SINGLE SHOT FASCIA ILIACA COMPARTMENT BLOCK BY AN ORTHOPAEDIC RESIDENT ANALGESIA FOLLOWING HIP SURGERY

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ABSTRACT

Background: Trauma and surgery are among the leading causes of acute pain globally. However, acute pain is inadequately managed in approximately 50% of these patients. Fascia Iliaca Compartment Block (FICB) is an inexpensive regional anaesthesia that offers additional pain control as part of multimodal analgesia.

Objective: The study assessed the efficacy of a single shot FICB in reducing post-operative pain when administered by an orthopaedic resident.

Design: This was a two-arm single blinded Randomized Controlled Trial (RCT) among patients who had undergone hip surgery at a Kenyan tertiary hospital between July 2017 and March 2019.

Methods: Those in the intervention arm received a single shot block administered through the landmark technique while the control arm received systemic analgesia alone. Pain intensity was assessed using the numerical rating scale after hip surgery with the limb in anatomical position and flexed at 15 degrees.

Results: Thirty five participants were randomized into each arm of the trial. The mean pain scores significantly declined at two, four and six hours following hip surgery in the intervention arm. The block failure rate was six (17%). Neck of femur fracture diagnosis and posterior surgical approach were associated with FICB failure (p=0.001).

Conclusions: Pain relief following hip surgery was superior for the first 6 hours in patients who received FICB based on the landmark technique by an orthopaedic resident compared to standard of care. Failure could be attributed to surgical approach.

Recommendations: A formal education program on FICB should be introduced for orthopaedic residents in a bid to improve postoperative pain management following hip surgery in low resource settings.

Key words: Postoperative pain, Fascia iliaca compartment block, Hip surgery, Numerical rating scale.

INTRODUCTION

Lower extremity pain from trauma is a commonly presenting complaint in clinical settings (1). Particularly, hip fractures can cause intense pain making analgesia challenging (2). A 2011 survey by the International Association for the Study of Pain (IASP) established that acute pain is inadequately managed in nearly 50% of patients with trauma and in patients who have undergone surgery (3).

Lower extremities are innervated by the sciatic nerve, femoral nerve, obtrutor and the lateral femoral cutaneous nerve (2,4). All the nerves originate from the lumbar plexus with the sciatic nerve carrying nerve roots from S1-S3 (5). The femoral nerve is the second largest of the nerves and is situated laterally to the femoral artery on top of the iliac muscle (5,6). The fascia iliaca separates the femoral nerve from the femoral artery (7). It runs below fascia lata and anterior to the iliac, psoas muscle and pectineus muscle (8). The sartorious muscle and femoral vessels are located between fascia lata and fascia iliaca (7).

Fascia Iliaca Compartment Block (FICB) is a low-tech, inexpensive regional anaesthetic

block commonly performed by anaesthetists, emergency nurses, emergency doctors and paramedics (9). First described in 1989 (10), the block provides analgesia for hip fractures, above knee amputations, knee surgery (in combination with sciatic nerve block), femoral bone fractures, lower limb tourniquet pain and following hip surgery. The block was initially described using the landmark technique, also known as the 'two pop' technique. In this technique, a blunted or short-bevelled needle is inserted at a point 1cm caudal from the lateral and middle third of a line drawn from the anterior superior iliac spine and the pubic tubercle and a 'pop' felt first in the fascia lata and then second 'pop' fascia Iliaca penetration.

Anatomically, the needle penetrates the femoral triangle in the fascia Iliaca sheath, to target the femoral nerve and the lateral cutaneous nerve of the thigh (Range & Egeler, 2010). In one third of cases, the obturator nerve is blocked by the spread of local anaesthetic between the psoas and iliacus muscles. The block may be administered either as a single shot or as a continuous infusion via a catheter. Studies conducted in Argentina reported a significant reduction of pain among patients who received FICB for a hip fracture (8). In a ten-point scale, the patients initially rated the pain averagely at 8.5 prior to administration which significantly reduced to an average of 2.3 two hours post injection (11). Patients on FICB have been reported to receive significantly less amounts of morphine over a 24-hour course of treatment in comparison to those who used morphine alone (12). Longer duration of analgesia has been demonstrated among patients on FICB that lasts eight to ten hours following a single shot block (13).

The study primarily aimed at assessing whether a single shot FICB performed by an orthopaedic resident using the landmark technique would be effective in reducing post-operative pain when used as part of multimodal analgesia following hip surgery at a tertiary hospital in Kenya. Specifically, it compared postoperative pain intensity with the limb in the anatomical position and when flexed at 15 degrees between two arms. Lastly, the study assessed the block failure rate.

MATERIALS AND METHODS

This was a two-arm single blinded Randomized Controlled Trial (RCT) conducted among patients who had undergone hip surgery at Moi Teaching and Referral Hospital (MTRH), Eldoret-Kenya. The intervention arm received a single shot of Fascia Iliaca Compartment Block (FICB) along with standard analgesia while the other group received standard analgesia alone. The block was performed by an orthopaedic resident (NM) following a 2-day training under the supervision of a consultant anaesthesiologist with fellowship training in regional anaesthesia (SN). The procedure was carried out in the Post-Anaesthesia Care Unit (PACU) immediately following surgery. The presence of intravenous access was confirmed and vital signs (blood pressure, heart rate, respiratory rate and temperature) were noted. With aseptic precautions, an imaginary line was drawn on the operative limb from the anterior superior iliac spine to the pubic tubercle and divided into thirds. A blunted short bevelled needle was then introduced one centimetre distal to the junction of the medial two thirds and the lateral third. The femoral artery was palpated to ensure that the vessels were medial to the point of entry. Once through the skin the needle was angled to 60 degrees, directing the tip cranially. The needle was then advanced, keeping it in the sagittal plane to avoid injury to the vessels, until two distinct pops were felt. The needle angle was then reduced to 300 and advanced another 1-2mm to enter the fascia iliaca compartment. Local anaesthesia was then injected in 5mls aliquots with intermittent aspiration so as to ensure that needle was not in a vessel. Plain bupivacaine 0.5% was used at a dose of 0.35ml/kg (1.75mg of bupivacaine/kg). Drug dosages were calculated by the resident administering the FICB and counter-checked by a clinician in theatre. Vital signs were monitored continuously before, during and after block performance as is standard practice in the MTRH PACU. Procedure notes were documented in the patient's file. The study definition of a successful block was the lack of perception to cold stimuli (the metallic handle of a patella hammer) on the anterior, medial and lateral compartment of the thigh and a 3-point drop on the numerical rating scale. A failed block was defined as the absence of a 3-points reduction in the Numerical Rating Scale (NRS) 15 minutes after block administration, and normal sensation to cold. Block efficacy was determined by the difference between numerical rating scale pain scores at rest and at 150 leg lift between the intervention and control arms of the study. Follow-up pain scores were collected after 2, 4, 6 and 8-hours following surgery.

Socio-demographic and clinical data were obtained through medical chart reviews. Hip fractures were classified as either: neck of the femur, inter-trochanteric fracture, and sub-trochanteric fractures. Data analysis was done descriptively and

inferentially. Descriptive statistics such as the mean and the corresponding Standard Deviation (SD) and median and the corresponding Interquartile Range (IQR) were used to summarize the continuous variables. Frequencies and the corresponding percentages were used to summarize categorical variables. Inferentially, the median for the continuous variables were compared between the two groups using two sample Wilcoxon rank-sum test. Categorical variables were compared using Pearson's Chi Square test. Fishers' exact test was used to compare the categorical variables between the two groups whenever the Pearson's Chi Square assumption was violated. Independent t-test were used to compare the two-arms of the study. Cohen's D effect sizes were calculated for the mean differences at each time point. The study was conducted after approval from the Institutional Research and Ethic Committee (Formal Approval Number: IREC 1767) and permission from the MTRH administration.

RESULTS

Socio-demographic and clinical characteristics of the study participants: A total of seventy participants were recruited into the study. Of these, equal proportions were assigned to the two arms. The median age of participants in the FICB and analgesics arm was 67 (IQR: 49.0, 75.0) years while that of the second arm was 70 (IQR: 60.0, 78.0) years.

Table 1

Comparison of the participants' socio-demographic and clinical characteristics

		Treatment Group		
		Arm 1	Arm 2	
Variable	No.	(n=35)	(n=35)	P-value
Age (years), Median (IQR)	70	67.0 (49.0, 75.0)	70.0 (60.0, 78.0)	0.559w
Range (Min. - Max.)		22.0 - 89.0	25.0 - 100.0	
Gender, n (%)				
Female		16 (45.7%)	15 (42.9%)	
Male	70	19 (54.3%)	20 (57.1%)	0.810c
Diagnosis, n (%)				
Intertrochanteric fracture		14 (40.0%)	12 (34.3%)	
Neck of femur fracture	70	19 (54.3%)	21 (60.0%)	0.923f
Subtrochanteric fracture		2 (5.7%)	2 (5.7%)	
ASA classification				
I		8 (22.9%)	11 (31.4%)	
II	70	22 (62.9%)	21 (60.0%)	0.603f
III		5 (14.3%)	3 (8.6%)	
Anaesthesia				
General		16 (45.7%)	18 (51.4%)	
Spinal	70	19 (54.3%)	17 (48.6%)	0.632c
Surgical treatment				
Angle blade		5 (14.3%)	3 (8.6%)	
Bipolar		19 (54.3%)	21 (60.0%)	
Dynamic hip screw	70	3 (8.6%)	3 (8.6%)	0.969f
Intramedullary nail		1 (2.9%)	1 (2.9%)	
Proximal femur nail		7 (20.0%)	7 (20.0%)	
Procedure				
Lateral		19 (54.2%)	15 (42.9%)	
Anterolateral	70	13 (37.1%)	13 (37.1%)	0.795c
Posterior		3 (8.6%)	7 (20.0%)	

c Pearsons' Chi-Square test, f Fisher's exact test, w Wilcoxon rank-sum test

However, this age difference was not statistically significant (p-value = 0.559). Furthermore, there was no statistically significant difference between diagnosis and ASA, administration of general versus spinal anaesthesia, surgical treatment, and procedure in both arms of the study (Table 1).

Postoperative pain intensity assessment using the numerical rating scale

Assessment at the anatomical position: Following the administration of FICB, the mean pain score was at two, four and six hours and was significantly lower among participants in and the first arm compared to those in the second arm who did not receive the block as shown on Table 2. There was no statistically significant association between the mean pain scores among participants in both arms of the study at the eighth hour following surgery. The strength of compartment block declined over time as demonstrated by the reduction in the Cohen's D effect size.

Table 2

Comparison of the pain scores between Arm 1 and Arm 2 with limb in anatomical position: Comparison of the pain scores between Group A and Group B with limb in anatomical position

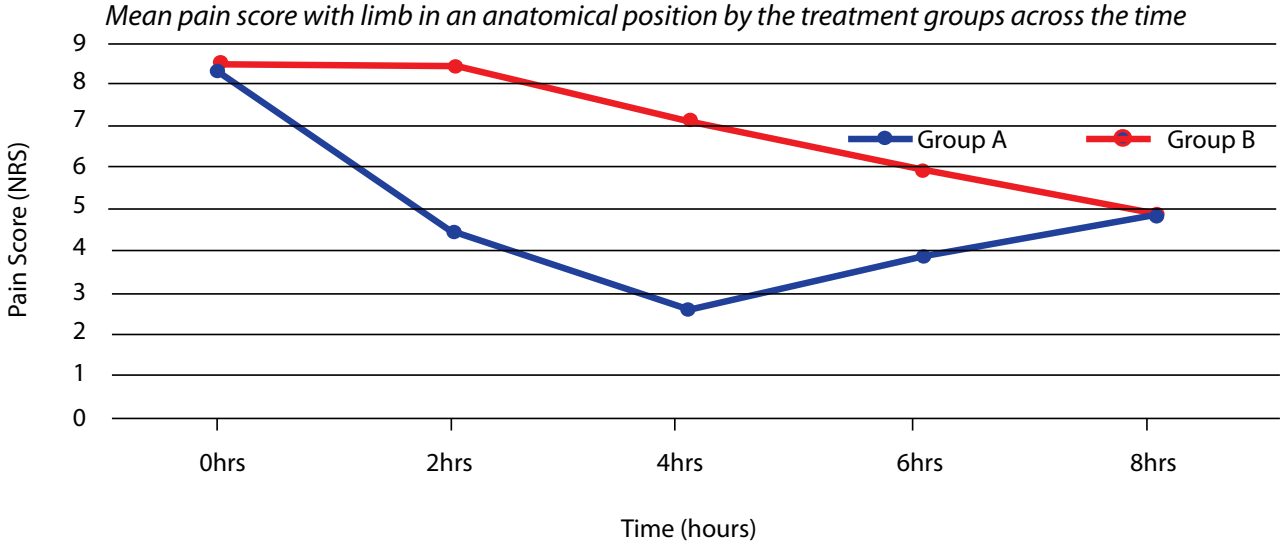
		Treatment Group			
		Arm A	Arm B		
Variable	No.	(N=35)	(N=35)	P-value	Cohen's D effect size (95% CI)
Time (Hours) post-FICB		Mean (SD) Pain score			
0 hours	70	8.3(0.9)	8.5(0.8)	0.67	0.1(-0.6,0.4)
2 hours	70	4.5(1.9)	8.4(0.8)	<0.0001	2.6(1.9,3.2)
4 hours	70	2.7 (2.1)	7.1 (1.1)	<0.0001	2.6 (1.9, 3.2)
6 hours	70	3.9 (1.5)	6.0 (1.6)	<0.0001	1.4 (0.8, 1.9)
8 hours	70	4.8 (0.9)	4.9 (1.3)	0.659	0.1 (-0.4, 0.6)

The mean-pain score for the participants in the second arm (analgesia only) declined steadily across all the time points. However, among the participants on the FICB arm, a decline in mean pain score between the second- and fourth-hour post-surgery (4.5 to 2.7) was reported. However, there was a steady rise in mean pain score from the fourth to the eighth hour as shown on Figure 1. Despite this, having received both FICB and analgesia was associated with lower mean anatomical position pain scores compared to those who received analgesia alone (control group).

Pain assessment with the limb at 15-degree flexion: When the limb was flexed at 15 degrees, it was evident that the pain-score was substantially lower among participants in the first compared to the second arm of the study at all the time points assessed. This is because, following

Figure 1

Mean pain score with limb in an anatomical position by the treatment groups across the time



FICB administration, the mean pain scale was significantly lower for among these participants compared to those who only received analgesics at two, four and six hours after surgery as shown. There was no statistical difference in the pain tolerance in the two study arms after 8 hours following surgery. The strength of the FICB declined over time as demonstrated by the reduction in Cohen's D effect size.

Table 3

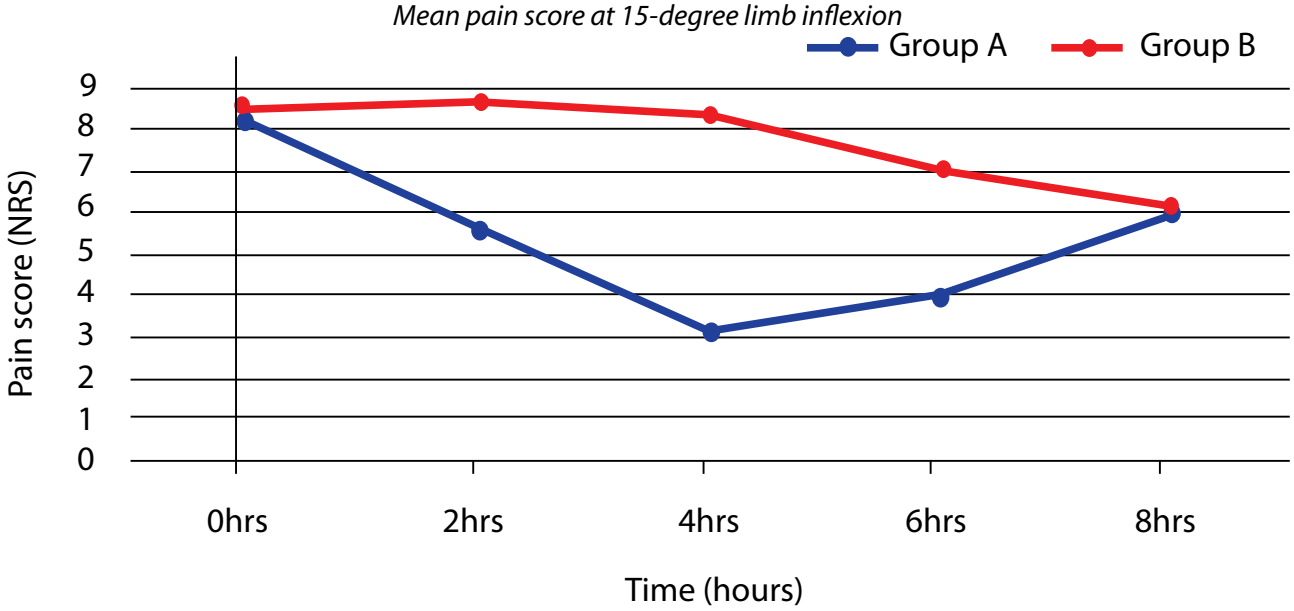
Comparison of the pain scores when the limb was flexed at 150 Flexion

		Treatment Group			
		Group A	Group B		
Variable	No.	(N=35)	(N=35)	P-value	Cohen's D effect size (95% CI)
Time (Hours) post FICB		Mean (SD) Pain score			
0 hours	70	8.2(0.5)	8.5(1.0)	0.933	0.4(-0.8,0.1)
2hours	70	5.5(1.5)	9.2(0.6)	<0.001	3.3(2.6,4.0)
4 hours	70	3.2(2.9)	8.4(1.0)	<0.0001	2.4 (1.8, 3.0)
6 hours	70	4.0(2.0)	7.1(1.2)	<0.0001	1.9 (1.4, 2.5)
8 hours	70	5.9(0.9)	6.1(1.1)	0.4599	0.2 (- 0.3, 1.0)

The pain score for the second (analgesics/ control) arm of the study declined steadily across all the time points. However, for those who received FICB, there was an initial decline followed by a surge in the mean pain score values. The mean pain score for patients who received FICB was lower compared to the control group.

Figure 2

Mean pain score at 15-degree limb inflexion



All the study participants who failed the FICB had a neck of femur fracture (p=0.047). Majority (83.3%) of those who failed FICB had a posterior surgical approach used. This relationship between surgical approach and FICB failure was statistically significant (p<0.001) as shown on Table 4.

Table 4
Factors associated with FICB failure

Variable	FICB Failure		Total	P--value
	Yes No. (%)	No No. (%)		
Surgical approach				
Lateral	0(0)	17(100)	17	<0.001
Anterolateral	1(7.7)	12(92.3)	13	
Posterior	5(100)	0(0)	5	

DISCUSSION

Severe postoperative pain is often observed among orthopaedic patients. This necessitates the use of effective analgesia to decrease morbidity, facilitate postoperative rehabilitation and reduce postoperative hospital discharge time. This study assessed the efficacy of FICB in acute post-operative pain management by comparing pain scores between those on FICB versus standard of care. Mean pain scores were compared when the limb was at an anatomical position and when flexed at fifteen degrees using numerical rating scale at 2, 4, 6 and 8 hours following surgery. The difference in mean scores between the intervention and control groups were found to be statistically significant ($p<0.001$). These findings build on those from a Spanish observational study conducted among 41 post hip-surgery patients. When pain was assessed within the first 24 hours using a visual analogue scale, its intensity was significantly lower ($p<0.001$) among those who had a two-pop technique used to administer a single shot of 0.45% ropivacaine FICB (blocking group) compared to the control group. Similar findings were also reported in Japan among 56 post-hip surgery patients (14). In the Japanese study, mean pain scores were assessed using the Visual Analog Scale after 10 minutes, 6 hours and 10 hours of administration. The mean pain scores at 6 hours were lower in the FICB compared to the control group just like in the current study. In a Chinese study assessing the efficacy of continuous postoperative analgesia after hip fracture surgery (15), mean postoperative pain scores assessed using the numerical rating scale at 2, 4, 6, 8 and 12 hours after analgesia administration were significantly lower ($p=0.039$) among FIBC group compared to systemic analgesia (paracetamol, diclofenac and PCIA morphine) alone. A meta-analysis evaluating the efficacy and safety of FICB in alleviating pain after lower limb surgery was conducted on the findings from seven clinical trials (12). The results revealed that patients receiving FICB had a statistically significant lower mean pain score at 4, 12 and 24 hours compared to those who did not. This finding matches that of the current study where the least pain score was demonstrated after four hours of FICB administration. The block is therefore an effective and safe method for alleviating acute pain following lower limb surgery.

Despite the similarities of the current study to previously reported ones, this study mean pain score reduction finding contrasts that reported from the New York's Roosevelt Hospital Center that did not demonstrate a reduction in pain intensity after hip surgery following ultrasound guided FICB and 0.5% ropivacaine (11). This discordance could be attributed to the possibility of interuser variability during ultrasound guided FICB administration and low dose ropivacaine that is inadequate for analgesia. Longer duration of analgesia has also been demonstrated among patients on FICB that lasts eight to ten hours following a single shot block combined with epinephrine (13). As opposed to the Lopez (13) study, the mean pain scores among those in the intervention arm was optimum in the first fours but began declining to the eighth hour. This could be attributed to the fact that co-administration of epinephrine increases FICB's half-life and prolongs the duration of efficacy as was demonstrated in the Roosevelt Hospital's study findings.

Because anaesthesia of the hip joint could be affected by the fascia iliaca compartment block anatomy, negative analgesic findings could be due to the influence of innervation from the sacral plexus and the limitations of the more distal approaches when the landmark block administration technique are considered (8). Furthermore, at times the part of the surgical incision may extend outside the dermatome of the lateral cutaneous nerve of the thigh's nerve root (16). Irrespective of the administration approach adopted, the obturator nerve is most frequently missed in two thirds of the cases leaving the femoral nerve the most reliably blocked (17).

Previous studies have also reported FICB failure rate as low as 3% (18) to as high as

35% (19). In this study, six (17.1%) of the study participants in the intervention arm were deemed to have failed. The low failure rate reported in this study when compared to Hanna *et al* (19) could be attributed to the limited inter-user variability in the block administration, as only a single resident was involved in the administration process. Lower failure rates of 10% were associated with limited interuser variability in Australia (10), where a femoral three in one block was administered by a single anaesthetist to limit the likelihood of interuser variability. The lowest failure rate (3%) was documented in a British study that attributed it to the fact that the block was performed by single trained personnel further reducing inter-person variability in the block's administration (18).

Even though most of the previously reviewed studies attribute failure to inter-user variability and challenges in the learning curve, this study demonstrates that a posterior surgical approach is significantly associated with FICB failure.

CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates that multimodal analgesia combining Fascia Iliaca Compartment Block (FICB) and systemic analgesia is more effective than systemic analgesia alone in reducing post-operative pain intensity following hip-surgeries. We also report a low FICB failure rate at a tertiary hospital in Western Kenya. Furthermore, surgical approaches that extend past the lateral cutaneous nerve of the thigh dermatome could also increase the likelihood of block failure.

There is need for more training and adoption of FICB among orthopaedic surgeons and residents for acute post-surgical pain management. There is the need to standardize block administration to reduce the likelihood of interuser variability that could affect patient outcomes.

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