Original Research Article

Fascia iliaca compartment block versus 3-in-1 block in patients undergoing lower limb surgeries under spinal anesthesia: A comparative study

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Abstract

Background: Major limb surgeries are associated with significant pain and discomfort requiring aggressive pain relief measures. Various methods used for relieving postoperative pain in these patients include parenteral NSAIDs, neuraxial local analgesia, peripheral nerve block, wound infiltration and patient controlled IV analgesia. **Materials and Methods:** The study was conducted in the department of anesthesiology of a tertiary care medical college. A total of 120 patients belonging to ASA grade I, II and III undergoing lower limb surgeries under spinal anesthesia were included in this study. Out of 120 cases 60 patients were given facia iliaca compartment block (Group 1) and remaining 60 patients were given 3-in-1 block (Group 2). Both groups received 0.25% Bupivacaine after negative aspiration for blood. The demographic details and baseline vital parameters were noted and compared. In both the groups type and duration of surgeries were also compared. VAS scores before surgery and at 6, 12 and 24 hours postoperatively was noted in both the groups. Sensory and motor blockade of the nerves were also compared. Duration of analgesia, total analgesic dose in 24 hours and quality of postoperative analgesia was compared in both the groups. **Results:** Mean age, gender, ASA grades, baseline vital parameters and mean duration of surgery were found to be comparable in both the groups (P>0.05). Dynamic hip screw was the most common surgery performed in group 1 (53.33%) as well as group 2 (46.66%). Preoperative mean VAS scores were found to be comparable in both the groups. Sensory nerve blockade was found to be comparable in both the groups for Femoral, obturator and genitofemoral nerve (P>0.05) whereas higher sensory blockade was seen in lateral femoral cutaneous nerve in patients of group1 (P<0.001). Motor blockade of femoral and obturator nerve was found to be comparable with no statistically significant difference (P>0.05). **Conclusion:** Fascia iliaca compartment block and 3-in-1 block both are effective methods of postoperative analgesia in patients undergoing lower limb surgeries. Significantly higher number of patients who had been given facia iliaca compartment block reported the quality of analgesia to be excellent making it a better choice as compared to 3-in 1 block

Key Word: Lower limb surgeries, Fascia iliaca compartment block, 3-in-1 block, postoperative analgesia.

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INTRODUCTION

A detailed understanding of sensory perception and the experience of pain is fundamental to the practice of anesthesia. Anesthesia has flourished and evolved to encompass the management of pain itself in many settings, from acute postoperative pain to chronic pain states.[1] Major lower limb surgery is often painful and requires aggressive management[2]. Inadequate pain relief particularly in elderly patients may be associated with adverse effects on hemodynamic status of the patients. Severe pain may be associated with increased catecholamine release causing hemodynamic instability

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including hypertension and tachycardia. There are studies which shows that inadequate pain control may be associated with poor immune responses and delayed healing of the wound[3]. Postoperative pain relief can be achieved by a variety of techniques including parenteral NSAIDS, neuraxial local analgesics and narcotics, epidural analgesia, peripheral nerve block, wound infiltration and patient controlled IV analgesia with opioids[4].The use of lower extremity peripheral nerve blocks is a safe and effective approach to perioperative pain management[5]. One of the most common peripheral nerve blocks to facilitate postoperative analgesia for lower limb surgery is the 3-in-1 nerve block, which uses a single injection to block the femoral, lateral femoral cutaneous and obturator nerves simultaneously. The technique of 3-in-1 nerve block was first described by Winnie *et al* in 1973 in a paper titled "The inguinal paravascular technic of lumbar plexus anesthesia: the "3-in-1 block" [6]. An alternative to 3-in-1 block is Fascia iliaca compartment block (FICB) which was originally described by Dalens *et al* in 1989 for use in pediatric patients. FICB works by blocking femoral nerve as well as lateral cutaneous nerve of thigh and provides effective and safe analgesia in lower limb surgeries. One of the advantages of preoperative FICB is that adequate preoperative analgesia helps to relieve the pain associated with positioning of patient for spinal anesthesia thereby increasing the patient compliance. FICB is placed more laterally than 3-in-1 block, thereby decreasing potential for an intravascular or intraneural injection. This block reported consistent capture of the three major nerves innervating the lower extremity, combined with the anatomical safety profile and the ease in placing the block, has made the FICB a viable alternative to 3-in-1block[7]. The present study is conducted to compare the efficacy of Fascia iliaca compartment block (FICB) and '3 in 1' block in relieving post-operative pain and facilitating physiotherapy in a patient with lower limb fracture operated under spinal anesthesia.

MATERIALS AND METHODS

This was a prospective randomized control clinical study conducted in the department of anesthesiology of a tertiary care medical college situated in an urban area. The purpose of the study was to compare Fascia iliaca compartment block and 3-In-1 block for postoperative analgesia in patients undergoing lower limb orthopaedic surgeries. After approval from institutional ethical committee, sixty patients of 18-65 years of age belonging to ASA Class I, II and III, of either sex posted for hip and femur shaft surgery were selected and randomly divided into two groups. Thorough preoperative evaluation was done and all the routine investigations were carried out. Patients were kept NBM 6-8 hours before surgery. Informed written consent was obtained from all patients after detail explanation of the procedure to be performed. All the patients were taught to assess the intensity of pain using visual analogue pain scale (0-10). In preoperative room pulse rate, blood pressure, respiratory rate and Visual analogue Scale (VAS) for pain at rest and at movement were noted. After securing intravenous line, preloading was done with Inj. Ringer Lactate 10 – 15 ml/kg I.V. Patients were premedicated with either inj. Atropine 10 µg/kg or inj. Glycopyrrolate 5 µg/kg and inj. Midazolam 50 µg/kg I.M. half an hour before operation. In the operation theatre, Spinal anesthesia was given under all aseptic and antiseptic precaution using 25-gaugeQuinke's spinal needle with 2.5-3.0 ml of Bupivacaine Heavy 0.5% at L2–L3 or L3–L4 intervertebral interspace. Heart rate, non-invasive blood pressure, electrocardiography and peripheral oxygen saturation were monitored at regular interval.

At the end of surgery patients of:

Group '1: received Fascia iliaca compartment Block

Group '2: received '3 in 1' Block

Patients of both groups received 35-40 ml of 0.25% bupivacaine. The time at which, block performed was noted. In patients of group 1 Fascia iliaca compartment block was given in supine position as technique described by Dalens *et al.* with line drawing on the skin connecting the anterior superior iliac spine to pubic tubercle at the level of inguinal ligament. This line was divided into three equal parts. At the junction of the lateral and medial two thirds, a second line is drawn perpendicular to and intersecting the line joining anterior superior iliac spine and pubic tubercle. One cm below this line is the insertion point. A Tuhoy's needle is inserted perpendicular to the skin at this point. The femoral artery and nerve are 3 to 4 cm medial, so no muscle stimulation end point is sought. A "pop" or give is felt as the needle passes through the fascia lata, and a second loss of resistance is felt as it passes through the fascia iliaca. After this angle is reduced to 30degrees and needle is advanced 1-2mm further. Anesthetic solution containing 35-40 ml of 0.25% bupivacaine was injected after negative aspiration for blood. Distal compression is applied immediately caudal to needle puncture site for ten minutes to favor the proximal spread of local anesthetic drug. In patients of Group 2, the '3 in 1' block was given in supine position by the technique described by Winnie *et al.* Femoral artery was palpated below the inguinal ligament. A 3.5 cm, short bevel 23-gauge needle was advanced lateral to the artery in the cephalad direction till a 'double pop' was felt after piercing fascia iliaca and pectineal fascia, and 35-40 ml of 0.25% bupivacaine was injected after negative aspiration for blood. Distal pressure was applied

with the thumb, to the femoral sheath for ten minutes, to facilitate proximal spread. Three hours after spinal anesthesia, sensory blockade of opposite limb using pin prick test and motor blockade of opposite limb by checking movement of great toe was done to ensure that the effect of spinal anesthesia has been weared off. After that sensory blockade of operated limb on the territories of femoral nerve (anterior aspect of thigh), obturator nerve (medial aspect of thigh), LFC nerve (lateral aspect of thigh) and genitofemoral nerve (skin over scarpa's triangle) was evaluated using pin prick test. Motor blockade was assessed using knee extension (femoral nerve) and thigh adduction (obturator nerve).The results of these sensory and motor blockade were reported as either yes (complete motor and sensory blockade) or no (partial or absent motor and sensory blockade) of a given nerve territory. The patients were also assessed for pain using 10-point visual analogue scale at 30 min, 1, 2, 4, 6, 12 and 24 hours after performing block. In the postoperative period, inj. diclofenac sodium 1.5 mg/kg IV was given as rescue analgesic when VAS≥4. The time to first analgesic (duration of analgesia), total doses of analgesic requirement during 24 hours were also noted. Patients were also asked to rate their satisfaction to postoperative analgesia (excellent, good, poor).Side effects like hematoma at injection site, intravascular injection, block failure, local anesthetic toxicity was noted. The results were statistically analyzed by student's t-test and Mann-Whitney U test for Quantitative data and Chi-square test for Qualitative data.[17]P value less than 0.05 was taken as statistically significant.

Inclusion Criteria

- Patients undergoing lower limb surgeries under spinal anesthesia.
- ASA grades I, II, III.
- Age group 18-70 years.
- Patients giving informed consent.

Exclusion Criteria

- Patient giving negative consent
- Coagulation disorder
- Infection at the site of block,
- Past history of any drug reaction to local anesthetic drug.
- Neurological disease affecting lower limb.
- history of previous femoral bypass surgery
- Patient having psychiatric illness.

RESULTS

The present study was conducted in 120 patients of either sex belonging to ASA grade I, II and III scheduled for orthopedic surgeries at our hospital. The demographic data and the results obtained were compiled and analyzed statistically. The mean age, weight and gender distribution of the studied cases in both the groups were found to be comparable. Vitals were comparable in both the groups except diastolic blood pressure (P=0.03).

Table 1: Demographic details, ASA Grades and Vitals in Studied cases

Characteristics		Group 1 (n=60)	Group 2 (n=60)	P value
Age in years (Mean±SD)		41.10+15.7	41.87+15.3	0.29
Weight in kg (Mean±SD)		57.24±7.0	58.6±9.9	0.37
Sex	Males	24	26	0.96
	Females	6	4	
ASA Grades	ASA-I	22(36.66%)	18(30.0%)	0.787
	ASA-II	34(56.67%)	38(63.3%)	0.793
	ASA-III	4(6.67%)	4(6.67%)	>0.99
Vitals	Pulse /min	84.27 ± 7.57	83.13 ± 8.06	0.057
	Systolic blood pressure	123.13 ± 11.76	124.4 ± 9.95	0.074
	Diastolic blood pressure	78.80 ± 8.04	80.40 ± 6.89	0.039
	Respiratory rate /min	16.33 ± 2.35	16.4± 2.04	0.419

In Group 1 there were 53.33% patients were operated for DHS,20% patients for PFN, 10% patients for IL Nail, 6.66% patients for Hip replacement arthroplasty, 3.33% patients for Femur plating, Implant removal and Riming and K nail. In Group 2 there were 46.66% patients were operated for DHS ,30% patients for IL Nail ,10% patients for PFN, ,6.67% patients for Hip replacement arthroplasty, 3.33% patients for Dynamic condylar screw and Riming and K Nail. Maximum patients in both groups were operated for DHS. Type of surgery was comparable in both groups.

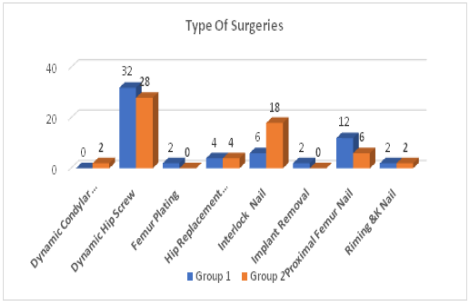

Figure 1: Type of Surgeries in studied cases.

Mean duration of surgery was 136.5±12.9 min in Group1 while 135.6 ±12.6 min in Group 2 which was comparable in both groups. (P>0.05).

Table 2: Duration of surgery

Duration of surgery	Group (n=30)	Group 2(n=30)	P-value
Time (min)Mean ±SD	136.5±12.9	135.6±12.6	0.75

In Group 1 63.33% patients had mild pain, 36.67% patients had moderate pain at rest whereas in Group 2 56.66% patients had mild pain, 43.34% patients had moderate pain at rest preoperatively. In Group 1 56.66% patients had moderate pain and 43.33% patients had severe pain whereas in Group 2 60% patients had moderate pain and 40% patients had severe pain during movement pre operatively. Preoperatively mean VAS in group 1 was 4.27±0.74 and in group 2 was 4.57± 0.73 at rest. During movement mean VAS in group 1 was 7.50±1.10 and in group 2 was 7.63± 0.25 preoperatively. Here both at rest and during movement the difference between two groups was statistically not significant. (p>0.05)

Table 3: Preoperative Visual Analogue Scale for pain

Visual Analogue Scale	VAS at rest		VAS at Movement	
	Group 1	Group 2	Group 1	Group 2
Nil	0	0	0	0
Mild(VAS ≤3)	38 (63.33%)	34 (56.66%)	0	0
Moderate(VAS 4-7)	22 (36.67%)	26 (43.34%)	34 (56.66%)	36 (60%)
Severe(VAS 8-10)	0	0	26 (43.33%)	24 (40%)
VAS(Mean±SD)	4.27±0.74	4.57±0.73	7.50±1.1	7.63±0.25
P value	**0.193**		**0.664**	

In group 1, femoral nerve was blocked in 54(90%) patients, obturator nerve was blocked in 50 (83.33%) patients, LFC nerve was blocked in 56 (93.33%) patients, genitofemoral nerve was blocked in 33(55.0%) patients. In group 2 femoral nerve was blocked in 56 (93.33%) patients, obturator nerve was blocked in 44(73.33%) patients, LFC nerve was blocked in 38 (63.33%) patients, genitofemoral nerve was blocked in 36(60%) patients. Thus, sensory blockade of femoral nerve and genitofemoral nerve was higher in patients of group 2 as compared to group 1 (93.33% v/s 90%, 60% v/s 55.0%), the difference was statistically insignificant. (p value>0.05).

Table 4: Sensory Blockade of Nerves

Sensory Blockade	Femoral	Obturator	LFC	Genito- femoral
Group 1	54/60	50/60	56/60	33/60
(n=30)	90%	83.33%	93.33%	55.0%
Group 2	56/60	44/60	38/60	36/60
(n=30)	93.33%	73.33%	63.33%	60.0%
P-value	>0.05	>0.05	<0.001	>0.05

In Group 1 motor blockade of femoral nerve occurred in 26 (43.33%) patients, obturator nerve occurred in 18 (30%) patients. While in Group 2 motor blockade of femoral nerve occurred in 36 (60.0%%) patients and obturator nerve occurred in 38(63.33%%) patients. Motor blockade of both femoral and obturator nerve was higher in patients of Group 2 in comparison to Group 1 but it was statistically not significant. (p >0.05).

Table 5: Motor Blockade of Nerves

Motor Blockade	Femoral	Obturator
Group 1(n=60)	26/60 (43.33%)	18/60 (30.0%)
Group 2(n=60)	36/60 (60.0%)	38/60 (63.33%)
P-value	0.795	0.584

In both the groups, none of the patients had complained of pain at rest up to six hours postoperatively. In group 1 at twelve hours after surgery, 18 patients had no pain, 20 patients had mild pain, 22 patients had moderate pain and no patients had severe pain at rest. In group 2 at twelve hours after surgery 8 patients had no pain, 20 patients had mild pain, 32 patients had moderate pain and no patients had severe pain at rest. All patients were given supplemental dose of analgesic in the form of inj. Diclofenac sodium 75 mg IV when VAS ≥4 at rest. After surgery, at movement up to 4 hours no patient had complain of pain in both groups. Four patients in both groups complained of mild pain at movement six hours postoperatively. In group 1 at movement, 12 patients had no pain, 22 patients had mild pain, 26 patients had moderate pain and none of the patient had severe pain at 12 hours postoperatively. In group 2 at movement, 4 patients had no pain, 24 patients had mild pain, 32 patients had moderate pain and no patients had severe pain at 12 hours postoperatively.

Table 6: Post-operative Visual Analogue Scale for Pain at rest and at movement

Pain At rest								
Time Since Block	Number of Patients (Group A)				Number of Patients (Group B)			
	No Pain	Mild Pain	Moderate Pain	Severe Pain	No Pain	Mild Pain	Moderate Pain	Severe Pain
Upto 6 hrs	60	0	0	0	60	0	0	0
12 hrs	18	20	22	0	8	20	32	0
24 hrs	0	0	60	0	0	0	60	0
Pain at Movements								
Time Since Block	Number of Patients (Group A)				Number of Patients (Group B)			
	No Pain	Mild Pain	Moderate Pain	Severe Pain	No Pain	Mild Pain	Moderate Pain	Severe Pain
Upto 4 hrs	60	0	0	0	60	0	0	0
6 hrs	52	8	0	0	52	8	0	0
12 hrs	12	22	26	0	4	24	32	0
24 hrs	0	0	56	4	0	0	54	6

Mean visual analogue scale 6 hours after surgery during movement was 0.33±0.88 in group 1 while in group 2 was 0.67±0.02. Mean visual analogue scale 12 hours after surgery at rest was 2±1.71 in group 1 while 2.8±0.9 in patients of group 2 , which was statistically not significant.(p=0.06).There was significant difference in visual analogue scale at 12 hours after surgery during movement with mean VAS of 3.43±2.36 in group 1 and mean VAS of 4.57±0.15 in group 2.(p=0.03).There was no significant difference noted in both groups in terms of VAS at 24 hours postoperatively both at rest and during movement. (p value >0.05).

Table 7: Mean Visual Analogue Scale (at different time interval)

Time	At Rest		P Value	During Movement		P Value
	Group 1	Group 2		Group 1	Group 2	
6 Hrs	0	0	>0.99	0.33±0.88	0.67±0.02	0.105
12 Hrs	2±1.74	2.8±0.9	0.060	3.43±2.36	4.57±0.15	**0.036**
24 Hrs	4.47±0.50	4.57±0.15	0.531	6.67±0.66	6.57±0.22	0.518

Total duration of analgesia was 12.97±3.06 hours in fascia iliaca group compared to 11.93±3.02 hours in 3 –in -1 group which was statistically not significant (p = 0.190).

Table 8: Duration of Analgesia in Hours

	No. of patients	Duration of analgesia in hours
Group 1	60	12.97 ± 3.06
Group 2	60	11.93± 3.02

Mean requirement of supplemental analgesic was 1.50±0.63 in group 1 and 1.67±0.71 in group 2

Table 9: Analgesic dose required in 24 hours

Total analgesic dose required in 24 hours	Group 1	Group 2
1	34 (56.7%)	28 (46.67%)
2	22 (36.66%)	24 (40%)
3	4 (6.66%)	8 (13.33%)
Mean±SD	1.50±0.63	1.67±0.71

which was statistically insignificant. (p = 0.331).

At the end of study, patients were asked about the quality of postoperative analgesia. In group 1 quality of analgesia was rated as excellent by 76.67%, good by 15.0% and poor by 8.3% of the patients. In group 2 quality of analgesia was excellent in 46.7%, good in 40.0% patients and poor in 13.3%. Thus, both the block provides effective analgesia postoperatively, the difference is

Table 10: Quality of postoperative analgesia

Patient's Acceptance	Group 1	Group 2
Excellent	46 (76.67%)	28 (46.7 %)
Good	9 (15.0 %)	24 (40.0%)
Poor	5 (8.3 %)	8 (13.3%)
Total	**60 (100.0%)**	**60 (100.0%)**

highly significant (p<0.001)

No incidence of side effects like hematoma, accidental intra vascular injection, Block failure or local anesthetic toxicity was seen during the study in any patients of both groups.

DISCUSSION

The purpose of our study was to determine which, the femoral nerve block or fascia iliaca compartment block, provides superior postoperative analgesia. We conducted prospective randomized controlled study in 120 patients of ASA Class I, II and III scheduled for lower limb orthopedic surgeries. In Group 1, mean age was 41.10±15.7 years whereas in Group 2 mean age was 41.87±15.3 years (P>0.05). The age distribution in both groups was almost similar. Mean weight, sex distribution as well as ASA status of the patients were comparable amongst two groups. This is similar to the study conducted by Capdevila X *et al.*, a comparison of 3-in-1block (Group 1) and fascia iliaca compartment block (Group 2) in adults by two single-injection, anterior approach techniques to simultaneously block the femoral, obturator, and lateral femoral cutaneous (LFC) nerves in which no difference between two groups were noted concerning age, weight, type and duration of surgery[8]. Type of surgery was comparable in both groups. Maximum patients in both groups were operated for DHS. Duration of surgery was 136.50±12.9 min in Group1 while 135.6±12.6 min in Group 2 which was not significant (P>0.05) and maximum duration of surgery in our study was 150 min. We conducted surgeries under spinal anesthesia because regional anesthesia provides special benefits in lower limb orthopedic surgeries. All patients received spinal anesthesia with hyperbaric bupivacaine 13-15 mg with fentanyl 13-15µg and epinephrine 100 µg.[3] Similar technique was used by the authors such as Shrivastava Uma et.al[9] and Souza De Lima R *et al*[10]. We observed that sensory blockade of femoral nerve was present in 90% patients in Group 1 compared to 93.33% patients in Group 2.Motor blockade of femoral nerve was found in 43.33% patients in Group 1compared to 46.67% patients in Group 2.Though the sensory and motor blockade was higher in patients of Group 2, the difference between two groups was statistically not significant. Capdevila X compared the 3-in-1 (Group 1) and fascia iliaca compartment (Group 2) blocks by two single-injection, anterior approach procedures used to simultaneously block the femoral, obturator, and lateral femoral cutaneous (LFC) nerves after lower limb surgery. They observed sensory blockade of femoral nerve in 90% patients of Group 1 and in 88% patients of Group 2. The motor blockade of femoral nerve was present in 76% patients in Group 1 and 80% patients of Group 2.Similar sensory block pattern was reported by the authors such as Wallace B *et al*[11] and Ashraf *et al*[12]. We observed blockade of LFC nerve in 93.33% patients of group 1 as compared to 63.33% patients of group 2 and this difference was statistically highly significant. (p<0.005). Dalens B *et al*[7] in 1989 compared Fascia Iliaca block and 3-in-1 block in children. They observed blockade of LFC nerve in more than 90% patients who received fascia iliaca block compared to only in 15% patients who received 3-in-1 block. The difference noted by them was statistically significant.[4] We observed blockade of genitofemoral nerve in 53.33% patients of group 1 as compared to 60% patients of group 2. The difference between both groups was not statistically significant. Similar outcome was reported by EhadawayS *et al*[13]. Postoperatively patients were assessed for pain by Visual analogue scale (0-10) at regular intervals both at rest and during movement. All patients had either no pain or mild pain up to six hours after performing block and there was no significant difference between two groups up to this time both at rest and during movement. All patients had received inj. diclofenac sodium 1.5mg/kg i.v. as rescue analgesic when patient complained of moderate pain (VAS ≥ 4). No significant difference in VAS was noted at 24 hours after surgery. Total duration of analgesia was 12.97±3.06 hours in fascia iliaca group and 11.93±3.02 hours in 3 –in -1 group. However, the difference between two groups was statistically not significant. (p value = 0.190). Mean requirement of supplemental analgesic was 1.50±0.63 in group 1 and 1.67±0.71 in group 2 which was statistically not significant. (p >0.05). The results were similar to the study undertaken by Farid Is *et al*[14] and Kearns R *et al* [15] .

Although the difference noted in postoperative VAS was statistically insignificant at 30 min 1, 2, 4,6,12 hours at rest in both groups, lower VAS was observed in group 1 patients suggest more effective analgesia in this group. Significant difference in VAS was noted at 12 hours postoperatively during movement; with a lower VAS in patients of group 1 compared to group 2 However VAS at 24 hours postoperatively was comparable in both groups. Though the duration of analgesia was longer in group 1 as compared to group 2, the difference was statistically not significant. Rescue analgesic consumption in 24-hour period was more in group 2 but the difference was statistically insignificant. Patient acceptance was similar in both groups.

CONCLUSION

The fascia iliaca compartment block and the 3-in-1 block, both are effective methods of postoperative analgesia following hip and femur shaft surgery. As compared to 3-in-1 block, Fascia iliaca compartment block provides more consistent sensory blockade of lateral femoral cutaneous nerve which innervates the skin of the incisional area of hip and femur shaft surgery. Fascia iliaca compartment block may be useful when continuous passive motion is initiated in early postoperative period as it improves analgesia during activity. Thus, the fascia iliaca compartment block may represent an attractive alternative to 3-in-1 block for treatment of pain after lower limb orthopedic surgery.

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