

## Original Research Article

# Comparison between caudal epidural block and popliteal nerve block for postoperative analgesia in children undergoing foot surgery: a randomized controlled trial

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## ABSTRACT

**Background:** Pain following surgery in children cause discomfort, restlessness and agitation in the postoperative period which may result in an increased incidence of nausea, vomiting and maladaptive behavioural changes. Regional anaesthesia is commonly used as an adjunct to general anaesthesia for perioperative analgesia in children as part of a multimodal approach of pain relief. This study is to compare between caudal epidural block and popliteal nerve block for postoperative analgesia in children undergoing foot surgery.

**Methods:** A prospective randomized single blind study was carried out on 30 children aged 1-12 years of either sex undergoing foot surgery. Patients were randomly assigned into caudal epidural block group and Popliteal nerve block group, 15 children each. Both groups receive 1 ml/kg of 0.25% bupivacaine. Foot surgery was carried out under general anesthesia along with regional block for all children. After completion of surgery, children were shifted to PACU and HR, BP, SPO2 were monitored. Patient was discharged from PACU after CHEOPS (1-5 years) or VAS (6-12 years) <4. Parental satisfaction, sedation score, PONV, and any other side effects were recorded.

**Results:** Demographic data and baseline vital signs were comparable between two groups. Statistically significant difference ( $p=0.025$ ) in number of attempts in giving block in group A ( $1.20\pm 0.41$ ) than group B ( $1.80\pm 0.86$ ). The mean postoperative pain scores, CHEOPS and VAS were comparable in both groups.

**Conclusions:** Both caudal epidural block and popliteal nerve block provides comparable and adequate analgesia in children undergoing elective foot surgery.

**Keywords:** Caudal, Children, Foot surgery, Nerve block, Postoperative

## INTRODUCTION

Pain after surgery in children cause discomfort, restlessness and agitation in the postoperative period. This pain may result in an increased incidence of nausea, vomiting and maladaptive behavioral changes.<sup>1</sup> The

various modalities for postoperative pain relief in children include opioids, non-steroidal anti-inflammatory drugs, paracetamol, regional and local anesthetic techniques. Caudal block is a commonly performed for perioperative analgesia in children. However, anatomical changes may pose difficulties and result in failure of

block. It is contraindicated in the presence of local infection, pilonidal cyst, meningomyelocele of sacrum, meningitis, hydrocephalus and intracranial tumors. The use of regional anesthesia in orthopedic operations is gaining popularity.<sup>2,3</sup> The practice of peripheral nerve blocks has improved with the introduction of newer techniques like ultrasound and nerve stimulator guided blocks. The safety of peripheral nerve blocks has been established in large-scale prospective studies in children and hence it has been recommended, rather than central neuraxial techniques.<sup>4</sup>

Popliteal nerve block along with general anesthesia is commonly used for analgesia in foot operations in children.<sup>5</sup> With the availability of nerve stimulators and ultrasound, peripheral nerve block can be placed accurately, and less dose of local anesthetic will be needed. It is associated with fewer side effects compared to caudal epidural block.<sup>6</sup> The safety and efficacy profile of popliteal nerve block and epidural caudal block have been established, and comparison between epidural block and peripheral nerve blocks like sciatic, femoral and saphenous nerve blocks have been evaluated.<sup>6</sup> On literature search, there were no studies comparing single shot caudal epidural block and popliteal nerve block for postoperative analgesia in children undergoing foot surgery.

## METHODS

This study was conducted in the tertiary care postgraduate teaching hospital in India after Institutional Ethics Committee approval. Informed written consent was taken from the parents and guardians of the thirty children enrolled in the study.

### Inclusion criteria

- Age 1-12 years
- American Society of Anesthesiologist (ASA) - Grade I/II status
- Elective surgeries in foot surgery

### Exclusion criteria

- Refusal by parents or guardians for their wards to participate in study
- Children undergoing emergency surgeries
- Children with peripheral nerve disorders
- History of allergy to local anesthetics
- Presence of spinal deformities
- History of any bleeding disorder
- Presence of local infection at the site of caudal block
- History of any derangement of liver or renal functions

This prospective, randomized, single blind study was conducted over period of two years (January 2012 to December 2013) on 30 children.

A routine pre-anesthetic check was done before the surgery. Fasting period of 8 hours for solid food and 2 hours for clear fluids before surgery was advised. Premedication was given with oral midazolam 0.5 mg/kg, 30 minutes before starting anesthesia for all patients in both groups. Sedation score was assessed.<sup>7</sup>

In the operation theatre pulse oximeter, Non-Invasive Blood Pressure (NIBP), Electrocardiogram (ECG) was attached and baseline Heart Rate (HR), Respiratory Rate (RR), Blood Pressure (BP), Spo2 was recorded.

Patient was induced with sevoflurane / halothane in 100% O<sub>2</sub> and Intravenous access is secured. Fentanyl 2 microgram/kg was given. After the loss of jaw tone, appropriate size of LMA or endotracheal tube is inserted. Patient was maintained on spontaneous ventilation/ assisted ventilation with 50% oxygen, 50% nitrous oxide and isoflurane (MAC 1-1.5) and the EtCO<sub>2</sub> is kept between 35-45 mmHg.

Children were randomly assigned into two groups, (15 children each) and method of randomization was done by computer generated.

### Group A: Caudal epidural block (Figure 1)

Patient was turned to lateral position. A short-beveled needle of 22G or 23G was used. After antiseptic dressing and draping, sacral cornua and hiatus felt, and needle was inserted at the sacral hiatus at an angle 45 to skin directing cephalad. Caudal epidural space is identified by the loss of resistance once the needle has passed the sacrococcygeal ligament. 1 ml/kg of Bupivacaine 0.25% was injected after negative aspiration.



Figure 1: Caudal block.

### Group B: Popliteal nerve block (Figure 2)

Child in supine position with leg flexed at hip and knee or in lateral position, a triangle is constructed with skin crease behind the knee as base and two sides by the

semimembranosus (medially) and the biceps femoris (laterally). A bisecting line is drawn from apex to the base of the triangle. The needle is advanced at a 45-degree angle aiming cephalad just lateral to bisecting line of the triangle until nerve stimulator is elicited. Distance from the base of triangle to needle insertion is estimated based on weight. If the weight is less than 10 kg, then the distance is 1 cm, if the weight is 10-20 kg, then the distance is 2 cm and for each 10 kg increment in weight, needle was 1 cm cephalad in the triangle.



**Figure 2: Popliteal nerve block.**

Timing of the block and start of surgery was recorded. Time required for caudal block and popliteal nerve block was also recorded. Intraoperative vitals were noted every 5 minutes. If there were signs of inadequate analgesia (as evidenced by increasing in HR or SBP 20% above baseline) i.v. bolus fentanyl 1 microgram/kg was administered. The total requirement of fentanyl in the intraoperative period was recorded.

The patient was shifted to Post Anesthetic Care Unit (PACU). In the PACU HR, BP, SPO2 were monitored. If CHEOPS was  $\geq 6$  or VAS  $\geq 5$ , Rescue analgesia was given with i.v fentanyl 0.5 microgram/kg incrementally. The time of first rescue analgesia, number of doses and total amount of fentanyl required was recorded. Oral paracetamol 15-20 mg/kg was started after the demand of first rescue analgesia and was continued every 6<sup>th</sup> hourly. If pain is not controlled with oral paracetamol, i.v fentanyl 0.5 microgram/kg was given incrementally. No. of doses of paracetamol required was also recorded. Vomiting was treated with i.v ondansetron 0.1 mg/kg.

Assessment of pain was done at recovery room, 1 hr, 4 hr, 8 hr, 12 hr, 18 hr and 24 hr post operatively. Pain assessment in children's age 1-5 Years was by CHEOPS (Children's Hospital of Eastern Ontario Pain Scale) and for children's age 6-12 years by VAS (visual analogue scale).<sup>8,9</sup> Nausea and vomiting, patients leg movements, duration of stay in recovery room were also assessed.

Parental satisfaction score, sedation score and the number of failures while giving the block were also assessed. Any bleeding or hematoma formation in the surgical site was also noted. Patient was discharged from PACU after CHEOPS or VAS  $< 4$ , no nausea and vomiting, patient was hemodynamically stable and fully awake. Patient was followed in the orthopedic ward up to 24 hours.

**Data analysis**

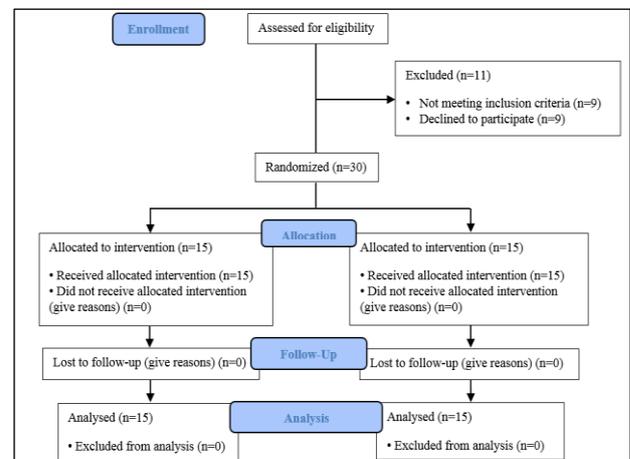
All statistical analysis was conducted using SPSS 15 software. Student t test/ Mann-Whitney test were used for continuous data and chi-square test for qualitative data. Besides to see the changeover the time, repeated major analysis followed by post hoc comparison by Fisher's Least Significant Difference (LSD) method/ Friedman test wherever applicable. p value  $< 0.05$  was taken to be statistically significant for all data in this study.

**Sample size calculations**

Assuming baseline values are same in caudal epidural nerve block and popliteal nerve block ( $3.8 \pm 1.2$  and  $3 \pm 0.8$ ) after 24 hours in pilot study. With seven follow-ups,  $\alpha = 5\%$  and power 90%. Total of 28 cases with 14 each in two groups was needed.

**RESULTS**

In this study, forty-one patients were assessed for eligibility for inclusion, eleven of whom were excluded: nine patients did not meet inclusion criteria and parent of two patients declined to participate. Therefore, thirty patients were randomly allocated into two groups who underwent caudal epidural block (Group A, n=15) and popliteal nerve block (Group B, n=15) (Figure 3). The demographic data and the patient's characteristics between the two groups were statistically insignificant (Table 1). There was statistically significant difference ( $p = 0.025$ ) in number of attempts in giving block in group A ( $1.20 \pm 0.41$ ) than group B ( $1.80 \pm 0.86$ ) (Table 2).



**Figure 3: CONSORT flow diagram outlining patient inclusion.**

The Mean Arterial Pressure (MAP) and mean heart rate during intraoperative period in both groups were comparable.

There was no episode of hypotension and bradycardia which required intervention. The changes in intraoperative MAP and heart rates were found to be statistically not significant (Figure 4 and 5). The mean postoperative pain scores (CHEOPS) and (VAS) was comparable in both groups and the changes of postoperative pain scores over the time were also analyzed and there were no statistically significant differences between two groups (Table 3 and 4).

There were no statistically significant differences between the two groups with respect to duration of anaesthesia, time taken to give block, number of fentanyl doses requirement intraoperative and postoperative, time of first rescue analgesic administration, number of paracetamol, episode of nausea and vomiting, duration of stay in recovery room, sedation score, parental satisfaction score and urinary retention.

**Table 1: Comparisons of demographic characteristics.**

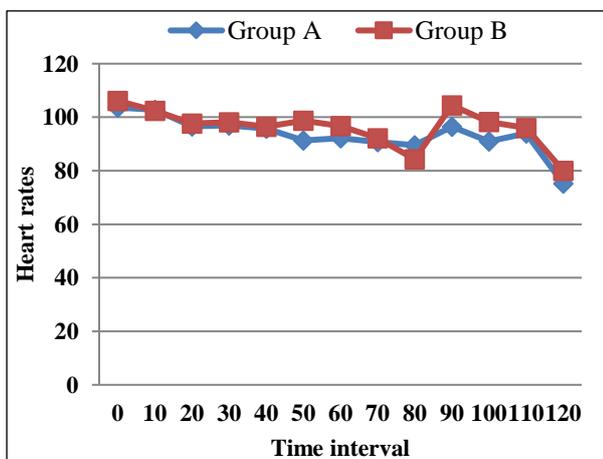
Variables	Group A (n=15)	Group B (n=15)	p value
Age (yr)†	4.10 ±3.09	4.22 ±2.51	0.775
Sex (m/f)	9/6	8/7	
Body weight (kg)†	13.67±4.78	13.87± 7.94	0.934

(†) corresponding values in mean±standard deviation

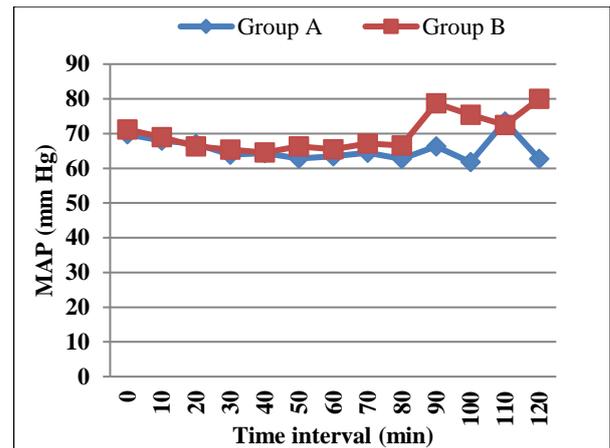
**Table 2: Block variable.**

Block variables	Group A (n=15)	Group B (n=15)	p value
No. of attempt in performing block	1.20±0.41	1.80 ±0.86	0.025*

(\*) statistically significant



**Figure 4: Intra-operatives heart rates.**



**Figure 5: Intra-operatives MAP.**

**Table 3: Postoperative pain scores (CHEOPS).**

Time interval	Group A (n=15)	Group B (n=15)	p value
0	4.75±0.96	4.67±1	0.849
1	4.56±1.01	4.56±1.01	0.436
4	4.42±0.51	4.11±0.33	0.138
8	4.33±0.50	4.33±0.51	1.000
12	4.58±1.73	4.67±2	0.920
18	4.42±0.9	4.67±1.32	0.612
24	4.08±0.28	4	0.400

Changes in CHEOPS over the time, p=0.232

**Table 4: Postoperative pain scores (VAS).**

Time interval	Group A (n=15) median (range)	Group B (n=15) median (range)	p value
0	4(2-4)	3.5(2-4)	0.905
1	4(3-5)	3.5(2-6)	0.905
4	3(3-4)	2.5(2-3)	0.167
8	3(2-4)	3(2-3)	0.714
12	3(2-4)	2.5(1-3)	0.381
18	3(0-5)	2(1-5)	0.905
24	3(0-4)	2(2-3)	0.714

**DISCUSSION**

Foot and ankle surgery are associated with severe pain in the postoperative period. An effective postoperative pain management minimizes the suffering of the child and results in decrease in morbidity. This may facilitate a rapid recovery and early discharge resulting in a reduction in hospital cost.<sup>10</sup> As a part of multimodal regimen, regional anesthesia is commonly used for analgesia along with general anesthesia in children. The use of regional analgesia in children results in less analgesic requirement in the intraoperative period. An effective block also results in a comfortable child in the immediate postoperative period. This also results in a

decrease in need of analgesia and less distress for the family.

This prospective, randomized single blinded study comparing caudal block with popliteal nerve block for postoperative analgesia in 30 children aged 1-12 years undergoing elective foot surgery. The number of doses of fentanyl requirement during the intraoperative period and the doses of rescue analgesia administered was statistically similar between two groups. Authors conclude that both caudal epidural block and popliteal nerve block resulted in adequate and comparable analgesia in the intraoperative and postoperative period in children undergoing foot surgery. The side effects like sedation, nausea and vomiting, and urinary retention were comparable in both groups.

Fouk and co-workers studied the use of caudal epidural block in clubfoot surgery.<sup>11</sup> They concluded that children who underwent general anesthesia supplemented with caudal epidural block had a significant decrease in intraoperative narcotic requirement and resulted in good postoperative analgesia which lasted for 8-12 hrs. In this study, the requirement of fentanyl for analgesia during the intraoperative and postoperative period was similar and the analgesia lasted for 24 hrs. The children were admitted in the hospital and follow-up was done for 24 hrs whereas Fouk and co-workers studied children on an outpatient basis and their follow-up was done by interviewing the parents during their next visit in the outpatient clinic.

Elliot and co-workers compared popliteal nerve block by continuous infusion with single bolus of bupivacaine for ankle and hind foot surgery in 54 patients. They found low pain scores and significantly fewer requirements for supplementary opiate analgesic agent in both groups. According to them, it remained debatable whether the extra time and the cost involved warrants the use of continuous popliteal blockade over a single bolus injection.<sup>12</sup> In this study, authors also used single bolus injection of popliteal nerve block and have been found it to provide analgesia lasting for 24 hrs in the postoperative period which is comparable to caudal block in the perioperative period.

Continuous regional blocks can provide greater analgesia and lower opioid consumption when compared to single-injection techniques, but the difficulty in maintaining the position of the catheter can limit its application.<sup>13</sup> Due to this limitation and as foot surgery are usually done as a daycare procedure, authors used single shot caudal and popliteal nerve blocks in this study.

The commonly used methods for peripheral nerve localization are elicitation of paranesthesia and electrical nerve stimulation. In elicitation of paranesthesia, when a needle makes direct contact with a sensory nerve, a paranesthesia is elicited in its area of sensory distribution and in electrical nerve stimulation when the nerve is

stimulated a motor response is elicited in the muscles supplied by this nerve. It has the advantage of enabling exact and reliable nerve localization and there is a decrease in incidence of nerve injury. Davies and McGlade, states that either eliciting paraesthesia or a positive response to the peripheral nerve stimulator carries a high correlation with subsequent successful block, but that the use of the nerve stimulator provides a more consistent and reliable technique for nerve localization.<sup>14</sup> The main disadvantages of this technique are patient discomfort and the cost of the stimulating needle used.<sup>11</sup> Authors used peripheral nerve stimulator in this study and found that the time taken to administer the block was similar in the two groups, but the number of attempt in giving block in caudal block (group A) was less compared to peripheral nerve block (group B). This could be attributed to the fact that caudal epidural block is being performed more commonly than popliteal nerve block in authors institution and most doctors are familiar with administration of caudal block.

In the absence of objective tools, pain evaluation in children is influenced by the knowledge and personal impressions of the observer. Several score systems to quantify postoperative pain in pediatric patients have been developed and validated. CHEOPS and VAS were validated to determine the postoperative pain. Therefore, authors used CHEOPS in 1-5 years and VAS in 6-12 years. The mean Postoperative Pain Scores (CHEOPS) and (VAS) was comparable in both groups. The Changes of Postoperative Pain Scores (CHEOPS and VAS) over the time was also analyzed and there were no significant differences between the two groups.

There are some limitations of this study which are worth mentioning. First, the anesthesiologist performing the block could not be blinded. Second, caudal epidural block being performed more commonly than popliteal nerve block in authors institute, time taken to perform above block varies. Third, non-availability of ultrasound at the time of study period and finally, proper assessment of the incidence of side effect and motor weakness could not be appreciated due to presence of cast in the lower limb. Few topics for further study that are worthy of consideration here, nerve localization with the help of ultrasound, additives and continuous infusion may be needed for ascertaining these blocks effect as analgesia in children.

## CONCLUSION

Both caudal epidural block and popliteal nerve block provides comparable and adequate analgesia in children undergoing elective foot surgery, with less number of attempts in performing caudal epidural block.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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