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ORIGINAL ARTICLE

TO EVALUATE THE ANALGESIC EFFICACY OF IPSILATERAL TRANSVERSUS ABDOMINIS PLANE BLOCK FOR LOWER ABDOMINAL SURGERIES IN CHILDREN: A PROSPECTIVE RANDOMISED CONTROLLED STUDY

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ABSTRACT: BACKGROUND: Appendectomies and lower abdominal surgeries are associated with significant postoperative pain in children. Transversus Abdominis Plane (TAP) block provides effective analgesia for patients undergoing lower abdominal surgeries. Our aim is to evaluate its analgesic efficacy for lower abdominal surgeries in children when compared to standard systemic analgesia. **METHODOLOGY:** After institutional Ethics Committee approval, 50 children, ASA I/II 7-13 yrs. undergoing lower abdominal surgeries were randomized into groups A and B of 25 each. All patients received standard General Anesthetic with standard monitoring. In Group A, TAP block was performed under land mark technique with 2.5mg/kg of 0.5% ropivacaine which is equivalent to 0.3ml/kg after General Anesthesia. In Group B, standard systemic analgesia was given which served as the control group. In addition, patients of both groups received regular IV paracetamol 15mg/kg immediately after completion of surgery. **STATISTICS AND RESULTS:** Statistical analysis was performed with student's t-test and Fisher's exact test. P<0.05 was considered significant. TAP block with ropivacaine reduced mean tramadol requirements in the 1st 24hrs postoperative period [42+15.89 vs. 80.35+19.16mg; p<0.001]. Postoperative VAS scores significantly reduced in TAP block group until 24hrs after surgery. No complications were reported with TAP block in our study. **CONCLUSION:** Land mark based TAP block, as a part of balanced analgesia regimen provides superior analgesia than systemic analgesia alone in children undergoing lower abdominal surgeries.

KEYWORDS: Transversus Abdominis Plane (TAP), Ropivacaine, Postoperative pain.

INTRODUCTION: Appendectomies and inguinal surgeries are the commonly performed surgical procedures in children and cause significant pain in the post-operative period.[1] until recently caudal epidurals and systemic opioids have been the standard of care for post-operative pain in children. Recently transversus abdominis plane block has been described as an effective technique to reduce postoperative pain and analgesic consumption for lower abdominal surgeries in various clinical trials.[2]

The nerves that supply the anterior abdominal wall course through the neuro fascial transversus abdominis plane (TAP) between internal oblique and transversus abdominis muscles.[3] Injection of local anesthetic into the TAP can therefore potentially provide unilateral analgesia to the skin, muscles and parietal peritoneum of the anterior abdominal wall from T_7 to L_1.[4] This abdominal field block has been described by "A.N. Rafi" in 2001 and modified by Mc Donnell et al., in 2004.

This blind technique requires identification of a fixed and palpable land mark, the lumbar triangle of petit which is bounded anteriorly by external oblique, posteriorly by latissimus dorsi, inferiorly by iliac crest and superiorly by sub-coastal margin (Figure-1). Various studies proved the

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efficacy of TAP block in inguinal hernias, gynecological surgeries, retropubic prostatectomies, abdominoplasties, lower abdominal surgeries and renal transplantations also as a part of balanced analgesia regimen.

A recent review, "refining the course of thoracolumbar nerves; a new understanding of the innervations of anterior abdominal wall", found that the fascial layer between the internal oblique and transverses abdominis muscles was more extensive than previously described.[5] Hence single injection in the TAP can produce analgesia over several dermatomes. The aim of our study is to evaluate the efficacy of TAP block as a part of multimodal analgesia regimen in children undergoing lower abdominal surgeries.

METHODOLOGY: After institutional Ethics Committee approval and written informed parental consent, 50 children aged 7-13yrs, ASA Grade I-II, posted for lower abdominal surgeries were randomly allocated into groups of A and B of 25 each.

Exclusion Criteria:

1. H/o drug allergy to local anaesthetics and other study drugs.
2. Skin infection at puncture site.
3. Contraindications to paracetamol, opioids.
4. Children unable to independently assess their pain.

Patients of Group A were randomly allocated to receive TAP block after General Anesthesia.

Patients of Group B received standard intravenous analgesia and served as the control group. The procedure of randomization was done using computer generated random numbers. Two anesthesiologists were involved in the study. One anesthesiologist performed the technique in the operating room and the second anesthesiologist who assessed the patients postoperatively was unaware of the group allocation.

Patients of both groups were premedicated with oral midazolam syrup 0.5mg/kg 25 minutes prior to surgery. Base line parameters heart rate, NIBP, respiratory rate and SpO_2 were recorded in both the groups. In the operating room, after pre-oxygenation for 5 minutes, standard general anesthesia regimen was instituted in all the patients with glycopyrrolate 10μg/kg, fentanyl 2μg/kg, thiopentone sodium 5mg/kg and intubated with succinylcholine 1.5mg/kg with appropriate sized portex cuffed endotracheal tube and maintained with Atracurium 0.5mg/kg and oxygen and nitrous oxide mixture of 50% and sevoflurane 1-1.5%.

Immediately after GA, in group A, TAP block was performed using the land mark technique with 23G or 24G 50mm needle and 0.5% ropivacaine 0.3ml/kg was injected on the ipsilateral side of the surgical procedure. The surgical procedures included in our trial were open appendectomies, inguinal hernias and pelvic colostomies.

TAP block was performed in Group A patients after identification of the lumbar triangle of petit. The puncture site is just above the iliac crest and just posterior to the midaxillary line with in the triangle of petit. The needle is inserted perpendicular to skin in the coronal plane and advanced slowly until two distinct pops were felt. First pop indicates that the needle is between external oblique and internal oblique muscles. Second pop indicates that the needle traverses the plane

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between internal oblique and transversus abdominis muscles. After careful negative aspiration the solution of ropivacaine 0.5% of 0.3ml/kg was injected slowly into the TAP.

Group B patients served as the control group. In two patients of Group A, resistance occurred while injecting the local anesthetic solution and skin bulge was raised indicating that the needle is not in TAP. Hence these two patients were deleted from the study assuming them as failed block. Heart rate, respiratory rate, NIBP, SpO_2 were monitored intraoperatively.

After completion of surgery, all patients were reversed with Glycopyrrolate 10µg/kg and Neostigmine 70µg/kg. They were shifted to PACU and were monitored for 6hrs and then shifted to the ward. Immediately after surgery, patients of both groups were given IV paracetamol 15mg/kg as a part of multimodal analgesia regimen and repeated 6th hourly. All patients were assessed for pain using visual analogue scale (superimposed with verbal pain intensity scale), sedation with 4-point sedation scale, and PONV using numerical rank score. Assessments were made immediately after surgery, 1hr, 2hrs, 4hrs, 6hrs and 24 hrs. after the procedure.

Tramadol 1mg/kg IV was given as rescue analgesic if post-operative VAS score >3. Rescue antiemetic ondansetron 0.1mg/kg was given to patients who complained of nausea and vomiting. Time to 1st request of rescue analgesic, 24hrs Tramadol consumption, post-operative VAS scores and other side effects like PONV & sedation were analyzed statistically.

Statistical Analysis and Results: Analysis was done using the software Graphpad Quickcalcs. Demographic data was analyzed using Fischer's exact test. Repeated measurements like VAS scores were analyzed using t-test after ANOVA. Times to first requirement of rescue analgesic, 24hrs Tramadol consumption, were analyzed using student-t-test. Incidence of PONV was expressed as percentage. $p<0.05$ was considered significant.

50 patients were enrolled for this randomized and controlled clinical study. 25 patients were randomized to receive TAP block ipsilaterally with 0.5% ropivacaine and 25 patients were randomized to receive standard intravenous analgesic regimen.

Two patients of Group A were assumed to have failed TAP block and were excluded from the study.

The groups were comparable in terms of age, weight, height, duration of surgery and ASA grading (Table-1).

There were 22 male children and 26 female children in the study.

TAP block significantly reduced mean tramadol consumption at 24 hrs. [Group A-47 (15.89) mg Vs. Group B-80.35 (19.16) mg, $p<0.001$) (Table-3).

The mean time to 1st request of rescue analgesic was 527.25(71.07) minutes in Group A (TAP) compared to 45.95(8) minutes in control Group ($p<0.0001$) (Table-3, Figure-2).

There were no significant differences in the hemodynamic parameters in both the groups throughout the intra operative period.

VAS scores for pain were significantly reduced in the first 24 hours at the specific time points assessed after the TAP blockade when compared with the control Group ($p<0.05$, t-test after ANOVA) (Table-4, Figures-3&4).

The incidence of PONV was reduced in the TAP Group by approximately 50% than the control Group (Table-5, Table-6).

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There was no significant difference in the incidence of sedation and distribution of sedation scores in the both the groups (Table-7).

No complications were reported in this study.

DISCUSSION: The benefits of adequate post-operative analgesia include a reduction in the post-operative stress response, morbidity and accelerates recovery from surgery.[7] The potential benefits of regional techniques include opioid sparing effects and reduction in the side effects from analgesics and improved patient comfort.[8] TAP block is a relatively new technique that provides effective analgesia for lower abdominal surgeries by blocking the somatic nerves of anterior abdominal wall from T_7 to T_{11} dermatomes.

Various cadaveric studies have identified the anatomical planes of this block and also determined the spread of injectate.[9, 10]

In our study, we performed TAP block through landmark technique without any complications. We assessed TAP block as a component of multimodal analgesia because it provides only somatic analgesia and visceral component should be supplemented with opioids. [11, 12]

The results of our study showed that patients of TAP group had effective post-operative analgesia for (8.5 to 9 hours) when compared to control group. The mean consumption of Tramadol was significantly reduced in TAP group than the control group over 24hrs post-operative period. Post-operative pain scores were significantly low in the TAP group.

The incidence of PONV was significantly high in the control group (52%) than TAP group (26%). There were no significant differences in the incidence of sedation in both groups.

The results of our study correlated with the results of earlier study done by John Carney MB, John G, Mc Donnell et al., where TAP block decreased the morphine requirements by approximately 50% in the first 24 hours after open appendectomies in children.[13]

Though ultrasound guided TAP blocks are gaining prominence, we still have a place for landmark based techniques where ultrasound facilities were not extended into operating room.[14, 15] With carefully placed landmark TAP blocks, analgesia can be provided for duration of 7-11 hours in the post-operative period as demonstrated in previous studies.[16, 17]

Mukhtar K. and Singh S. reported the successful use of TAP block to provide analgesia for 12 post-operative hours following laparoscopic appendectomies in patients aged between 14-17 years.[18] TAP block offers advantage of being feasible even in patients with vertebral anomalies and can be preferred over central neuraxial techniques in older children.

In a meta-analysis conducted by F.N. Abdallah, J.G. Laffey et al., to assess the duration of analgesic effectiveness after posterior and lateral approaches for TAP block for transverse lower abdominal incisions, concluded that TAP block using posterior approach (through triangle of petit) reduced the rest and dynamic pain scores as well as the consumption of morphine up to 24 hrs. [19]

The mean time to first request of analgesia was 8.5 to 9 hours in our study which was highly significant than control group. Our study has certain limitations. Firstly, the blinding procedure is not ideal as we did not perform a placebo TAP block in the control group. But the patients and the observer who did the post-operative assessments were blinded to group allocation.

Secondly, we did not assess the plasma ropivacaine concentrations. Ropivacaine with its lower toxicity profile and its effectiveness for post-operative analgesia made us to choose it for our study.

More over the dose of ropivacaine used in our study did not exceed 2.5mg/kg which is a safer dose. We selected tramadol as rescue opioid because of its moderate potency and easy availability. The incidence of nausea and vomiting was high in the control group in our study when compared to other studies which can be attributed to not administering prophylactic antiemetic in our study.

Bharathi N, Kumar P et al., evaluated the efficacy of TAP block after colorectal surgeries and reported that there was 65% decrease in the 24 hour morphine consumption and lower pain scores in the TAP group compared to the control group.[20]

TAP block has got advantages like technical simplicity, effective analgesia opioid sparing, long duration of action with minimal side effects.[21-23] The simplicity of loss of resistance techniques allow them to be used with minimal resources with excellent out comes.[24, 25] Understanding the anatomy and careful technique makes TAP block a promising clinical utility with good safety profile to date and an alternative to central neuraxial blocks for lower abdominal surgeries for postoperative pain relief.

Carney J, Mc Donnell JG et al; in a similar study reported that TAP block with o.75% ropivacaine significantly reduced postoperative morphine consumption for 48 hours and significantly prolonged the time to first rescue analgesia after abdominal hysterectomy.[26]

Farooq M and Carey M reported a case of liver trauma with a blunt regional anesthesia needle while performing TAP block in a female patient posted for total abdominal hysterectomy.[27] Immediately after laparotomy incision they found that the liver is enlarged and almost reached the right iliac crest. This study reminds the clinicians that it is prudent to palpate the edge of the liver before performing the block.

Till date the complications reported with this block were very rare. Recently catheters were inserted into the TAP to provide continuous analgesia in various surgeries. Further studies are awaited regarding the efficacy of catheter techniques.

Complications attributable to TAP block like liver trauma, bowel injury, spleen injury, local anesthetic toxicity, intravascular injection of local anesthetic, transient femoral nerve palsy were not reported in our study. Other complications related to opioids were not reported in our study except nausea and vomiting.

CONCLUSION: Our study concludes that TAP block provides effective post-operative analgesia of prolonged duration along with reduced opioid consumption and opioid related side effects when instituted as a component of multimodal analgesia regimen in pediatric patients undergoing lower abdominal surgeries.

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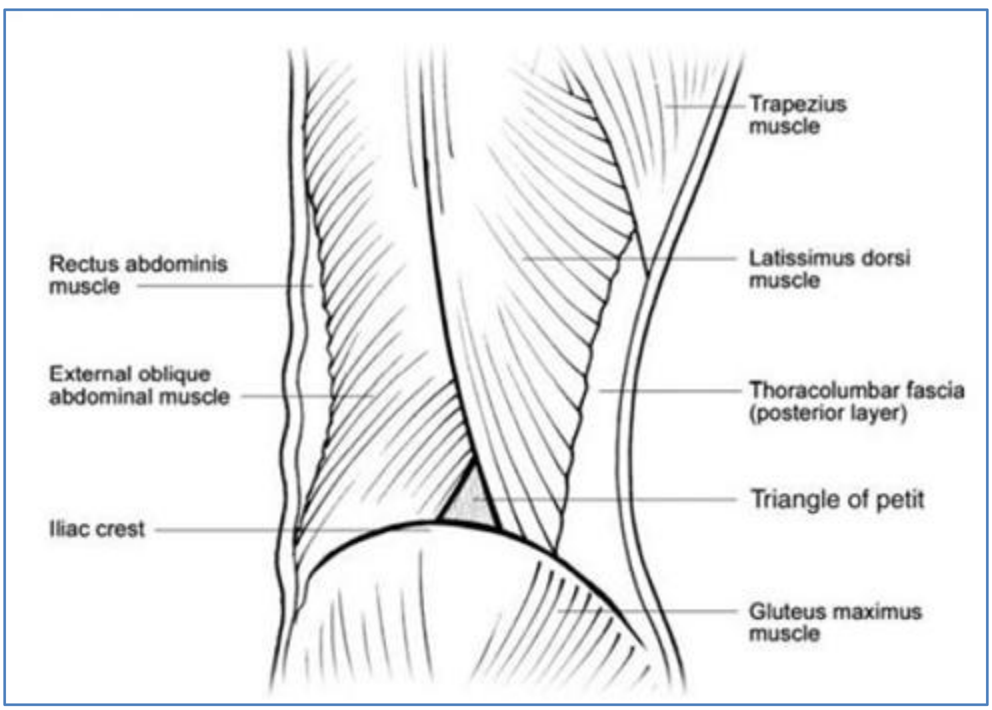

Figure 1

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	Group A (n=23)	Group B (n=25)	p value*
Age in years	9.25(+2.05)	9.25(+2.17)	(p=1.000)
Height in cms	131.58(+10.17)	131(+11.03)	(p=0.86)
Weight in kgs	28.625(+6.85)	27.1(+5.91)	(p=0.46)
ASA status I/II	12/11	15/10	
Sex M/F	10/13	12/13	
Duration of Surgery (in min.)	44.95(+7.98)	44.25(+5.53)	(p=0.75)

Table 1: Demographic Data

Data expressed as mean (SD) or ratio or absolute numbers

*Fischer's exact test

	Group A (n=23)	Group B (n=25)
Appendectomies	10	12
Herniotomies	7	6
Pelvic colostomies	6	7

Table 2: Types of Surgeries

	Group A (n=23) Mean+SD	Group B (n=25) Mean+SD	p value*
Time to 1st request of rescue analgesic (min.)	527.25(71.07)	45.95(8)	p<0.0001
Mean 24 hr. tramadol consumption (mg)	42(15.89)	80.35(19.16)	p<0.001

Table 3: Mean duration of analgesia and opioid consumption

*student-t-test

p value <0.05 statistically significant

SD- Standard Deviation

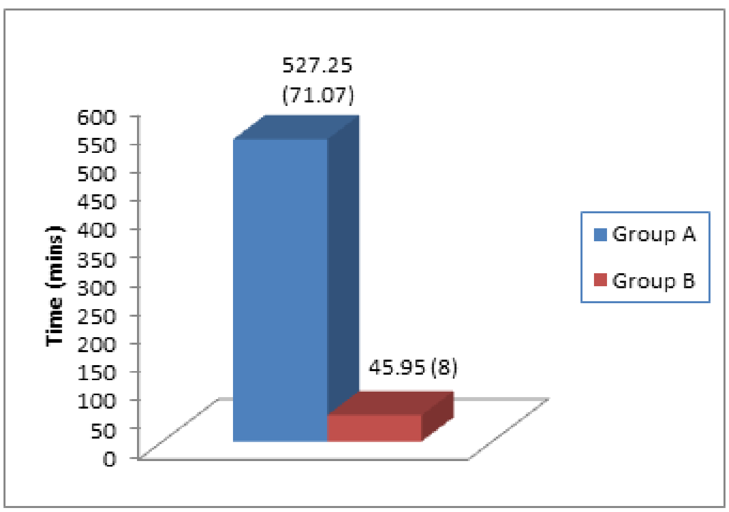

Figure 2: Time to First Request of Rescue analgesic (Mean/SD)

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	Group A Mean+SD (n=23)	Group B Mean+SD (n=25)	p value*
2hrs	1.8+1.36	6.2+0.85	0.000
4hrs	2.2+1.28	4.8+0.92	0.000
6hrs	2.6+1.14	4.8+1.43	0.000
8hrs	3+1.57	4+1.24	0.000
10hrs	3+1.57	4.2+1.39	0.000
12hrs	2.8+1.28	3.5+1.40	0.001
24hrs	2+1.36	3.5+0.73	0.001

Table 4: Mean VAS scores for pain

* p value <0.05, t-test after ANOVA
SD=Standard Deviation

VAS=Visual Analogue Scale:

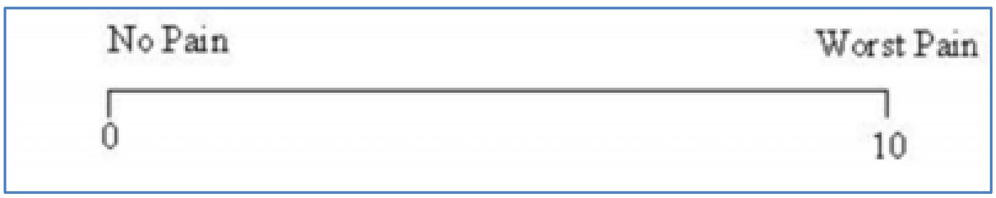

Figure 3

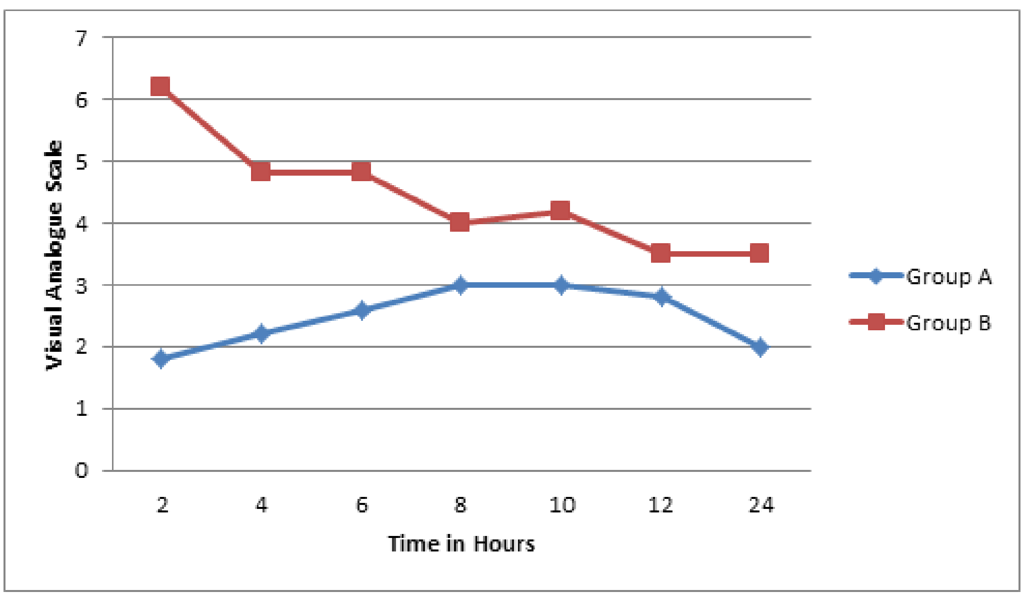

Figure 4: Mean VAS scores for pain

Numerical Rank Score	Group A (n=23)	Group B (n=25)
0- No Nausea No Vomiting	17	12
1- Nausea + No Vomiting	4	8
2- Vomiting + Once / twice	2	5
3- Vomiting >2 Times	-	-

Table 5: PONV Scores

Data expressed in absolute numbers

Group A (n=23)	Group B (n=25)
26.08% (6)	52% (13)

Table 6: Incidence of PONV

Data expressed as % and absolute numbers.

4-Point sedation scale	GROUP A (n=23)	GROUP B (n=25)
0- (Awake & alert)	15	13
1- (Quietly awake)	8	12
2- (Asleep but easily aroused)	-	-
3- (Deep sleep)	-	-

Table 7: Sedation Scores

Data expressed in absolute numbers

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