Original Article

Ultrasound-guided transversus abdominis plane block versus caudal block for postoperative analgesia in children undergoing inguinal hernia surgery: A comparative study

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Abstract

Background and Aims: Ultrasound-guided (USG) transversus abdominis plane (TAP) block has emerged as a safe and effective regional anesthesia technique as it provides adequate postoperative pain relief for lower abdominal surgeries. Caudal block is a gold standard technique in pediatric surgeries. Our aim was to compare the duration of postoperative analgesia between TAP block and caudal block in children undergoing inguinal hernia surgeries.

Material and Methods: In a prospective, randomized, controlled study, 112 children of age 2-8 years and ASA grade I and II, undergoing elective inguinal hernia surgery were randomly allocated into two groups: Group T (n = 56) received USG-guided TAP block with 0.5mL/kg of 0.2% ropivacaine and Group C (n = 56) received caudal block with 1mL/kg of 0.2% ropivacaine. The primary outcome variable was the duration of postoperative analgesia and the secondary outcome variables included variation in hemodynamic parameters and adverse effects, if any.

Results: There was no significant difference in median of CHEOPS score till 5 postoperative hours, thereafter till 24 postoperative hours, significantly lower CHEOPS score were found in Group T. Mean duration of analgesia was 523.44 ± 61.30 min in Group T, whereas in Group C, it was 352.59 ± 32.54 min. No significant difference was observed in hemodynamic variations and adverse effects.

Conclusion: TAP block and caudal block both are effective in providing postoperative analgesia in children undergoing inguinal herniotomy. USG-guided TAP block was found to be superior as it provided longer duration of analgesia and reduced rescue analgesic dose without any significant adverse effects as compared with caudal block after inguinal herniotomy.

Keywords: Caudal block, inguinal herniotomy, pediatric, postoperative analgesia, transversus abdominis plane block

Introduction

Inguinal hernia repair is a commonly performed surgery in day care pediatric surgical units; it is associated with significant postoperative pain and discomfort. This pain is derived from abdominal wall incision.[1] The nerves that supply abdominal wall course through the neurofascial transversus abdominis plane between the internal oblique and transversus abdominis muscle.[2] For effective pain control, various analgesic modalities have been tried, including low-dose opioids, non-steroidal anti-inflammatory drugs, local wound infiltration, neuraxial anesthesia and peripheral nerve blocks like ilioinguinal/iliohypogastric nerve block, transversus abdominis plane (TAP) block. Multimodal approach provides better pain control.

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Caudal block analgesia is a popular and reliable technique for lower abdominal surgeries and found to be safe and effective for providing intra and postoperative analgesia in pediatric patients. It is used with greatest frequency in pediatric anesthesia practice.[3,4] The main disadvantage of caudal analgesia is the limited duration of action after a single injection.[5]

Peripheral nerve blocks have gained popularity in recent years because of lower incidence of side effects compared with neuraxial techniques. Introduction of ultrasound in anesthesiology, has improved the reliability and safety profile of the TAP block due to direct visualization of needle and spread of local anesthetics.[6] The efficacy of the TAP block in providing postoperative analgesia and decreasing analgesic requirements for 24 h has been shown in pediatric patients.[7-9]

Few studies have described the use of TAP block for hernia repair in children, but there is paucity of literature regarding comparison of Ultrasound-guided TAP block and caudal block in terms of postoperative analgesia duration. We hypothesized that compared with caudal block, the USG-guided TAP block would result in better postoperative pain relief after inguinal hernia surgery in pediatric patients.

Material and Methods

This prospective, randomized, comparative study was conducted in a tertiary care center from October 2016 to March 2017 with due permission from Institutional Ethics Committee (Ref no 2352/MC/EC/2016) and written informed parent consent. Total 112 patients of ASA physical status I-II, aged 2–8 years, scheduled for inguinal hernia surgery were randomized into two groups of 56 patients each, using a computer-generated random number table. Exclusion criteria included lack of consent by parents, blood coagulopathies, local infection, vertebral deformity, and allergy to drugs. Patients in:

Group T: received TAP block with 0.5mL/kg of 0.2% ropivacaine under USG guidance.

Group C: received caudal block with 1mL/kg of 0.2% ropivacaine, with children in left lateral position.

All patients were visited 1 day prior to surgery and explained about the anesthesia technique and perioperative course. Each patient underwent a thorough pre-anesthetic check. On arrival in OT, multipara monitoring of ECG, SpO_2, NIBP were established. Base line parameters (SpO_2, pulse rate, SBP, DBP) were recorded. Patient was pre-medicated with glycopyrrolate 0.005mg/kg, midazolam 0.05mg/kg, and fentanyl 2μg/kg intravenously (IV) through already secured IV line, and ringer lactate infusion was started. After pre-oxygenation with 100% O_2, anesthesia was induced with propofol 2–3mg/kg and atracurium 0.6mg/kg; endotracheal intubation was done using appropriate size endotracheal tube. Anesthesia was maintained with O_2:N_2O ratio 40:60 and sevoflurane (1%–2%) and atracurium 0.15mg/kg SOS. In Group T, patients were placed in supine position and the abdomen exposed, skin and transducer was aseptically prepared. The abdominal wall was scanned using a linear array transducer probe (6–13 MHz) in the multibeam mode, connected to a portable ultrasound unit (S-Nerve® SonoSite, Bothell, WA, USA). Probe was placed in midline over the rectus abdominis muscle at umbilicus level and traced laterally to region above the iliac crest to the petit triangle. A 22-G short beveled block needle was inserted in plane with transducer, in anterior-posterior direction. After visualization of needle tip in-between internal oblique and transversus abdominis fascial sheath, local anesthetic 0.5mL/kg of ropivacaine 0.2% was deposited. Correct local anesthetic drug placement was indicated by hypoechoic elliptical fluid pocket between these two muscles. In Group C, with all aseptic measures caudal block was performed using 25-G needle in left lateral decubitus position. Needle position was confirmed by the pop felt during penetration of the sacrococcygeal ligament, further ensured by doing whoosh test using 0.5 mL of air.Inj. 0.2% ropivacaine 1mL/kg was administered after negative aspiration of blood and CSF. Intraoperative hemodynamic parameters were recorded throughout the surgery at fixed intervals (at time of skin incision then after every 5 min till the end of surgery).

To maintain blinding, postoperative evaluation of pain scores was done by an anesthesiologist, who was not involved in administering block. Postoperative pain was assessed by CHEOPS score in which six parameters (cry, facial expression, child verbal, torso, touch, and leg movements) are included. Duration of postoperative analgesia, total number of rescue analgesic requirement and total dose of rescue analgesic required in 24h and any side effects (hypotension, bradycardia, respiratory depression, urinary retention, postoperative nausea and vomiting) were recorded. Pain scores ≥6 For rescue analgesia in form of syrup paracetamol 10mg/kg orally was administered.

Sample size was calculated considering confidence level 99% and power of study 95%, 53 patients in each group will be required to show a difference of 30% in CHEOPS score at 6h.We, therefore enrolled 56 subjects in each group to replace any dropouts.

Data was enetred at the end of study using Microsoft excel and was analyzed using SPSS statistical software

(version 20.0) (IBM Corporation, NY, USA). Numerical variables (e.g. age, weight, HR and BP) were presented as mean ± SD and categorical variables (e.g., sex and adverse effects) were presented in numbers and percentage (%). The quantitative variables were compared using unpaired *t*-test or Mann–Whitney *U*-test (when the data set was not normally distributed) between the two groups. The qualitative variables were compared using the Chi-square test. For all statistical analysis, the level of significance was fixed at the 1% level. A *P* value <0.01 indicates significant difference.

Results

In total, 112 patients were enrolled in the study (56 in each group) undergoing elective inguinal hernia surgery. There was no significant difference with respect to demographic characteristics age, weight, gender, surgical procedure, and duration of surgery between two groups [Table 1].

Intra-operative hemodynamic parameters (HR, SBP, DBP, and MBP) were within normal limits and did not show any significant increase (>20%) from the baseline values in both groups [Figures 1and 2].

The CHEOP scores were analyzed every 30 min for first hour, hourly for next 12 hours, and thereafter at 24 h. On comparing the median of CHEOPS score between Group T and Group C in postoperative period, there was no statistically significant difference at 30 min, 1h, 2h, 3h, 4h, and 5h; indicating good quality of analgesia in both groups during early postoperative period. Thereafter, CHEOPS score increased more rapidly in Group C and significant difference in CHEOPS was observed after 6h to 24h, in postoperative period between Group T and Group C [Table 2].

Our primary outcome variables are presented in Table 3.The mean duration of analgesia in Group T was longer compared with Group C (*P* value: 0.0001). The mean number of rescue analgesia asked in first 24 postoperative hours in Group T was less compared with Group C (*P* value: 0.0001). Difference in total dose of rescue analgesic requirement in first 24 postoperative hours was reduced in Group T and this difference was statistically significant.

In postoperative period, total 8 patients in Group T and 14 patients in Group C suffered from nausea and vomiting, but this difference did not achieve significance level. Other side effects, such as hypotension, bradycardia, respiratory depression, and urinary retention, were not reported in both the groups.

Table 1: Demographic variables

Variable	Group T	Group C	*P*
Age (year)	4.09±2.12	3.73±1.78	0.337
Gender (M/F)	52/4	50/6	0.371
ASA (I/II)	52/4	50/6	0.371
Weight (kg)	15.11±5.31	13.59±3.08	0.312
Duration of surgery (mins)	22.71±3.55	23.11±3.63	0.282

Group T=TAP block; Group C=Caudal block; ASA=American Society of Anaesthesiologists. P<0.01 taken as significant

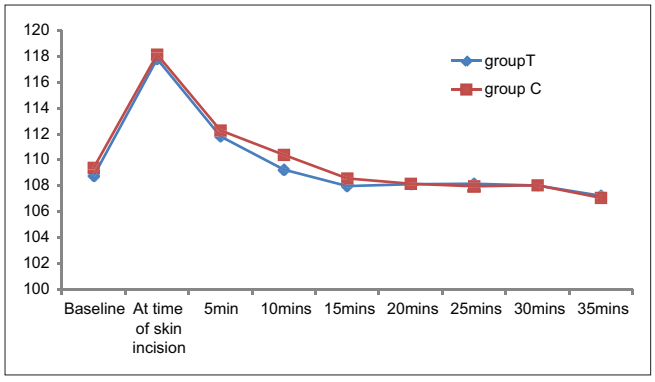

Figure 1: Mean MBP changes over different time points among study subjects (n = 112)

Discussion

TAP block has emerged as a safe and reliable technique to provide postoperative analgesia in children. In this prospective randomized study, we compared USG-guided TAP block with caudal block for postoperative analgesia after inguinal herniotomy.

Our results showed that USG-guided TAP block provided longer duration of analgesia compared with the caudal block at 6–24 h after block placement, as demonstrated by a

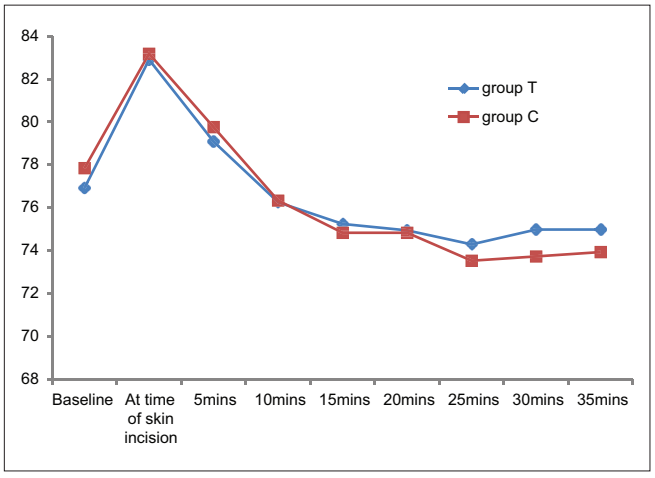

Figure 2: Mean HR changes over different time points among study subject (n = 112)

statistically significant decrease in number of rescue analgesic doses and reduced total rescue analgesic consumption in 24 h.

Adequate postoperative pain relief is essential for day care surgical procedures such as inguinal herniotomy as it allows same day discharge. Currently, postoperative pain management practices rely heavily on opioids and NSAIDs, which are associated with several unwanted adverse effects. Apart from it, various regional anesthesia techniques are being used as a part of multimodal analgesia regimen. Caudal block has been the cornerstone in regional anesthesia techniques for lower abdominal surgery in children till now. Recently, the surge in the use of TAP block shown to provide analgesia for 24h seems promising alternative analgesic option. Wide choice of local anesthetic agents is available, but ropivacaine, the S-enantiomer of the amide local anaesthetic, is more suitable for day care surgery in children as it produces differential neural blockade and has less cardiovascular and neurological toxicity.

We observed that the duration of analgesia (CHEOPS <6) without the need for rescue analgesic drug was significantly lower in the group receiving USG-guided TAP block than the group receiving caudal block. These results are in accordance with other studies; they concluded that both TAP block and caudal block provided lower pain score as compared with control group and there was no significant difference in pain score in TAP and caudal block group up to 6h, and thereafter, pain was significantly less in TAP block group as compared with caudal block group.[10,11]

Table 2: The CHEOPS score median and range for two groups

Postoperative time	Group T		Group C		*P*
	Median	Range	Median	Range	
30 min	5 (4-5)	4.67-5.33	4 (4-5)	3.67-4.33	0.038
1h	5 (4-5)	4.67-5.33	4 (4-5)	3.67-4.33	0.026
2h	5 (4-5)	4.67-5.33	5 (4-5)	4.67-5.33	0.166
3h	5 (4-5)	4.67-5.33	5 (4-5)	4.67-5.33	0.072
4h	5 (4-5)	4.67-5.33	5 (4-5)	4.67-5.33	0.299
5h	5 (4-5)	4.67-5.33	5 (4-6)	4.33-5.67	0.135
6h	5 (5-6)	4.67-5.33	6 (5-9)	4.67-7.33	0.000*
7h	5 (5-7)	4.67-5.33	7 (5-9)	5.67-8.33	0.000*
8h	5 (5-7)	4.67-5.33	8 (6-10)	6.67-9.33	0.000*
9h	6 (5-8)	5.00-7.00	9 (7-11)	7.67-10.33	0.000*
10h	7 (5-9)	5.67-8.33	9 (7-12)	7.33-10.67	0.000*
11h	8 (6-10)	6.67-9.33	10 (8-12)	8.67-11.33	0.000*
12h	8 (7-10)	7.00-9.00	10 (8-10)	9.33-10.67	0.000*
24h	7 (6-9)	6.00-8.00	8 (7-10)	7.00-9.00	0.000*

Group T=TAP block; Group C=Caudal block. P of CHEOPS score by Mann-Whitney U-test at 95% CI. P<0.01 taken as significant

Another study compared the postoperative analgesic effect of USG-guided TAP block (0.3mL/kg of bupivacaine 0.25%) and caudal block (1.25mL/kg of bupivacaine 0.25%) in infants and children undergoing surgical pyeloplasty. They concluded that unilateral TAP block provided superior analgesia compared with single shot caudal epidural injection in first 24 postoperative hours.[12]

In another trial, while comparing analgesic efficacy of TAP block and caudal block in paediatric patients, it was observed that pain scores were higher in TAP block group during initial 6 h, but later, this difference resolved. They also concluded that TAP block provided superior analgesia compared with the caudal block at 6–24 h after block administration.[13] Lower pain scores in caudal group during initial 6 h in that study was attributed to the caudal block's coverage of visceral stimulation arising from bladder spasm.

In another study, using triangle of Petit as a landmark for the TAP block (0.3mL/kg of 0.75% ropivacaine) in children, significant reduction in first 48 h postoperative VAS pain scores at rest and on movement was reported.[14] It has been suggested that blind TAP block technique via triangle of Petit might lead to a paravertebral spread of local anaesthetic, which may explain longer duration and greater analgesic efficacy up to 48 h postoperatively.[14]We monitored the postoperative pain relief for 24 h only.

We observed statistically significant reduction in total number and dose of analgesic requirement in 24 postoperative hours in USG-guided TAP block group as compared with the caudal group. These observations are consistent with various other studies.[15]

Hemodynamic variables (HR, SBP, DBP, and MAP) between the groups were comparable and were not statistically significant during intra-operative period. Similar results were reported in other studies.[10,11]

Table 3: Primary variable outcome in two groups

Variable	Group T (mean±SD)	Group C (mean±SD)	*P*
Mean duration of analgesia (minutes)	523.45±61.30	352.59±32.54	0.0001*
Total no. of rescue analgesia	2.73±0.59	3.64±0.48	0.0001*
Total dose of rescue analgesic given in 24h (mg/kg body weight)	21.71±6.26	36.31±4.87	0.0000*

Group T=TAP block; Group C=Caudal block; SD=standard deviation. P<0.01 taken as significant

Postoperative nausea and vomiting were less in TAP block group compared with caudal group, but the difference was not significant statistically. These findings are in accordance with other studies.[16]

There are some limitations to our study; first, we did not consider postoperative agitation effects of sevoflurane. Second, we did not evaluate the onset of TAP block. Third, ultrasound guidance for caudal block administration should have been considered for more precise drug deposition.

Conclusion

From the recent study, we concluded that TAP block and caudal block both are effective in providing early postoperative analgesia in children undergoing inguinal herniotomy. But USG-guided TAP block provided longer duration of postoperative analgesia, as demonstrated by a statistically significant decrease in number and dose of rescue analgesic drug requirement without causing any significant side effects as compared with caudal block.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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