Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5(9): 1552-1556
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.5918.20

A Comparative Study: Ultrasound Guided Transverse Abdominis Plane Block versus Caudal Block in Paediatric Patients for Lower Abdominal Surgeries

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Abstract

Background: Paediatric patients undergoing lower abdominal surgeries require adequate pain relief peri operatively, which is often neglected. Various methods of pain relief in paediatric patients are systemic opioids, NSAIDS and regional anaesthesia techniques like caudal block. Recently a newer technique i.e. ultrasound guided transversus abdominis plane (TAP) block is being taken into consideration. Therefore, we aimed to compare efficacy of USG guided TAP block Vs. Caudal block in paediatric patients undergoing lower abdominal surgeries for post-operative analgesia. *Methods:* Fifty patients were randomly allocated in two equal groups- group A received TAP block and group B received caudal block. Our study included children of age group one to ten years posted for lower abdominal surgeries. Both the blocks were performed after same general anaesthesia technique. We compared requirement of intra-operative additional analgesia, vital parameters, post op pain score and time of rescue analgesia. The entire data was statistically analyzed using SPSS software. The inter-group comparison is done using Chi-square test/ Fisher's exact probability test. *Result:* Intra-operative pulse rate did not differ significantly between two groups. The average requirement of intra-operative analgesia did not differ significantly in both the groups. The average post-operative Pain Score was significantly higher in group B compared to group A after 180 min (p=0.001). Significantly higher proportion of children from Group B required rescue analgesia compared to Group A (p=0.001). *Conclusion:* We conclude that USG guided TAP block is better alternative to caudal block for post operative analgesia in children undergoing lower abdominal surgeries.

Keywords: TAP Block; Caudal Block; Paediatric Patient.

How to cite this article:

Salil Kumar Singh & Sarita S. Swami. A Comparative Study: Ultrasound Guided Transverse Abdominis Plane Block versus Caudal Block in Paediatric Patients for Lower Abdominal Surgeries. Indian J Anesth Analg. 2018;5(9): 1552-56

Introduction

The impact of a painful experience on the young nervous system is so significant that long-term effects can occur, including a lowered pain tolerance for months after a pain-producing event [1, 2]. On the other hand there are benefits of adequate analgesia, which include attenuation of the surgical stress response, decreased perioperative morbidity and improved outcome in certain types of surgeries. Also, effective pain control facilitates rehabilitation and accelerates recovery from surgery [3,4]. Paediatric patients undergo a variety of lower abdominal surgical procedures that need adequate pain relief peri-operatively, which is often neglected.

Finely et al observed that many types of the so called "minor"surgeries can cause significant pain in children [5]. Regional anaesthesia and analgesia techniques are commonly used to facilitate pain control during paediatric surgical practice, reduce

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Received on 26.05.2018, **Accepted on** 09.06.2018

parenteral opioids requirement and improve the quality of post-operative pain control and patient-parent satisfaction.

There are various methods of pain relief in paediatric patients such as systemic opioids, NSAIDS (non steroidal anti inflammatory drugs) and various regional anaesthesia techniques for e.g.: caudal epidural block for analgesia. However, caudal epidural block has its own disadvantages, like accidental injection of LA into intrathecal space, invasiveness, accidental rectal puncture, and difficult anatomic variations. It is contraindicated in conditions such as spina bifida, meningomyelocele, etc. So trends are shifting towards peripheral nerve blocks or infiltration blocks.

In recent times, because of availability of imaging techniques, use of peripheral nerve blockade is advocated wherever applicable. It has lower incidences of adverse effects compared to neuraxial blocks and the procedure is easy, safe and reliable due to imaging aids [6]. So, among the peripheral nerve blocks, TAP (tansverse abdominis plane) block is a newer technique, which can be used in lower abdominal and inguinal surgeries.

On searching literature, we found that there are limited conclusive studies of USG (ultrasonography) guided TAP blocks in paediatric patients. Therefore, we aimed to compare the efficacy of USG guided TAP block vs. caudal block in paediatric patients undergoing lower abdominal surgeries for postoperative analgesia. Our primary objective was to compare analgesic effect of caudal block with TAP block peri-operatively. Secondary objectives were to know the duration of analgesia in post operative period, time to first dose of rescue analgesia and incidence of rescue analgesia between the two groups.

Methods

Institutional ethical committee approval was taken. The study was conducted over a period of 14 months. The study was a prospective, randomized study and included fifty patients of ASA grade I and II within the age group of 1-11 years. We used simple random sampling (SRS) method for randomization and the list of cases was generated based on the on-line random number generators. Necessary parental consent was taken for all patients. All these patients were posted for elective lower abdominal surgeries such as pyeloplasty (explained in reply template), herniotomy, laparoscopic appendicectomy, etc. We excluded the patients with neurological diseases, with coagulopathies and patients having infection at the puncture site.

Patients were divided into two groups (twenty five in each group) and randomly received either caudal block or USG guided TAP block after induction of general anaesthesia.

Group A: TAP block was performed under ultrasound guidance with 0.25 ml/kg of 0.25% Bupivacaine (bilateral block was given).

Group B: Caudal block was performed with landmark technique with 1 ml/kg of 0.25% Bupivacaine with the child in lateral position [7, 8].

Standard protocol of GA was followed in both the groups. A complete preanaesthetic check up of patients was performed before their scheduled allotment into the two study groups. Appropriate biochemical, haematological and radiological investigations were done as per hospital protocol. Standard NPO guidelines were followed. All children were allowed to take clear fluids 2h prior to surgery.

Children were premedicated with Syrup Midazolam 0.5 mg/kg in the pre operative room. On shifting the patient to the operation theatre (OT), monitoring devices were attached including three lead electrocardiogram (ECG), pulse oximeter and non-invasive blood pressure monitor. An intravenous (I.V.) line was secured.

Pre medication with injection Glycopyrrolate 0.004 mg/kg I.V was given. Patients were preoxygenated with 100% O_2 for 3 minutes. Pre induction injection Fentanyl 1mcg/kg I.V. was given in both the groups, the same was used for intraoperative analgesia supplementation as per requirement. Induction was carried out with injection Thiopentone Sodium 5mg/kg I.V. Intubation was done under the effect of injection Succinylcholine 2mg/kg I.V and uncuffed/cuffed endotracheal tube of appropriate size was secured. Maintenance of anaesthesia was done on O_2+N_2O+Sevoflurane with intermittent doses of Inj. Vecuronium 0.08mg/kg I.V. Jackson Rees circuit was used for IPPV.

During surgery, all patients received an I.V. infusion of Ringer lactate as a maintenance dose as per Holliday Segar formula. On completion of surgery, in both the groups of patients, neuromuscular blockade was reversed with injection Neostigmine 0.05 mg/kg and injection Glycopyrrolate 0.01 mg/kg.

In case of caudal block, the child was placed in lateral position and caudal block was performed

using aseptic technique and a short bevelled 22 gauge needle. After negative aspiration of blood and CSF, 1ml/kg of 0.25% Bupivacaine was administered.

The TAP block procedure was done under ultrasound guidance using Sonosite ultrasound machine and linear multi-frequency 6-13 MHz transducer scanning probe. Under all aseptic precautions, with the patient in supine position, the probe was placed in a transverse plane to the lateral abdominal wall in the mid axillary line between the lower costal margin and iliac crest. The scan showed three muscles of the abdominal wall - external oblique, internal oblique and transverse abdominis. A 22 gauge hypodermic needle was inserted, in plane approach; the end point was, as shown in the Image 1, in between the internal oblique and transversus abdominis muscle in the fascial layer that separates the two muscle layers [9]. The local anaesthetic, 0.25 ml/kg (on each side) of 0.25% Bupivacaine was deposited after confirmation of the needle tip between the two fascial planes. After completion of surgical procedure and emergence from anaesthesia, the patients were shifted to PACU (post anaesthesia care unit). Quality of analgesia was assessed by using the Wong Baker's pain score till patient received first dose of rescue analgesia in both groups. Rescue analgesia was considered when the Pain score was more than three.

Sample size calculation was based on the results (effect sizes) from the previously published studies. A sample of size 23 cases in each study group, i.e. total 46 cases with Group A (TAP Block) to Group B (Caudal Block) ratio being 1:1 and satisfying the inclusion criteria would produce more than 80.0% statistical power (type II error =0.20) and 5% type I error probability (a=0.05) clinically significant difference in outcome measures based on post operative pain scores between the two study groups with a two-tailed alternative hypothesis by using power and sample size calculation software (PS). On an average one unit difference of Wong Baker's post-op pain scale was considered to be clinically significant.

The data on categorical variables is shown as n (% of cases) and the data on continuous variables is presented as Mean and Standard deviation (SD) across two intervention groups. The inter-group comparison of categorical variables was done using Chi-square test / Fisher's exact probability test.

The p-values less than 0.05 are considered to be statistically significant. All the hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data was statistically analyzed using Statistical Package for Social Sciences (SPSS ver. 16.0, Inc. Chicago, USA) for MS Windows.

Results

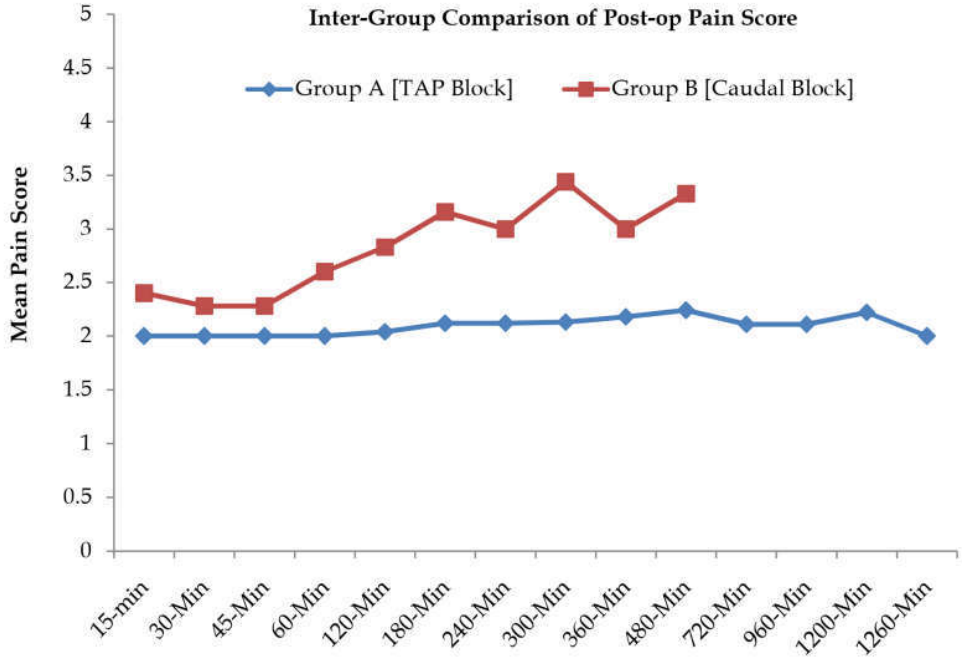
The demographic data: age, weight, sex, ASA grading and gender in both the groups were comparable (as shown in Table 1). The difference between average pain scores in post-operative period is shown in Graph 1.

The incidence of requirement of rescue analgesia was 36% in group A; however it was 96% in group B (p value-0.001) which was significantly higher.

Image 1: Muscle layers of abdominal wall with needle entry and drug spread in TAP block

Table 1: Demographic Data

	Group A(n =25)	Group B (n=25)	P Value
Age (in years)	4.48 ± 4.15	3.11 ± 2.20	0.923
Weight (in kgs)	16.14 ± 9.09	13.61 ± 4.69	0.223
Gender (Male/ Female)	16/9	19/6	0.538



Graph 1: Inter-Group Comparison of Post-op Pain Score

The average time to first dose of rescue analgesia was 9.56±6.48 hrs in Group A compared to 3.75±1.87 hrs in Group B, which was significantly higher (p value-0.001). There was no change in intra operative hemodynamic parameters in both the groups.

Discussion

This prospective randomised study compared the analgesic effects of both ultrasound guided TAP block and landmark guided caudal block (which is used by most of the anaesthesiologists). Intra operative analgesic requirement in both the groups did not differ significantly. Even pain scores in early post operative period showed no significant difference till 180 min. The duration of analgesia was significantly longer in TAP block as compared to caudal block which showed early requirement of rescue analgesia.

Improved analgesia in TAP block compared to caudal block may be explained by ease of approach making the ultrasound view clearer and thereby confirming the site of injection. Ultrasound views were satisfactory in all patients in TAP block group and the spread of local anaesthetic was seen as spindle shape in all TAP blocks. This helped in direct visualisation of spread of LA in neurofascial plane.

TAP block per se only covers somatic sensation to the abdominal wall and the parietal peritoneum. However, if high volume of LA is used it facilitates spread of LA into paravertebral spaces as the transverse abdominis plane is in continuum with paravertebral spaces resulting in some visceral analgesia. Therefore, it helps in eliminating the need of additional opioids [10].

However caudal block provides predominantly sympathetic blockade, while visceral pain could not be eliminated [7]. This could be the reason of early requirement of analgesia in caudal group. The results from our study are very well correlated with the study done by Kanojia el al. They also found that the children who received USG guided TAP block had longer duration of analgesia compared to children who received caudal block [11]. Kanojia et al. used 0.3ml/kg of 0.2% Ropivaicaine as LA. Alsadek et al also did the same study but they used

USG in both the groups for TAP block and caudal block. They found that the patients who received TAP block required less post operative rescue analgesia with better impact on pain scores than caudal block. They also observed that patient and parent satisfaction was markedly good in case of TAP block [12]. Alsadek et al used drug dose of 0.5ml/kg of Bupivacaine on affected side. We found similar results with 0.25ml/kg of Bupvacaine given bilaterally. More interesting findings were observed by Farid et al. They did a comparison between USG guided TAP block vs. ilioinguinal/iliohypogastric nerve blocks in children undergoing lower abdominal surgeries and they found that TAP block has longer duration of analgesia [13]. Though both ilioinguinal and iliohypogastric nerves enter transverses abdominis plane by penetrating transverses abdominis muscle midway between iliac crest and costal margin, longer duration of analgesia was found with TAP block. It may be because of more anterior injection site which was implemented in their study. This anterior approach brought the TAP block in close proximity to both ilioinguinal and iliohypogastric nerves, having better results and long duration of analgesia. We used this anterior approach in our technique of blocks, which must have helped us with longer duration of analgesia and lower pain scores. In our study, though early post operative pain scores were similar in both the groups, sustained lower pain scores were seen in TAP block (6-8h) as compared to caudal block (3h). The only limitation of USG guided TAP block is expertise in USG imaging and longer learning curve.

Conclusion

To conclude, TAP block under ultrasound guidance was easy, safe, reliable and effective in children undergoing lower abdominal surgeries in comparison to caudal block. The patients who received TAP block required less post operative rescue analgesia with better impact on pain scores than caudal block.

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