

Comparative study on analgesic efficacy between 0.25% Bupivacaine and 0.2% Ropivacaine for USG guided Fascia iliaca compartment block for femur surgeries under epidural anesthesia

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Abstract

Introduction: Femur fractures cause moderate to severe pain which requires effective analgesia both preoperatively and postoperatively, poor pain management can have serious physiological and psychological consequences.

Aim: To compare the postoperative analgesic efficacy between 0.25% Bupivacaine and 0.2% Ropivacaine in ultrasound guided fascia iliaca compartment block for femur surgeries under epidural anaesthesia.

Materials and Methodology: This is a randomized clinical study conducted at a tertiary care centre, after receiving approval from institute's ethical committee. 60 patients posted for femur surgeries under epidural anesthesia were divided into groups of 30 each. Postoperatively ultrasound guided fascia iliaca block using 0.25% bupivacaine 20 ml for group B and 0.2% Ropivacaine 20 ml was given to group R and are compared. The time from fascia iliaca compartment block to first requirement of analgesia for both the groups calculated.

Results: Demographic characteristics and BMI are statistically similar between both the groups. The mean time for duration of analgesia for bupivacaine group was 307.83 ± 34.43 minutes and that of Ropivacaine group was 262.67 ± 31.39 minutes. So, the mean duration of post-operative analgesia of the Bupivacaine group was more than that of Ropivacaine group which was statistically significant. Both the groups maintained hemodynamic stability.

Conclusion: We observed that the postoperative analgesia was definitely of a longer duration with the Bupivacaine group when compared to Ropivacaine group. So, it is concluded that 0.25% Bupivacaine is better in providing prolonged satisfactory postoperative analgesia as compared to 0.2% Ropivacaine when both are used as postoperative analgesia.

Keywords: Bupivacaine, ropivacaine, fascia iliaca compartment block, postoperative analgesia

Introduction

Preoperative analgesia in surgeries involving femur fractures has been a challenge to the Anaesthesiologist since ages. Perineural analgesia is becoming popular as it provides comparable pain relief and decreases the side effects associated with central neuraxial blockade. We decided to compare the post-operative analgesic efficacy between 0.25% Bupivacaine and 0.2% Ropivacaine in USG guided Fascia iliaca block for femur surgeries under Epidural Anaesthesia. Femur fractures cause moderate to severe pain which requires effective analgesia both preoperatively and postoperatively. Multimodal analgesic regimens which include Nonsteroidal anti-inflammatory drugs, opioids & various regional analgesic techniques have been used in femur surgeries so far. NSAIDs even in moderate dose cause adverse effects, especially in the elderly population. Although opioids are potent analgesics, they are associated with serious adverse effects like drowsiness, nausea, respiratory depression, constipation etc. limiting their use.

The Fascia iliaca block (also called the fascia iliaca compartment block) is considered an alternative to a femoral nerve or a lumbar plexus block. Since the femoral nerve and lateral cutaneous nerve (LFCN) lie under the fascia of the iliacus muscle, a sufficient volume of local anesthetic deposited deep to the fascia iliaca, may spread underneath the fascia in a medial and lateral direction to reach the femoral nerve and sometimes the LFCN.

Before ultrasound (US), the technique involved needle placement at the lateral third of the distance from the anterior superior iliac spine to the pubic tubercle, using a “double-pop” technique as the needle passes through the fascia lata and fascia iliaca. However, block success with this “feel” technique is sporadic because false “pops” can occur. In contrast, the USG-guided technique allows monitoring of the needle placement and local anesthetic delivery and ensures delivery of the local anesthetic into the correct plane.

Bupivacaine

Bupivacaine is an amide type long-acting local anaesthetic. It reversibly binds to specific sodium ion channels in the neuronal membrane and inhibition of depolarization and nerve impulse conduction and a reversible loss of sensation. It is used for local anesthesia by percutaneous infiltration, peripheral nerve blocks and central neuraxial blocks (caudal and epidural).

Ropivacaine

Ropivacaine is a long-acting amide local anaesthetic agent, structurally related to Bupivacaine. It is a pure S (-) enantiomer. It acts by reversible inhibition of sodium ion influx in nerve fibres. Ropivacaine is less lipophilic than bupivacaine and is less likely to penetrate large myelinated motor fibres, resulting in a relatively reduced motor blockade. The reduced lipophilicity is also associated with decreased potential for central nervous system toxicity and cardiotoxicity.

Materials and Methodology

This Prospective randomized double blinded clinical study conducted in Department of Anaesthesiology, Rajah Muthiah Medical College and Hospital, Chidambaram, in the study period of November 2020 to November 2022 (2 years), after approval from institutional

Ethical committee, study was conducted after obtaining informed consent from all the patient. 60 Patients posted for femur surgeries under epidural anesthesia, randomly assigned into 2 groups (group B & group R) with 30 patients each, Fascia iliaca compartment block was given at the end of surgery with 20 ml of 0.25% Bupivacaine for group B patients, and 20 ml of 0.2% Ropivacaine for Group R patients. Patient is monitored post operatively.

Inclusion criteria

Age 18-70 years, All ASA I & II Patients with Femur fractures posted for surgeries under Epidural Anaesthesia.

Exclusion criteria

ASA >III, BMI < 25 and > 35, Past H/O Cardiac, Respiratory, Hepatic and Renal diseases, Polytrauma, Coagulation abnormalities, disorders of spine, local infection at site of lumbar puncture and other contraindications for epidural anaesthesia including, Patient refusal, Patients allergy to any of study Medications, Patient on medication with Opioid and other adreno receptor agonist and antagonist, Patients with chronic pain disorders and abuse of drugs and alcohol.

Parameters monitored: NIBP, Heart Rate, Respiratory Rate, Spo2.

Onset and Duration of post-operative analgesia

- The time from Fascia iliaca compartment block to first requirement of analgesia was calculated.
- When VAS score reached more than 4, rescue analgesia was administered. Post-operative follow up was carried out in the recovery and post-operative ward.
- Vitals were monitored (HR/BP/SPO₂) continuously and recorded at regular intervals.

Side effects: If any (Hypotension, Bradycardia, Pruritus, Nausea, Vomiting) noted

Data collection: Information on age, gender, height, weight, comorbidities were extracted from proforma collected by anesthetist who is not involved in the study.

Statistical analysis

The data collected were entered into Microsoft excel 360 in order to create a master chart. The master chart was then loaded into statistical package for social sciences (SPSS) version 26 for further statistical analysis. Both quantitative and qualitative variables were present in the master chart. Both descriptive and inferential statistics were used for analysis.

For describing the qualitative variables, frequency and percentages were used. For describing the quantitative data, mean and standard deviation were used. In order to find out difference in distribution of qualitative variable between the experimental arms, chi-square test was applied. To find out the difference in mean between two groups, independent samples T test was applied. To find out the difference in change of mean between the groups for a repeatedly measured variables, Repeated measures analysis of variance (RM-ANOVA) was used. A P value of less than 0.05 was considered to be statistically significant.

Results

Table 1: Comparison of mean age between bupivacaine and ropivacaine groups

Groups	Age in years		t*	P value
	Mean	SD		
Bupivacaine	44.47	12.11	0.893	0.376
Ropivacaine	47.13	10.99		

*Independent samples t test was applied.

The mean age among the participants in the bupivacaine group was 44.47 ± 12.11 years and that of the ropivacaine group was 47.13 ± 10.99 years. The mean age of both the groups were found to be similar with P value of more than 0.05.

Table 2: Distribution of sex between the groups

Variables		Bupivacaine		Ropivacaine		X ² *	P value
		N	%	N	%		
Sex	Male	17	56.6	14	46.6	0.601	0.438
	Female	13	43.4	16	53.4		

*Chi square test was applied.

Among the participants in the bupivacaine group, 56.6% were males and among those in the ropivacaine group, 46.6% were males. The distribution of sex was found to be similar between the groups with P value of more than 0.05.

Table 3: Comparison of mean BMI between bupivacaine and ropivacaine groups

Groups	BMI in Kgs /m ²		t*	P value
	Mean	SD		
Bupivacaine	28.20	1.93	0.063	0.950
Ropivacaine	28.17	2.18		

*Independent samples t test was used.

The mean BMI among the participants in the bupivacaine group was 28.20 ± 1.93 Kg/m² and that of the ropivacaine group was 28.17 ± 2.18 Kg/m². The mean BMI of both the groups were found to be similar with P value of more than 0.05.

Table 4: Distribution of ASA between the groups

Variables		Bupivacaine		Ropivacaine		X ² *	P value
		N	%	N	%		
ASA	I	11	36.7	10	33.3	0.073	0.787
	II	19	63.3	20	66.7		

*Chi square test was applied.

Among the participants in the bupivacaine group, 36.7% were ASA I and among those in the ropivacaine group, 33.3% were ASA I. The distribution of ASA was found to be similar between the groups with P value of more than 0.05.

Table 5: Mean change in heart rate between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
0	81	8.83	80.80	8.68	0.007 ^s	0.272 ^s
15 mins	92.20	11.63	84.13	8.83		
30 mins	90.50	10.33	84.50	8.89		
45 mins	84.87	8.52	83.33	8.01		
60 mins	84.93	9.01	83.13	8.31		
90 mins	86.13	9.12	83.90	7.93		
2 hrs	84.40	8.58	83.47	7.66		
2.5 hrs	82.80	9.31	82.80	8.84		
3 hrs	81.33	8.41	81.87	8.71		
6 hrs	82.07	7.65	81.07	7.21		

*Repeated measures ANOVA was applied.

^sStatistically significant.

Over the follow up period the mean heart rate was found to be declining in both the groups. The decline was found to be significant within each group with P value of less than 0.05. The trend between the groups was similar with P value of more than 0.05.

Table 6: Mean change in systolic blood pressure between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
0	126	10.34	126.07	9.86	0.180 ^s	0.053 ^s
15 mins	112.87	12.21	119.40	9.71		
30 mins	113.73	10.41	120.13	9.21		
45 mins	119.67	8.23	123.07	9.31		
60 mins	117.07	9.61	122.60	10.25		
90 mins	118.60	10.79	122.27	10.68		
2 hrs	117.40	9.19	122.20	10.29		
2.5 hrs	118.0	10.31	122.67	10.54		
3 hrs	118.20	10.21	122.53	9.82		
6 hrs	118.40	10.05	122.93	10.42		

*Repeated measures ANOVA was applied.

^sStatistically significant

Over the follow up period there was not much change in mean systolic blood pressure with P value of more than 0.05. The trend between the groups were also found to be similar with P value of more than 0.05.

Table 7: Mean change in diastolic blood pressure between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
0	80.93	7.02	80.93	7.02	0.489 ^s	0.106 ^s
15 mins	76	7.22	78.40	6.99		
30 mins	76.73	5.78	78.67	6.22		
45 mins	76.33	6.43	78.27	6.59		
60 mins	75.13	5.52	78.07	5.83		
90 mins	75.20	4.35	78	5.81		
2 hrs	76.53	4.72	79.20	5.13		
2.5 hrs	77.33	4.99	79.27	5.11		
3 hrs	78.13	5.41	79.80	4.93		
6 hrs	78.60	4.98	79.80	4.81		

*Repeated measures ANOVA was applied.

^sStatistically significant.

Over the follow up period there was not much change in mean diastolic blood pressure with P value of more than 0.05. The trend between the groups were also found to be similar with P value of more than 0.05.

Table 8: Mean change in respiratory rate between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
0	14.07	1.33	14.07	1.23	0.984 ^s	0.058 ^s
15 mins	13.97	1.58	14.27	1.55		
30 mins	14.07	1.43	14.47	1.35		
45 mins	13.60	1.61	14.07	1.61		
60 mins	13.93	1.33	13.87	1.47		
90 mins	13.87	1.57	14.13	1.38		
2 hrs	14.07	1.43	14.07	1.53		
2.5 hrs	13.87	1.81	14.27	1.55		
3 hrs	13.73	1.25	14.00	1.81		
6 hrs	13.67	1.74	13.87	1.38		

*Repeated measures ANOVA was applied.

^s Statistically significant.

Over the follow up period there was not much change in mean respiratory rate with P value of more than 0.05. The trend between the groups were also found to be similar with P value of more than 0.05.

Table 9: Mean change in SpO2 between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
0	98.83	0.87	99.13	0.86	0.903 ^s	0.339 ^s
15 mins	98.83	0.64	98.97	0.71		
30 mins	98.87	0.82	98.97	0.81		
45 mins	98.90	0.71	99.10	0.81		
60 mins	98.97	0.67	98.90	0.75		
90 mins	99.10	0.71	99.10	0.71		
2 hrs	98.90	0.81	98.93	0.78		
2.5 hrs	98.90	0.75	98.83	0.83		
3 hrs	98.67	0.66	98.73	0.58		
6 hrs	98.97	0.55	98.90	0.66		

*Repeated measures ANOVA was applied.

^s Statistically significant.

Over the follow up period there was not much change in mean SpO2 with P value of more than 0.05. The trend between the groups were also found to be similar with P value of more than 0.05.

Table 10: Mean change in VAS between the groups over the timeline

Timeline	Bupivacaine		Ropivacaine		P value*	
	Mean	SD	Mean	SD	Within	Between
15 mins	0	0	0	0	0.001 ^s	0.001 ^s
30 mins	0	0	0	0		
45 mins	0	0	0	0		
60 mins	0	0	0	0		
90 mins	0	0	0	0		

120 mins	0	0	0	0		
150 mins	0.03	0.18	0.33	0.54		
180 mins	0.13	0.43	0.73	0.78		
240 mins	2.07	0.94	3.07	1.1		
300 mins	2.73	0.94	4.07	0.52		
360 mins	4.57	0.50	4.73	0.69		

*Repeated measures ANOVA was applied.

§ Statistically significant.

Over the follow up period the mean VAS was found to be increasing in both the groups with P value of less than 0.05. The trend was also found to be different between the groups with P value of less than 0.05.

Table 11: Parameter estimate showing difference in mean VAS score at each follow up period

Timeline	Bupivacaine		Ropivacaine		P value
	Mean	SD	Mean	SD	
15 mins	0	0	0	0	-
30 mins	0	0	0	0	-
45 mins	0	0	0	0	-
60 mins	0	0	0	0	-
90 mins	0	0	0	0	-
120 mins	0	0	0	0	-
150 mins	0.03	0.18	0.33	0.54	0.006
180 mins	0.13	0.43	0.73	0.78	0.001
240 mins	2.07	0.94	3.07	1.1	0.001
300 mins	2.73	0.94	4.07	0.52	0.001
360 mins	4.57	0.50	4.73	0.69	0.290

No one had reported pain in the initial 120 minutes of follow up. The mean VAS score reported in the ropivacaine group was more than the bupivacaine group at 150, 180, 240 and 300 minutes, respectively. At 360 minutes the mean VAS reported was similar between the groups with P value more than 0.05.

Table 12: Comparison of mean time for duration of analgesia between bupivacaine and ropivacaine groups

Groups	Duration of analgesia		t*	P value
	Mean	SD		
Bupivacaine	307.83	34.43	5.309	0.001
Ropivacaine	262.67	31.39		

*Independent samples t test.

The mean time for duration of analgesia among the participants in the bupivacaine group was 307.83 ± 34.43 minutes and that of the ropivacaine group was 262.67 ± 31.39 minutes. The mean duration of analgesia of the bupivacaine group was more than that of the ropivacaine group with P value of less than 0.05.

- No participant of either group reported any side effects.

Discussion

Successful pain management enhances early ambulation and reduces hospital stay ^[1]. Regional blocks are an essential tool in the field of pain management ^[2]. Peripheral nerve blocks can be used alternative to epidural analgesia, but failure rate was high in peripheral

nerve blocks in anatomic landmark based approaches^[3]. With the advent of ultrasonogram, peripheral nerve blocks gain popularity for lower limb surgeries^[4]. Ultrasonographic guidance has made the technique safer and reduced systemic side effects^[5]. Ultrasound guidance has improved the accuracy of anesthetic injections and increased procedural safety^[6]. One of the most easiest USG guided peripheral nerve block used for postoperative pain relief especially for femur surgery is the Fascia Iliaca Compartment Block (FICB)^[11]. FICB is an integral part of the multimodal analgesia that is used to provide postoperative analgesia in lower limb orthopedic surgeries^[7]. A single injection for FICNB could lead to postoperative pain relief, reduction of total analgesic consumption and prolonged time for the first analgesic request in the FICNB group after surgery for femur bone fracture^[8]. This single intervention blocks four nerves, namely, the femoral, lateral femoral cutaneous nerve, obturator and the genitofemoral^[9]. However, FICB is more of a sensory block^[10]. Being a pure sensory block, a lower concentration of LA, i.e., 0.25%, has been found to be effective^[11]. The FICB effectively blocks femoral and lateral cutaneous nerve of thigh, thus provides effective pre and post-operative analgesia in patients with fracture neck of femur, femoral shaft fracture, Trochanteric fracture and total hip replacement^[12]. In this technique the needle trajectory is unlikely to encroach on major blood vessels and nerve trunks^[13]. Hence the safety and simplicity of this block and its efficacy augmented by ultrasound makes the block most potential for hip fractures^[14]. For the same reason it would be very easy to teach and could be performed by healthcare professionals even with limited experience of ultrasound^[15]. In our study, Demographic characteristics and BMI are statistically similar between both the groups. Group B showed statistical similarity with Group R in view of HR, BP, RR and SPO2. Over the follow up period the mean VAS score reported in the Ropivacaine group was more than Bupivacaine group. The mean time for duration of analgesia for bupivacaine group was 307.83±34.43 minutes and that of Ropivacaine group was 262.67±31.39 minutes. So, the mean duration of post-operative analgesia of the Bupivacaine group was more than that of Ropivacaine group which was statistically significant.

Conclusion

We observed that postoperative analgesia with ultrasound guided FICB was definitely of a longer duration with the Bupivacaine group when compared to Ropivacaine group. So, it is concluded that 0.25% Bupivacaine is better in providing prolonged satisfactory postoperative analgesia as compared to 0.2% Ropivacaine when both are used as postoperative analgesia.

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