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Comparative Study of Ultrasound Guided Transversus Abdominis Plane Block with Caudal Epidural for Infraumbilical Surgeries in 1 to 7yr old Children: A Double Blind Randomised Prospective Study

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Abstract

Background: Transversus abdominis plane block (TAPB) has emerged as a safe and effective regional anaesthesia technique for providing postoperative analgesia following lower abdominal surgeries. Complications associated with ultrasound guided TAPB are rare and pose a lower overall risk to the patient receiving TAPB versus caudal block (CEB), which is considered as gold standard for paediatric lower abdominal surgeries. Our study hypothesis was that TAPB would initially be equivalent to caudal block in providing postoperative pain control but would also show improved pain relief beyond the anticipated caudal duration. *Methods:* This was a randomised controlled trial involving 80 children, 1-7yrs old, randomly allocated into one of the two equal groups; TAPB group (T-group) and CEB group (C group). Children underwent lower abdominal surgeries. All children received general anaesthesia using ketamine 2mg/kg and 1% sevoflurane. Group T received 0.5ml/kg of 0.25% bupivacine and group C received 0.75ml/kg of 0.25% bupivacaine under ultrasound guidance. Primary outcome measures were pain scores and duration of analgesia. Pain scores were assessed using Wong Baker FACES scale and FLACC scale. Secondary outcome measured were time taken for instilling the block, hemodynamics, and parent satisfaction and any other adverse events. *Results:* TAPB patients had significantly longer duration of analgesia compared to CEB patients ($p<0.001$). Regarding pain scores, after 6hrs, there was a significant difference in the pain scores ($p=0.02$) between two groups with group T having low pain scores. There was no statistically significant difference in the time taken for instilling the block ($p=0.139$). There was statistically significant increase in HR and MAP intra-operatively in group T patients ($p<0.001$) at 10 and 15min post block time. There was no statistically significant difference between two groups regarding parent's satisfaction. ($p=0.136$).Thus pain scores were significantly lower in group T and duration of analgesia also lasted longer. None of our patients had any complications postoperatively nor did we have any exclusions. *Conclusion:* Both CEB and TAPB give adequate analgesia during the early Post-operative period. However, TAPB results in prolonged analgesia beyond the anticipated CEB duration. Considering the safety profile of TAPB and avoiding the narcotics related side effects, this should be considered a preferred regional technique over CEB for lower abdominal surgeries whenever possible.

Keywords: Transversus Abdominis Plane Block; Caudal Epidural; Ultrasound Guided Abdominal Blocks.

Introduction

Management of postoperative pain is still unsatisfactory in paediatric patients. Most of the western studies using TAPB or CEB for analgesia have used them as a component of multimodal analgesia, which also included use of opioids in postoperative period. Opioids used for postoperative analgesia are frequently associated with adverse effects like nausea, vomiting, constipation, excessive sedation or inadequate pain relief. Because of these adverse effects and inadequate training in postoperative pain assessment and management by nursing staffs in most of the hospitals in India, and due to difficulty in obtaining licence for getting opioids, opioids are not used in postoperative period. Regional anaesthesia techniques are widely used to improve postoperative analgesia and reduce requirement of

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intravenous analgesics.

Caudal extradural block is gold standard technique followed around the globe, in conjunction with general anaesthesia for perioperative pain management in procedures involving lower abdominal surgeries including genitourinary surgeries. It blocks both somatic and visceral pain and thus reduces the requirement of general anaesthetics and attenuates the stress response to surgery. The caudal block has low complication rates (0.7 per 1000) [1], provide 4 to 6 hrs of analgesia, and results improved pain scores than in patients receiving general anaesthesia alone [2,3,4]. Nevertheless, as a neuraxial block, the potential complications are more serious than those associated with peripheral nerve blocks [5] and it is contraindicated in cases of impaired haemostasis, bacteraemia and neuraxial abnormality. Ultrasound is increasingly used to perform caudal block as an adjunct tool to guide cannula placement and to demonstrate accurate deposition of local anaesthetics in the caudal space; however its utility for decreasing the complication is yet to be determined [6,7].

An increasing understanding of abdominal wall anatomy has led to the introduction of Transversus abdominis plane block (TAPB) for managing pain after abdominal surgeries. It comprised of deposition of local anaesthetics into the anatomical plane between the transversus abdominis and internal oblique muscles, where thoraco-abdominal nerves (T6 – L1) contribute to the main sensory supply of skin, muscles and parietal peritoneum of the anterior abdominal wall [8,9].These nerves branch and communicate extensively with each other in this plane. TAPB provides reliable unilateral sensory block with single injection and results in significant reduction in opioid requirement and postoperative pain scores for 15 to 24 hours [10] after major abdominal surgeries. Complications associated with TAPB are rare, especially when performed under direct ultrasound visualisation, lack long-term consequences, and do not require additional interventions [11,12].

So we conducted this randomised controlled trial to compare the efficacy of ultrasound guided (USG) caudal epidural block (CEB) with that of USG guided TAPB for providing analgesia for children undergoing infraumbilical abdominal surgeries and also to know the effectiveness of these blocks in avoiding the need for additional anlgesics.

Materials and Methods

Source of Data

Ethical committee approval was obtained for this study from our hospital ethical committee (ICE NO: SIMS & RC/IECC/07/2017).The study was conducted on ASA1 and ASA2 children of 1yr to 7yrs patients admitted for elective infraumbilical abdominal surgeries under general anaesthesia. Purposive Sampling technique was used in selecting the patients for the study. Total number of abdominal surgeries per month at the department of paediatric surgery in our hospital is approximately 20. Study was planned for a duration of 6months [2017 Aug to 2016 Jan]. Considering the duration of study, number of surgeries in the department and exclusion criteria, we selected 40 patients in each group.

Exclusion Criteria

Parent Refusal

Allergy to local anaesthetics

Contraindication to caudal and TAP block due to local infection.

Hypospadiasis repair, PSARP, anorectal procedures where TAPB can't be given for pain relief.

Method of Study

Informed written parental consent was obtained from all. All children were premedicated with 0.1mg glycopyrrolate and 0.2mg/kg ketamine i.v. at receiving area. Once child is sedated, quickly shifted to operation theatre and preoxygenation was done for 3min while connecting the monitors. Monitoring included SpO_2, NIBP, ECG and $EtCO_2$. Then induction was done using sevoflurane3% inhalation in 33% O_2 and 66%N_2O. Fentanyl 1mcg/kg i.v. was given. Then appropriate size laryngeal mask airway [LMA] or i-gel was inserted when conditions were satisfactory. [Jaw relaxed, regular respiration, lash reflexes disappeared]. If endotracheal intubation [ETI] to be done, inj. atracurium 0.3mg/kg was given and mask ventilation was done for 3min.Then intubation was done using appropriate sized endotracheal tube.

Patients were randomised by sealed envelope technique to TAPB (group T) or to CEB (group C). Skin was prepared with betadine solution and a high frequency (8-13MHz) linear Ultrasound probe cleaned with same betadine solution was used for the block. Then USG guided TAPB was given at mid axillary line using **in plane** approach with 21G hypodermic needle connected to a 10cm extension

tube loaded with LA. TAPB given using 0.5ml/kg of 0.25% bupivacaine or USG guided CEB was done using o.75ml/kg of 0.25% bupivacaine. For pyeloplasty we used 1ml/kg of 0.25% bupivacaine for CEB. For midline incision surgeries bilateral USG guided TAP was given with 0.5ml/kg of 0.25% bupivacaine. For doing CEB, first linear US probe cleaned with betadine was placed over the sacral cornuae to visualise frogeye appearance. Then USG guided CEB was given using **out of plane** method to visualise the needle tip and widening of the frogmouth appearance. Time taken for instilling the block, i.e. from placement of USG probe till LA injection, was noted. After the block sevoflurane was reduced to 1%. An increase in blood pressure and heart rate by more than 15% from pre procedure value for skin incision was considered as insufficient analgesia and was supplemented with fentanyl 1mcg/kg and sevoflurane 2% in N_2O and O_2. Intraoperatively all children received fluids [500DNS+10meqKCL] according to Holiday Seggars formula. All children received antiemetic, inj. ondansetron 100mcg/kg towards the end of the surgery before extubation or removal of LMA or i-Gel. LMA /i-gel was removed when the child was, awake and airway reflexes were present. Intubated children were reversed with 0.05mg/kg neostigmine and 0.001mg/kg glycopyrrolate. Extubation was done when the child was fully awake. Then the child shifted to post-anaesthesia care unit.

Assessment

Pain was assessed using age appropriate scales, Wong Baker FACES scale and FLACC scale after shifting to PACU. First assessment of pain was done once the child started taking orally which is usually 3hr after the surgery in our institution. This is to avoid the bias of crying due to irritability or due to NPO status rather than the pain. Then assessment was done after 6 Hrs, 9 Hrs, 12 Hrs and 24 Hrs in

Fig. 1: Wong- Baker Faces Pain Rating Scale

Table 1: FLACC Scale

Face	0	1	2
	No particular expression or smile	Occasional grimace or frown, withdrawn,disinterested	Frequent to constant frown,clenched jaw,quivering chin
Legs	0	1	2
	Normal position or relaxed	Uneasy,restless,tense	Kicking,or legs drawn up
Activity	0	1	2
	Lying quietly, normal position,moves easily	Squirming, shifting back and forth,tense	Arched,rigid, or jerking
Cry	0	1	2
	No cry (awake or asleep)	Moans or whimpers, occasional complaint	Cries steadily,screams or sobs,freqent complaints
Consolability	0	1	2
	Content, relaxed	Reassured by occasional touching,hugging, or talking to; distractible	Difficult to console or comfort

the following manner.

Pain assessment was done by post-operative ward staff. Both, the patients and staffs were blinded to the group. All patients received paracetamol syr.15mg /kg 8th hrly. At any given point of time if the score is >4, it was instructed to give additional analgesia of inj paracetamol 15mg/kg. And that was considered the end point for assessment of postoperative analgesia. If pain still not relieved, diclofenac suppository 1mg/kg was advised. Those children whose NPO lasted more than 6hrs, received IV paracetamol 15mg/kg 8th hrly. Postoperative recordings also included heart rate and mean arterial pressure for two hrs.

Other complaints like irritability, nausea, vomiting, time when the child passed urine were recorded. Any other medications given were noted. Recovery room staff involved in assessment were blinded to the study groups.

Primary outcome measures were pain scores and duration of analgesia. Secondary outcome measures were time taken for instituting the block, hemodynamics, and any bladder dysfunction, parent satisfaction and any other adverse events.

Statistical Analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min–Max) and results on categorical measurements are presented in number (%). Significance was assessed at 5% level of significance. Student t – test and chi square test is used to find and compare the difference in each group. If P <0.005 is considered statistically significant [18,19,20].

Results

From aug 2017 to jan 2018, 80 patients were enrolled for the study. There were no exclusion since CEB and TAPB were done under USG guidance. Due to the nature of surgeries performed, there were more male patients than female; however, male to female ratio was similar in both the study groups. Data such as age (p=0.526), gender (p=1.00) and type of surgeries in both the groups were comparable.

Pain scores were comparable amongst two groups during initial postoperative period. (P=0.516; Table 2). However, after 6hrs, pain scores were better with TAPB. (Table 2). Similarly FLACC scores were comparable amongst both the groups during the initial 6hrs. After 6hrs there was a significant difference with pain scores between

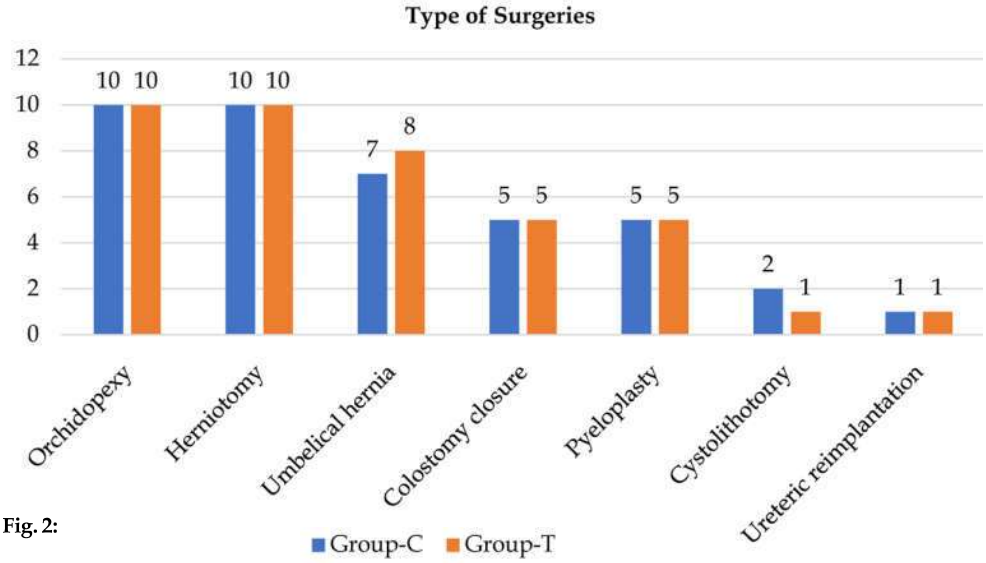


Fig. 2:

Table 2: Comparison of Pain Score in two groups of patients studied

Pain score	Group C	Group T	P value
3hr	0.50±0.88	0.63±0.84	0.516
6hr	0.55±0.90	0.95±0.93	0.055+
9hr	1.65±1.69	1.05±0.96	0.054+
12hr	1.70±1.60	1.05±0.90	0.028*
24hr	1.70±1.62	0.98±1.05	0.020*

both the groups (Table 3, p = 0.020).

TAPB patients had significantly long duration of analgesia compared to CEB (p < 0.001).

Time when rescue analgesia was given also was longer with TAPB than with CEB (p <0.001; Table 4). Analgesia lasted for more than 10hrs in all TAPB patients whereas none of the patients in CEB had analgesia more than 10hrs (Table 4)

Only two patients in CEB group who underwent orchidopexy and a patient in TAPB group who underwent ureteric re-implantation had postoperative vomiting which was treated with

Inj.ondansetron. None of our patients had any other problems like spasmodic pain, urinary retention, and respiratory problems.

Regarding the time taken for instituting the block, there was no significant difference (p=0.139, Table 5). There were no block related complications and all blocks were completed within 5 min.

Figure 3 and Figure 4 shows that the mean arterial pressure (MAP) and heart rate (HR) were comparable in both the groups except at 10 min and 15 min time. In patients who received TAPB there was increase in MAP and HR 10min and 15min. the difference was significant (p=0.01 at 10min and <0.001 at 15min). However, all the changes were within clinically accepted range.

There was no statistically significant difference between two groups with regard to parents

Table 3: FLACC SCORE- Comparative assessment in two groups of patients studied

FLACC Score	Group C	Group T	P value
3hr	0.50±0.88	0.60±0.78	0.591
6hr	0.55±0.90	0.83±0.84	0.164
9hr	1.50±1.68	0.93±0.86	0.058+
12hr	1.50±1.60	0.93±0.97	0.056+
24hr	1.70±1.62	0.98±1.05	0.020*

Table 4: Time when rescue Analgesia (Hrs.) given

Rescue Analgesia (hrs)	Group C	Group T
<8	17(42.5%)	0(0%)
8-16	23(57.5%)	11(27.5%)
>16	0(0%)	29(72.5%)
Total	40(100%)	40(100%)

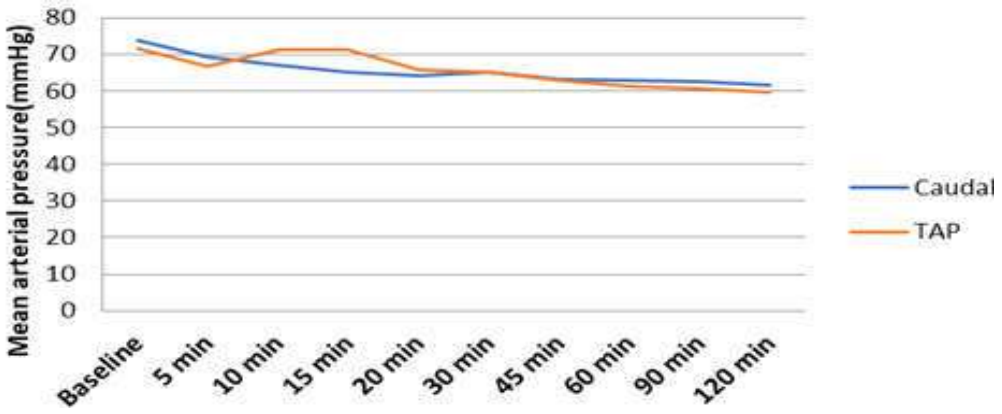
p<0.001**

Table 5: Procedure time (seconds)

Procedure time (seconds)	Group C	Group T
<80	3(7.5%)	19(47.5%)
80-160	33(82.5%)	9(22.5%)
160-240	0(0%)	4(10%)
>240	0(0%)	6(15%)
Total	40(100%)	40(100%)

P=0.139

Fig. 3:



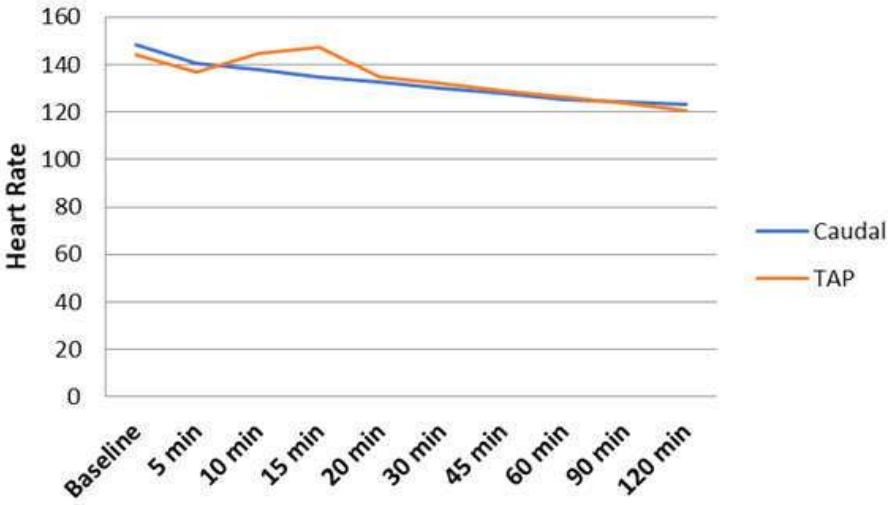


Fig. 4:

Satisfaction (chi sq value =2.222; p=0.136).

Discussion

TAPB has emerged as a safe and effective block for lower abdominal analgesia in children. Multimodal analgesic regimens are often limited by side effects. Even though caudal epidural is gold standard technique for perioperative pain management for lower abdominal surgeries in children, being neuraxial block, it carries its own disadvantages. Duration of analgesia also lasts for short duration. Recent studies suggest that the TAPB is an effective regional technique for postoperative analgesia following abdominal surgeries [21].

We carried out this study to compare the duration of analgesia provided by USG guided TAPB with that of USG guided CEB for variety of infraumbilical surgeries in children. Our results showed that TAPB provided superior analgesia compared with the CEB at 8 to 20hrs after the block placement, as demonstrated by statistically significant low pain scores (p=0.028), hemodynamic parameters and prolonged duration of analgesia (p <0.001).

TAPB block serves as a simple and effective analgesic technique, with the added advantage of preserved motor and bladder function and avoids hooking up the patient to infusion devices and IV poles, thereby allowing earlier ambulation.

Bryskin et al. [21] in their study found that the TAPB would initially be equivalent to caudal block in providing postoperative pain control but would also show pain relief beyond the anticipated caudal duration. But they had used multimodal in analgesia for pain management. We assessed the analgesic efficacy of TAPB with CEB without using any other supplementation. Our results correlate with their study. Avoiding opioids in the postoperative period may be the reason none of our patient had any vomiting, urinary retention. Only two patients in group C who underwent orchidopexy, and one patient of group T who underwent ureteric reimplantation had vomiting which was not significant. It was treated with inj.ondansetron 100cmc/kg.

Guidance on best volume and dose for the TAPB is lacking [16]. In a pilot study, we found 0.5ml of 0.25% bupivacaine is sufficient to provide analgesia for infraumbilical surgeries in children. This is also the dose used by Sahin et. al. [16] and Bryskin et. al. [21]. Also we selected this dose to avoid over dosage in case of bilateral blocks. Sandeman et al. [22] performed ultrasound guided bilateral TAPB in a group of children undergoing laparoscopic appendectomy. Contrary to our study, authors reported no difference in the proportion of patients requiring postoperative morphine compared to the control group. However, in their study, cases of complicated appendicitis were more frequent and duration of surgery was significantly longer in the TAPB group. Nevertheless, pain control was superior in the TAPB group in the postoperative period.

Intra operatively there was clinically significant increase in HR and MAP at 10min (p=0.031) and 15min (p<0.001) from preblock value in patients who received TAPB. This may be due to the pulling of the peritoneum and TAPB will take time for complete analgesia. This response was managed with additional dose of fentanyl 1mcg/kg and

2%sevoflurane. None of our patients received any additional analgesics during the postoperative period. TAPB supposed to provide analgesia for only somatic and parietal pain. Since our patients were comfortable without any additional analgesics, we assume that the local anaesthetics deposited in TAPB plane must have spread to the paravertebal space, resulting in visceral analgesia. Our findings correlate with those of Bergamans et. al [13].

We defined "adequate pain relief" as pain scores less than 4 during the observation period.

Adequate pain relief was achieved in all our patients. None of our patients required intravenous opioids in the postoperative period as long as the analgesic effect of the blocks lasted. Our results show the good quality of perioperative analgesia achieved with TAPB in children undergoing abdominal surgeries. Thus, TAPB may eliminate the need for IV opioids during first postoperative day when the pain severity is high. Our results show that TAPB gives adequate pain relief for 12 to 20hrs avoiding the need for additional analgesics and their associated adverse effects. Later pain relief can be achieved with the conventional analgesics.

An important methodological note was, our use of ultrasound guidance for all the blocks in both the groups and a predetermined end point for needle placement. Live verification of local anaesthetic spread avoided block failures.

Conclusion

Both caudal and TAPB block give adequate analgesia during the early post-operative period. However, TAPB results in prolonged analgesia beyond the anticipated caudal duration. Considering the safety profile of TAPB and avoiding the narcotic related side effects, this should be considered a preferred regional technique over caudal for lower abdominal surgeries wherever possible.

Limitations of the Study

Firstly, we could observe the patients for only 24 hrs because of the discharge criteria in the paediatric surgery clinic. Only pyeloplasty and colostomy closure patients were kept for more than 24hrs. Secondly TAPB cannot be given for hypospadiasis repair, PSARP and other anorectal procedures where still caudal is considered gold standard. Thirdly, we have compared the effectiveness of analgesia indifferent types of surgeries where the intensity of pain differs. However, we have tried to compensate it by comparing the analgesic effect of TAPB and CEB in each group of surgeries separately (Figure 2). Fourthly, we did not compare TAPB and CEB with ilioinguinal block. One comparison with USG ilioinguinal block found that it provided more effective analgesia than TAPB [17].

Conflict of Interest: Nil.

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