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Ultrasound guided lumbar erector spine block and caudal block for postoperative analgesia in pediatric lower limb orthopedic surgeries: A comparative study

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Abstract

Background & Aim: Caudal block has proven its efficacy in post operative pain management. We have compared ultrasound guided (US)erector spinae block (ESB) with caudal block (CB)for control of postoperative pain in pediatric lower limb orthopedic surgeries.

Material and methods: This study was conducted among 44 children posted for lower limb orthopedic surgeries. All the children were divided into two equal groups of 22 each. Both caudal block group and erector spinae plane block group received 0.25% bupivacaine (0.5 ml/Kg) each. Both US guided blocks were given after administration of anesthesia and before surgery.

Results: Pain scores at 4h, 6 h and 8 h were significantly less in group ESB compared to CB group. The number of children who required intraoperative paracetamol (as rescue analgesic) was more in CB group compared to ESB group. Group ESB provided prolonged postoperative analgesia compared to CB group.

Conclusion: US guided ESB provided better intra and post operative analgesia compared to caudal block in pediatric lower limb orthopedic surgeries.

Keywords: Erector spinae block, caudal block, post operative analgesia, pediatric, lower limb surgery, orthopedic

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Introduction

Pediatric postoperative pain management is still a challenge in spite of many advances in acute post-surgical pain management. Search for effective and safe analgesic approach still goes on.[1] In pediatric population, caudal block (CB) is commonly given for post operative analgesia in lower limb orthopedic surgeries.[2]But it has its own limitation like limited duration of postoperative analgesia. Also anatomical abnormalities and infection at the injection site are other contraindications.[3] ESB is gaining popularity in pediatric patients due to the increasing number of studies demonstrating its potency for managing postoperative pain in various lower limb surgeries.[4] However, no study have directly compared ESB and CB for pediatric lower limb orthopedic surgeries. Therefore, this study was done to assess the efficacy and safety of US guided ESB with CB for post operative analgesia.

Materials and method

This is a randomized double-blind study conducted among44 children of aged 2 to 15 years of either sex, posted for lower limb orthopedic surgeries. The study was conducted at a tertiary care hospital in Odisha after taking signed consent from parents. Children with spine or chest wall deformity, coagulation disorders, respiratory and cardiac disorders, renal or hepatic insufficiency, and known allergy to study drugs were excluded. All children were assessed preoperatively. Computer generated random numbers were used to allocate children through sealed opaque envelopes into two equal groups. The envelope was opened by anesthesiologist, not involved in the study or data collection. Parents and outcome assessors were blinded by group allocation. Upon arrival in the operating room, an intravenous line was established. Non-invasive blood pressure, electrocardiogram (ECG), temperature probe, capnograph and pulse oximeter were used to monitor patients. Anesthesia was induced in all patients with fentanyl 1 μg/Kg, propofol 2 mg/kg, and cis-atracurium 0.15 mg/kg IV and endotracheal intubation was done. Anesthesia was then maintained with isoflurane 1–2% in oxygen and air mixture and cis-atracurium 0.03 mg/kg. Then anesthesiologist performed both block as allocated using ultrasound guidance. The blocks were done guided by an ultrasound machine (Philips ® CX50) with a longitudinal parasagittal transducer probe (6–12 MHz).For caudal block,[5]the sacral hiatus was visualized using ultrasound while the patient was positioned at left lateral decubitus. The needle had pierced the skin at a 45° angle. After confirming needle position,0.5 ml/kg of 0.25% bupivacaine (maximum 15 ml) was injected between the two sacral cornu. ESB was performed[6] on the side of operation at L1-L4. In the sagittal plane, the probe was longitudinally positioned at the mid-vertebral line. To visualize the erector spinae muscle with the transverse process, the transducer was displaced 3.5–4 cm laterally from the midline to the surgery site. The precise placement of the needle point in the fascial plane proximal to the erector spinae muscle was verified by injecting 0.5–1 ml of saline and observing the fluid lifted the erector spinae muscle off the transverse process without stretching the muscle. As soon as the needle was positioned properly, a negative aspiration test was verified. The hyperechoic transverse process's shadow must lie superficial to the trapezius,

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erector spinae, and main rhomboid muscles. A 22 G needle was inserted with the level pointing cephalo-caudally, and 0.5 ml/kg of 0.25% bupivacaine (maximum 15 ml) was injected Then, surgery was allowed. Intraoperatively, the administration of tramadol 2 mg/Kg IV was used to control the rise in heart rate and mean arterial pressure of more than 20% of baseline values in response to surgical stimuli. The number of patients who required intraoperative tramadol was recorded. Mean arterial pressure (MAP) and heart rate (HR) were recorded at baseline before induction of anesthesia and every 15 min during surgery. Postoperatively, patients were shifted to PICU and the pain score was assessed using Face, Legs, Activity, Cry, and Consolability (FLACC)[7] for patients aged 2–7 years and Numeric Rating Scale (NRS) scores for patients >7 years at 2, 4, 6, 8, 12 and 24 h. Patients with pain score ≥4 received paracetamol 10 mg/kg IV. Moreover, time to first analgesic request and postoperative paracetamol consumption in first 24 h were recorded. Adverse effects like postoperative nausea and vomiting, local anesthetic toxicity, and hematoma were recorded for both groups. The primary aim was the duration of analgesia. The secondary aim was pain score, total postoperative paracetamol consumption and time to 1st rescue analgesia. According to previous study [8], the duration of analgesia in the caudal group was 4 ± 0.56 h. To detect a difference of at least 1 h in analgesia duration between the two groups, the sample size calculation required a minimum of 20 patients in each group at α error of 0.05, effect size 1.03 and 95% power of the study. So, we enrolled 22 patients in each group to compensate possible dropouts. By using SPSS v26 (Inc., Chicago, IL, USA), the statistical analysis was done. Using t test, the quantitative data were compared and presented as mean ± SD. The Chi-square test or Fisher's exact test was employed to ascertain the statistical significance of categorical data, which was presented as numbers and percentages. *P* value < 0.001 was considered significant.

Results

44 children were randomly divided into two equal groups. The demographic characteristics, surgical duration, and type of surgery were similar in both groups.(Table 1)

Table 1:Patient demographic and surgical profile

Variables	Group ESB(n=22)	Group CB(n=22)	P value
Age (year)	8.6±3.8	8.5±3.4	0.936
Sex ratio (M/F)	12/10	11/11	0.895
Weight (kg)	21.4±11.42	22.2±10.64	0.467
ASA Grade (I/II)	20/2	20/2	0.895
Duration of Surgery (min)	92.6±28.4	91.8±29.6	0.922

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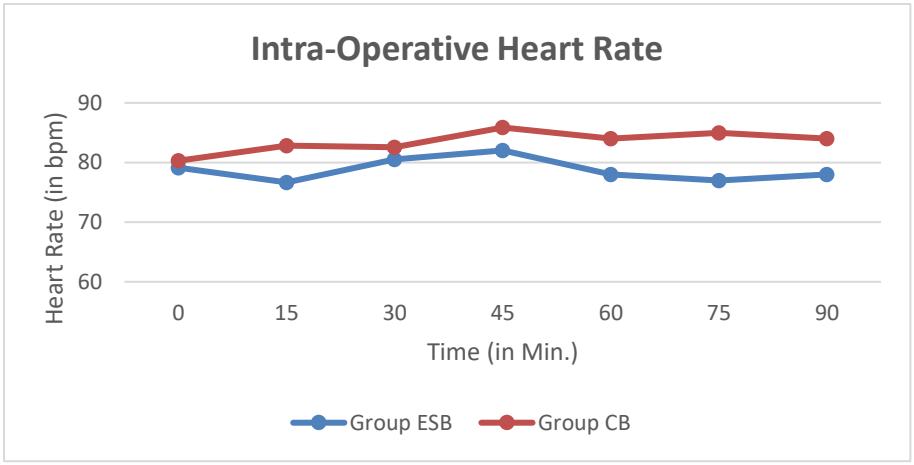
FLACC/NRS measurements were low in ESB group postoperatively but were significantly low in group ESB than group CB at 4h, 6 h and 8 h (P value < 0.001). (Table 2)

Table 2:FLACC/NRS measurements in both groups.

Time interval in PACU	Group ESB(n=22)	Group CB(n=22)	P value
0h	1(0-1)	1(0-1)	1.0
2h	1(0-1)	2(1-2)	0.321
4h	1(1-2)	3(2-3)	<0.001
6h	2(2-3)	4(3-4)	<0.001
8h	3(2-4)	4(3-6)	<0.001
12h	4(3-5)	4(3-6)	0.531
18h	4(3-5)	4(3-6)	0.427
24h	4(3-5)	4(3-5)	0.421

HR measurements were lower in ESB group compared to CB group but it was not statistically significant. (Figure 1).

Figure 1: Intraoperative changes in heart rate in both group



MAP measurements were lower in ESB group compared to CB group but it was not statistically significant. (Figure 2).

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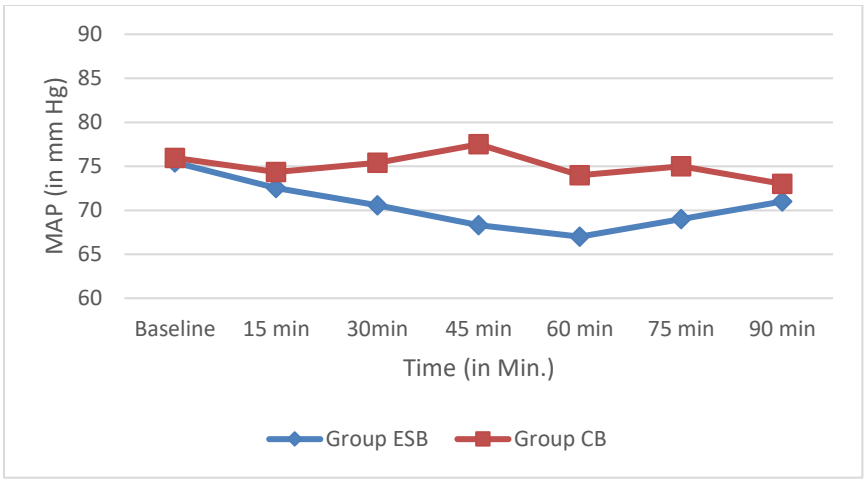

Figure 2: Intraoperative changes in MAP in both group

The number of children who required intraoperative tramadol was low in group ESB compared to CB group which was not significant. The first analgesic request time was delayed and duration of the analgesia was remarkably prolonged in group ESB compared to group CB (P value <0.001). The mean number of doses and total postoperative paracetamol consumption in first 24 h were statistically lower in group ESB than in group CB (P value < 0.001). (Table 3)

Table 3. Analgesia profile in ESB and CB groups.

Parameters	**Group ESB(n=22) Mean ±SD**	**Group CB(n=22) Mean ±SD**	**P value**
No of children requiring intra operative tramadol	4	6	0.009
Time of 1st analgesic request block (hr)	8	4	<0.001
Post operative paracetamol consumption(mg)	250 ±60.3	380.45±68.7	<0.001
Duration of analgesia (min)	686±56.8	565.8±62.5	<0.001

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Discussion

Our study showed that ultrasound guided ESB provided better and prolonged postoperative analgesia compared to caudal block in children undergoing lower limb orthopedic surgeries. Also it reduced the postoperative pain scores, prolonged the time to the first rescue analgesia and there by fewer patients required rescue analgesia. So ultrasound guided ESB can be considered in the multimodal analgesia protocol for pediatric lower limb orthopedic surgeries as an alternative to caudal block. In our study, hemodynamic parameters like HR and MAP were statistically higher in group CB than in group ESB intraoperatively. The exact mechanism of action and spread of local anesthetics in erector spinae plane block remains poorly understood. Holland et al. [9] established a systematic review that confirmed the significant beneficial effect of ESB on acute post-surgical pain after different pediatric surgeries, including hypospadias, inguinal hernia repair, varicocelectomy, cholecystectomy, nephrectomy, and thoracotomy. Moreover, Singh et al. [10] reported that the FLACC score in the EPB group was significantly low at 3 h and 6 h, resulting in a prolonged duration of analgesia with no intra or postoperative hypotension, tachycardia, or anaphylactic reaction. Our results are supported by Mostafa et al. [11] who reported that the MAP and HR were comparable between control and ESB in pediatric patients undergoing open midline splenectomy with no complications associated to ESB group and lower pain score. Also, El-Emam and Abd El Motlb [12] concluded that US guided ESB block provided superior postoperative analgesia than that provided by an ilioinguinal nerve block, as evidenced by lower FLACC score, and for a longer analgesic duration. Moreover, Karaca and Pinar [13] reported that using 0.5% bupivacaine for ESB in children undergoing laparoscopic cholecystectomy results in lower pain scale with no need for rescue analgesia. Aksu et al. [14] found low pain scores after pediatric lower abdomen surgery suggest that ESB offered sufficient perioperative analgesics and no patients required rescue analgesia during follow-up. Our results are also supported by Tulgar et al. [15] who observed that ESB had lower pain score at the 1st, 3rd, and 6th h and lower rescue analgesic doses compared to control in patients undergoing hip and femur surgeries. Our study, however, had several limitations. First, sensory test was not conducted to map the block area, as all blocks were performed under general anesthesia. Small sample size, no control group.no estimation of satisfaction of patients and their parents were other limitations. Consequently, further evaluation is required to determine the validation of our findings.

Conclusion

Compared to CB, US guided ESB produced better pain control and prolonged analgesia in pediatric patients undergoing lower limb orthopedic surgeries without any side effects.

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