

# Fascia iliaca compartment block: How far does the local anaesthetic spread and is a real time continuous technique feasible in children?

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## ABSTRACT

**Background and Aims:** The fascia iliaca compartment block (FICB) is commonly administered in children for anterolateral thigh surgery. The actual spread of the local anaesthetic (LA) beneath the fascial layers in children is not known. We hypothesised that in children there could be a possibility of the LA to reach lumbar plexus with the dose we used. **Methods:** This study included 25 children, aged 1-15 years for lower limb surgeries after standardised general anesthesia, the FICB was done with ultrasonography. Radio-opaque dye was tagged to LA and the fluoroscopic study was performed. The catheter was placed under ultrasonography. The primary objective was to investigate the fluoroscopic demonstration of the extent of LA spread by our technique and drug volume which is not known in children. The secondary objectives were to evaluate the intraoperative and postoperative analgesic efficacy, complications if any, of the continuous FICB catheters placed by our method. **Results:** In all patients, the visualisation of ilium and iliacus muscle, the fascia iliaca and needle tip was possible. The fluoroscopic imaging showed that the LA did not spread till the lumbar plexus in 20 patients. In 5 patients, delineated the psoas muscle and reached the L4 vertebral level. The analgesia was adequate. In the postoperative period, 92% had sufficient pain relief. Mild soakage was an issue with catheters. **Conclusion:** Although single shot fascia iliaca compartment block has limited spread of local anaesthetic in children, it is efficacious. Continuous fascia iliaca compartment block is feasible and effective in this age group.

**Key words:** Acute pain, child, lower limb surgery, regional ultrasound

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## INTRODUCTION

The efficacy of any regional block is determined by the local anaesthetic (LA) pocket formed around the nerves. In a compartment block, the LA has to reach the nerves located in the compartment. Adequate volume is a key in such cases because the LA is not deposited exactly in the close vicinity of the nerves. Fascia iliaca compartment block (FICB), known to provide analgesia to the anterolateral aspect of thigh and hip<sup>[1]</sup> is one such example. Recently, Eastburn *et al.* reported the technical success of the ultrasound-guided supra-inguinal fascia iliaca compartment block in older children and adolescents for hip arthroscopy.<sup>[2]</sup> Miller *et al.* described FICB in paediatric patient as a

case series of three cases, high lighting longitudinal placement of probe.<sup>[3]</sup>

It would be interesting to investigate the fluoroscopic demonstration of the extent of LA spread by our

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technique and drug volume which is not known in children. We hypothesised that in children there could be a possibility of the LA to reach lumbar plexus with the volume we used.

In children, the efficacy of single shot FICB to provide analgesia is well described and known. The feasibility and efficacy of continuous FICB in the post-operative period to render analgesia is not very well known in this population.

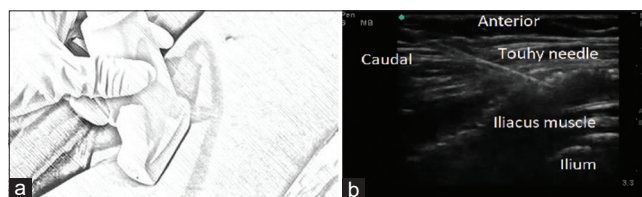
## METHODS

This study followed the ethical standards of our institutional ethical board committee. The Academics research ethics committee approved the research (EC-05/04/2016). The study adhered to the principles of the Declaration of Helsinki. This prospective descriptive study was approved by the institutional ethical committee. Study was done within a period of one year from May 2016 to May 2017. Written informed parental consent was obtained from consent was obtained from all participants.

The study included 25 consecutive patients scheduled for femoral plate removal, in the age group of 1- 15 years of American Society of Anesthesiologists (ASA) physical status I, II. Exclusion criteria were any contraindication to regional anaesthesia and refusal by the parents. Perioperative anaesthetic management was standardised. Midazolam 0.75 mgkg<sup>-1</sup> orally was given in children without an intravenous access. Propofol 2-3 mg/kg or Sevoflurane in incremental dial flows from 1 to 8% were used for induction. Airway was secured by the Supreme laryngeal mask (Teleflex). The maintenance was provided by Sevoflurane 2 to 2.5% in equal mix of oxygen and air. Intravenous (IV) fentanyl 2 mcg kg<sup>-1</sup> was used as rescue analgesic. Standard monitoring of vital parameters was used. Ultrasound (US) guided FICB was performed with standard aseptic conditions by a senior anaesthesiologist experienced in the technique. The skin incision was allowed approximately 20 minutes after performing the FICB. Baseline values of blood pressure and heart rate were noted before and after skin incision. An increase in heart rate or mean arterial blood pressure of more than 20% compared to baseline values was considered as an unsuccessful or failed FICB. Variations in vital parameters such as heart rate or mean arterial blood pressure of less than 20% compared to baseline values was considered as successful FICB. In case of block failure,

intraoperatively, IV fentanyl 2 mcg kg<sup>-1</sup> was given. The blocks were administered after induction. The anaesthesiologist stood on the side of the block. The high frequency linear ultrasound probe (M turbo, Sonosite Inc, Bothell, WA) was placed perpendicular [Figure 1] to the inguinal ligament, between the anterior superior iliac spine (ASIS) and the femoral artery. The orientation marker was placed facing the caudal end of the patient. The edge of the ilium was identified as a hyperechoic line. Atop the ilium, the iliac muscle with semi-circular fibers was identified. The unmistakable hyperechoic fascia iliaca over this muscle was located. The needle was inserted from the inferior end of the probe as shown in Figure 1a. The needle tip (22-gauge short bevel needle) tenting over, and penetrating the fascia iliaca was observed [Figure 1b]. Ropivacaine 0.2% 1 ml kg<sup>-1</sup> was tagged with radio-opaque dye, Iohexol (0.2 ml kg<sup>-1</sup> in children). The dye spread was evaluated fluoroscopically [Figure 2a] in supine and 30-degree oblique view. This was followed by the administration of continuous fascia iliaca compartment block. The steps for catheter placement (21 gauge) were similar except an 18-gauge Tuohy needle was used [Figure 2b]. The distance of the needle tip from the skin was calibrated using the calibration key. The catheter emerging from the tip was seen. The catheter was passed approximately 8 to 10 cm, tunneled and secured with dressing. An infusion of Ropivacaine 0.2% 0.4 mg kg<sup>-1</sup> hr<sup>-1</sup> was activated.

The surgical incision was planned over the previous incision line. The incision line was infiltrated by lignocaine adrenaline 5 mg kg<sup>-1</sup> by the surgeons before incision. The catheters were removed after 48 hours and patients were discharged. The nature and duration of surgery was noted. The ease of our technique and feasibility for each block were assessed by the following data: Sonographic identification of anatomical structures such as the hyperechoic edge of the ilium, the iliac muscle with its semicircular fibers and the hyperechoic fascia covering the iliacus muscle. The visualisation of needle with subsequent



**Figure 1:** (a) Illustrates the position of probe. (b) Illustrates a longitudinal section of the ultrasound scan in the inguinal region

local anaesthetic spread was categorised as easy or difficult. Complication during the procedures such as blood aspiration was noted.

Fifteen minutes before the end of surgery, all patients received systemic analgesia, using paracetamol 20 mg kg<sup>-1</sup> IV and Diclofenac 2 mg kg<sup>-1</sup> IV. The catheters were removed after for 48 hours.

The first 24 hours post-operative analgesia regime was standardised. This included, IV paracetamol (15 ml/kg) every 6 hours, Diclofenac suppository 2 mg/kg or oral Diclofenac as suitable for age and continuous FICB infusion of 0.2% Ropivacaine at a dose of 0.4 mg/kg/hr.

The LA infusion was continued for 48 hours. Catheter related issues such as leakage, blockage, oozing and dislodgements were noted. Children's and Infants' Postoperative Pain Scale CHIPPS score was recorded for the first 48 hours every 6 hourly in children till 5 years of age. VAS score every 6 hourly was recorded in children after age of 6 years. Rescue analgesia by IV Tramadol 2 mg. kg<sup>-1</sup> was administered if necessary, on floors.

The primary aim of this study was to demonstrate the extent of local anaesthetic spread by tagging radio opaque dye with the amount of LA we used. The second objective was to evaluate its analgesic efficacy as continuous block for post- operative analgesia along with any practical issues in every day work.

**Statistical Analysis**

Data was expressed as mean and standard deviation. SPSS +(V.15.0) package was used for statistical analysis. 95% Confidence Intervals was interpreted as we are 95% confident that the interval will have true mean. 95% Confidence Interval gives a range of

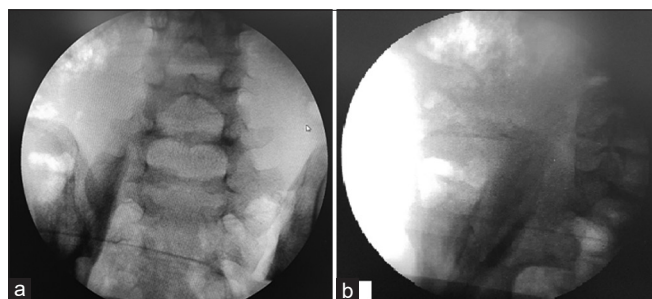
plausible values for a population parameter. Failures were noted in percentages.

As the study was pilot or preliminary, statistical calculation of sample size formula was not used.

**RESULTS**

In our study 25 single shot and continuous US-guided FICB were performed on 25 patients (17 boys, 8 girls). Table 1 shows the demographics in each age group category. Out of 25 patients, 19 were posted for proximal plate removals and 6 were posted for distal femur. The mean duration of surgeries was 99.67+/38.47 and 85.87+/-8.72 minutes respectively. Intraoperatively, all the block were considered effective and none of the patients required rescue fentanyl. Under US guidance, in all patients the anatomical structures visualisation such as the hyperechoic edge of the ilium, the iliac muscle with its semicircular fibers and the hyperechoic covering of the fascia iliaca was visible. Needle and drug injection were categorised as easy in all cases. Tuohy needle visualisation, catheter emerging from the Tuohy needle was seen in all 25 cases. The passage of catheter and tunneling was uneventful in all patients. Table 2 shows the details of issues regarding catheter placement and post-operative infusion. The pattern of dye spread in the FICB was noted to be similar, as shown in Figure 2a and b. The dye was seen lining the iliacus muscle along the lesser trochanter, further up towards the internal lip of iliac crest, iliac fossa it further delineated the distal psoas muscle. The upper most spread of the dye did not exceed beyond L4 vertebral level as seen in the image. In none of the 25 cases we observed the dye spread till the proximal aspect of psoas muscle or beyond L4 vertebral level.

The pain scores in the post-operative period are shown in the Graphs 1 and 2, 23 of 25 (92%) did not require any rescue analgesics. Two patients required rescue analgesic on the same day of the surgery.



**Figure 2:** (a) Shows A P view obtained with an image intensifier showing the lumbo- sacral spine and sacroiliac joint. The radio opaque dye is seen delineating the proximal aspect of the Psoas muscle. (b) Shows A- P view of the right hip. The patient's hip is placed with a 30-degree tilt towards the left. This shows the dye delineating the proximal 3 aspect of the Psoas muscle

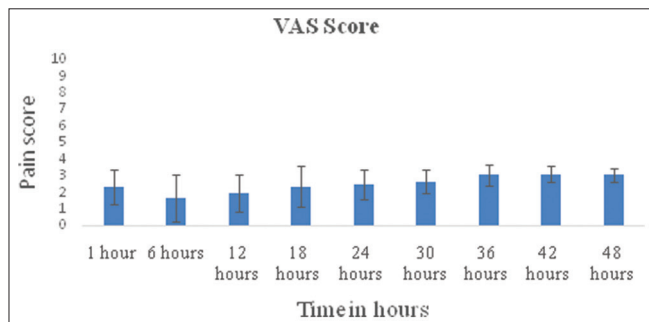
**Table 1: Shows the demographics in each age group category**

Age in years	n	Weight (Mean±SD)	95% confidence interval	
1-3	1	11.00	NA	
4-7	11	13.73±1.62	10.49	16.97
8-11	11	19.09±3.96	11.17	27.01
12-15	12	34.00±11.31	11.38	56.62

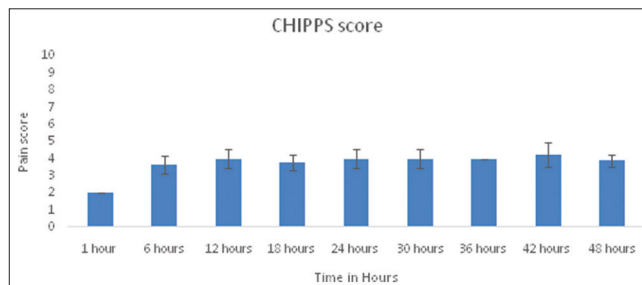
N – Number of patients

**Table 2: The details of issues regarding catheter placement and post-operative infusion**

Issues	Number of patients	Techniques to minimise issues
Peri-catheter leakage	14 patients	Pressure dressings.
Catheter blockage	1 patient	The catheter and the catheter connector were separated and reconnected. Resolved
Early catheter removal	2 patients	1 <sup>st</sup> patient, it got accidentally removed while position change 2 <sup>nd</sup> patient accidentally removed while the surgical dressing was changed



**Graph 1:** Illustrates the VAS pain scores



**Graph 2:** Illustrates the CHIPPS pain scores

## DISCUSSION

We refute our primary hypothesis. The results of this study show that LA of 1 ml kg<sup>-1</sup> volume deposited in the FICB does not reach beyond L4 vertebral level. The radio opaque dye spread was consistently similar in all cases. We found the psoas major was demarcated distally in all cases but the classic spread till the lumbar plexus (till L1) was not seen with the volume we studied and the age group we worked with.

Marhofers<sup>[4]</sup> studied three-in-one blocks using 30 mL of bupivacaine 0.5% under the guidance of a nerve stimulator. They performed a contrast MRI study and post block it emerged that the local anaesthetic blocks the femoral nerve directly, the lateral femoral cutaneous nerve through lateral spread and the anterior branch of the obturator nerve by slightly spreading in a medial direction. There was no involvement of the proximal and posterior portions of the obturator nerve, nor was there any cephalad spread that could have resulted in a lumbar plexus blockade. From our observations, a consistent dye spread pattern emerged. The dye was seen lining the iliacus muscle along the lesser trochanter, further up towards the internal lip of iliac crest, iliac fossa it further delineated the psoas muscle distally unlike the direct spread towards the femoral and lateral femoral cutaneous nerve as described in the above study. In none of the cases, we observed the dye spread till the proximal aspect of psoas muscle or the lumbar spine beyond. Our study also differs in age group, the modality used to administer FICB and assessment of drug spread.

Although they studied 3 in 1 block, it is interesting to note that cephalad spread was not observed in their study as well as ours. Secondly, we did not find any spread in medial direction towards the obturator nerve.

We further ascertain that the real-time US-guided FICB is feasible and easy in children. The catheter placement, infusion activation and monitoring are not cumbersome, making it a very doable, easy day to day technique. The Tuohy needle and catheter visualisation is always possible, a crucial point in establishing the efficacy of this continuous technique. This FICB catheter technique allows an efficient postoperative pain management with low rate of patient requiring rescue analgesia on the floors. A minor concern here is leakage of LA. Tunneling the catheter offers help in this aspect. Pressure dressing and reassurance works. Soakage associated with LA infusion is common.<sup>[5]</sup>

Peri-catheter leakage is expected because the Tuohy needle used for catheter insertion is wider than the diameter of the catheter.<sup>[6-14]</sup> Several authors have had similar experience of leakage of perineural catheters and some have come up with suggested solutions to reduce or prevent catheter leakage. These solutions include securing the catheter with glue<sup>[15,16]</sup> and use of a “catheter-over-needle” method.<sup>[6,11,17-19]</sup> Another method is use of pressure dressings, as we did. Tunneling was done to minimise leakage of LA and enhance fixation.

We chose plate removal surgeries because they seemingly are simple and fast procedures.

However, plate removals are bony procedures and post-operative pain is usually underestimated. They

can get tedious if the plate and screw retrievals get difficult especially in older plates. The plates were in proximal or distal femur. The incision line by default was along the previous surgical scar. Plate removals from the proximal femur were done in semi lateral position. The incision at times could further tilt a little more posterior and could overlap the sciatic innervations. Local infiltration of lignocaine adrenaline was administered to take care of this aspect. Secondly, it favored hypo vascularity of the field.

Continuous fascia iliaca blocks with traditional technique has been described previously.<sup>[20-26]</sup> We find catheter insertion under real time vision quite simple, easy and effective.

Recently supra-inguinal approach USG guided FICB has been described.<sup>[2,21-23]</sup> The authors found this approach clinically more efficacious than the approach we used. We placed our probe perpendicularly across the inguinal ligament and on it. We find the efficacy of the latter approach reliable in our everyday work.

Alternatively the block can be prolonged by addition of adjuncts such as dexmedetomidine, demonstrated by Sivakumar.<sup>[27]</sup> In this RCT, the authors demonstrated that addition of dexmedetomidine in FICB prolongs the analgesia better than intravenous administration. Although this conducted on adults, the use of adjuncts in children is very much possible.

The limitation of the study as we see it is, the dye spread images after some time gap may have given a better idea of drug spread although we are not sure of this. This study perhaps would have answered more if radiopaque dye was injected through the catheter. We followed this protocol because we wanted to understand the dye spread through single shot injection and the limitation was an afterthought.

## CONCLUSION

The LA volume of 1 ml kg<sup>-1</sup> in children does not reach the lumbar plexus as shown by the fluoroscopic dye spreads. There is a possibility of the LA to spread proximally towards the psoas muscle and reach till L4.

## Declaration of patient consent

The written informed consent was obtained from the first line relative of the patient for publication of the ultrasound images.

## Acknowledgements

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## Conflicts of interest

There are no conflicts of interest.

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