analysis was performed using (Microsoft office Excel).

4. Results

The demographic data are presented in (Table 1). One patient in group F and two patients in group P were excluded from the study due to technical difficulty in catheter insertion. The two groups were similar regarding age, sex, weight, height, ASA physical status and operation time.

Hemodynamic changes (heart rate and mean blood pressure) were similar in the two groups at 15 min, 30 min, 1 h, 6 h, 12 h, 18 h, and 24 h postoperatively (Tables 2 and 3).

The 24-h postoperative meperidine requirements and patients' satisfaction were similar in the two groups (Table 4). Also, there were no differences between groups in postoperative VAS at 1, 6, 12, 18, and 24 h (Table 5).

The sensory and motor blocks were similar in the two groups, femoral and lateral femoral cutaneous nerves blockade were similarly maintained 100% in the two groups until 12 h postoperative then started to decrease, while obturator nerve block was 88% and 89% in group P and group F respectively until 6 h postoperative then started to decrease similarly in the two groups (Table 6).

Regarding side effects, the epidural anesthesia occurred in two patients in group P, while nausea and vomiting occurred in two patients and three patients in groups P and F respectively. No patient developed clinical manifestations of local anesthetic toxicity (Table 7).

5. Discussion

In this study, both continuous psoas compartment block and continuous fascia iliaca compartment block provided good quality of analgesia and patient satisfaction during the first 24 h postoperatively after hip surgery as evidenced by low VAS and low postoperative meperidine requirements.

This is in agreement with many studies. Wathen et al. [7] reported that fascia iliaca compartment nerve block provided better analgesia compared with intravenous morphine in children with femur fractures. Dalens et al. [4] reported that the fascia iliac compartment block successfully block the femoral, genitofemoral, obturator nerves, and lateral femoral cutaneous nerve than the 3-in-1 block in children. Mariano et al. [8] found that both continuous femoral nerve block and continuous posterior lumbar plexus block provide good analgesia after hip arthroplasty in adults. Marino et al. [9] found that both continuous lumbar plexus and femoral blocks significantly

Table 1 Patient characteristics and operative data in the studied groups.

Variables	Group (P) (n = 18)	Group (F) (n = 19)
Age (years)	54(11)	52(10)
Weight (kg)	91.9(4.6)	92.8(4.4)
Height (cm)	173(3.1)	172(2.3)
Sex (M/F)	12/6	11/8
ASA physical status (I/II/III)	4/11/3	3/12/4
Operation time (min)	92.5(7.7)	91.5(6.80)

Values are presented as mean (SD) or number, group (P): psoas compartment block, group (F): fascia iliaca compartment block. No significant difference between the studied groups.

Table 2 Postoperative heart rate changes in the studied groups.

Time	Group (P) (n = 18)	Group (F) (n = 19)
15 min	70.8(3.5)	71.4(3.4)
30 min	69.6(4.2)	70(4.7)
1 h	71.5(3.9)	69.6(4.6)
6 h	71.6(4.4)	72.1(3.4)
12 h	68.6(4.3)	69.3(5.5)
18 h	70.8(3.9)	71.9(4.9)
24 h	66.7(4.8)	69.9(4.7)

Values are presented as mean (SD), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
No significant difference between the studied groups.

Table 3 Postoperative mean arterial pressure changes in the studied groups.

Time	Group (P) (n = 18)	Group (F) (n = 19)
15 min	98.6(3)	99.3(3)
30 min	99.2(3)	96.7(2.6)
1 h	96(3)	99.3(3)
6 h	99.1(2.6)	99.6(2.9)
12 h	99.8(2.6)	96.9(2.5)
18 h	99.3(2.9)	99.8(2.8)
24 h	96.7(2.7)	99.7(2.7)

Values are presented as mean (SD), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
No significant difference between the studied groups.

Table 4 Postoperative analgesic requirements and satisfaction score in the studied groups.

Variables	Group (P) (n = 18)	Group (F) (n = 19)
Postoperative meperidine requirements (mg/24 h)	44.4(18.3)	42.1(16.7)
Satisfaction score	90(80–100)	90(80–100)

Values are presented as mean (SD) or median (range), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
No significant difference between the studied groups.

Table 5 Postoperative Visual Analogue Score (VAS).

Time	Group (P) (n = 18)	Group (F) (n = 19)
1 h	1(0–2)	2(0–2)
6 h	2(2–3)	3(2–3)
12 h	3(2–4)	3(2–4)
18 h	3(2–4)	3(3–4)
24 h	3(3–4)	3(3–4)

Values are presented as median (range), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
No significant difference between the studied groups.

reduce postoperative opioids requirements. But continuous lumbar plexus block provided better analgesia than continuous femoral block during physical therapy following total hip

Table 6 Sensory and motor blockade.

Time	(P) group (n = 18)	(F) group (n = 19)
Femoral nerve		
1 h	18 (100)	19 (100)
6 h	18 (100)	19 (100)
12 h	18 (100)	19 (100)
18 h	15 (83)	15 (79)
24 h	14 (78)	14 (74)
Lateral femoral cutaneous nerve		
1 h	18 (100)	19 (100)
6 h	18 (100)	19 (100)
12 h	18 (100)	19 (100)
18 h	15 (83)	15 (79)
24 h	14 (78)	14 (74)
Obturator nerve		
1 h	16 (88)	17 (89)
6 h	16 (88)	17 (89)
12 h	14 (78)	14 (74)
18 h	13 (72)	13 (68)
24 h	12 (66)	11 (63)

Values are presented as number (percentages), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
No significant difference between the studied groups.

Table 7 Incidence of side effects during the follow-up period.

Variable	Group (P) (n = 18)	Group (F) (n = 19)
Epidural anesthesia	2(11)*	0
Local anesthetic toxicity	0	0
Nausea and vomiting	2(11)	3(15)

Values are presented as number (percentages), group (P): psoas compartment block, group (F): fascia iliaca compartment block.
* Significant difference ($p < 0.05$) compared to group F.

arthroplasty. Siddiqui et al. [10] concluded that continuous lumbar plexus block reduced opioid requirements, and enhances patient satisfaction compared with systemic opioids following hip replacement. Becchi et al. [11] concluded that continuous psoas compartment block is a reliable technique in providing effective postoperative analgesia after total hip arthroplasty compared to intravenous morphine/ketorolac infusion. Kaloul et al. [12] reported that both continuous psoas compartment block and continuous three in- one femoral block provided better analgesia than patient controlled analgesia (PCA) without differences between the two regional techniques after total knee replacement.

In this study, the distribution of sensory and motor block obtained by psoas compartment block or facia iliaca block was similar after the loading dose. Although the obturator nerve has been reported to be blocked better by the psoas compartment approach, I did not find any difference between the two techniques. During the study, the distribution of the sensory and motor block changed similarly with time in both groups. The block started to decrease particularly at 12 h after surgery. This can be explained by the lower volume of the local anesthetic given as infusion than the loading dose. This is in agreement with the result of Biboulet et al. [13].

In this study, the incidence of inadvertent epidural spread was 11%. While the incidence was 26% with Özalp et al. [14] and 3% with Biboulet et al. [13]. This could be explained by Mannion suggested that a large volume is more important than the approach of the PCB for epidural spread [15]. While, Gadsden et al. suggested that high injection pressure of local anesthetic could affect the occurrence of epidural spread of local anesthetics after a psoas compartment block (PCB) [16]. Also, Contralateral spread of local anesthetic may occur through the areolar connective tissue around the vertebral bodies in the lumbar region [17].

We concluded that the continuous fascia iliaca block and the continuous psoas compartment block were comparable in providing safe and effective analgesia after hip surgery. But the fascia iliaca block was simpler and could be performed with the patient supine and even in traction.

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