The Analgesic Effectiveness of Ipsilateral Transversus Abdominis Plane Block in Adult Patients Undergoing Appendectomy: A Prospective Randomized Controlled Trial

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ABSTRACT

Background

Transversus abdominis plane block (TAP) has been shown to produce effective pain relief following lower abdominal surgeries but is yet to be routinized in different type of surgeries including appendectomy. The main risk of visceral injury can be logically avoided when the block is performed with the abdomen open using landmark technique in the absence of ultrasound guidance.

Objective

To assess the effectiveness of TAP block with bupivacaine for postoperative analgesia using landmark technique (performed with the abdomen open) in adult patients undergoing appendectomy.

Method

Forty patients undergoing appendectomy were randomized to undergo ipsilateral TAP block with bupivacaine (n=20) versus control (n=20) in addition to standard postoperative analgesia. All patients received standard general anaesthesia. The block was performed using the landmark technique with 20 ml of 0.5% bupivacaine or isotonic saline on ipsilateral side just before abdominal closure. Pain severity was measured using Visual Analogue Scale (VAS). Tramadol 50 mg was administered as rescue analgesic intravenously when VAS was four or more postoperatively. The duration of analgesia and the requirement of tramadol in 24 hours postoperatively were recorded.

Result

Mean duration of analgesia in the TAP block with bupivacaine was longer as compared with placebo (724.00±299.07 min vs 168.25±55.18 min; p< 0.01). The TAP block with bupivacaine compared with saline significantly reduced postoperative VAS pain scores. Mean tramadol requirement in the first 24 hours was also reduced (42.50±37.25 mg vs 120.00±55.18 mg; p<0.01). There were no significant complications attributable to the TAP block.

Conclusion

Ipsilateral TAP block with bupivacaine using landmark technique with the abdomen open in appendectomy provides effective postoperative analgesia and opioids sparing effect.

KEY WORDS

Ipsilateral, landmark technique, postoperative analgesia, transversus abdominis plane block

INTRODUCTION

Due to involvement of significant tissue injuries, patients undergoing appendectomy suffer significant postoperative pain and require effective analgesia. Different modalities of pain management are in use and many being tried for postoperative analgesia in patients undergoing appendectomy. Among all, transversus abdominis plane block (TAP) has been shown to produce effective pain relief following lower abdominal surgeries but is yet to be routinized in different type of surgeries including appendectomy.[1-3] Though ultrasound guidance is recommended for the block, TAP block can be performed with reasonable safely using blind landmark technique through the lumbar triangle of Petit.[4] The main risk of visceral injury with the blind landmark technique can be logically avoided when the block is performed with the abdomen open.

The present study was therefore conducted to assess the effectiveness of TAP block (performed before closing the abdominal wall) with bupivacaine for postoperative analgesia using landmark technique in adult patients undergoing emergency appendectomy.

METHODS

Ethical clearance was obtained for the study from the Institutional Ethical Review Board (IERB). Informed written consent was obtained from each patient regarding the participation in the study. During the preoperative assessment, patients were familiarized and explained about Visual Analogue Scale (VAS) score for pain assessment in simple understandable language and baseline VAS was recorded at the same time. We studied adult patients aged 18 years and above of American Society of Anaesthesilogists physical status (ASA PS) I and II, scheduled for emergency open appendectomy. Patients were excluded if they had history of allergy to the drug used in the study, had chronic painful conditions, or were on analgesics on regular basis. Patients with known or suspected pregnancy, bleeding diathesis, morbid obesity and those showing unwillingness to participate in the study were also excluded.

Patients were randomly allocated to undergo ipsilateral TAP block with 20 ml of 0.5% bupivacaine or TAP block with 20 ml of 0.9% isotonic saline as per computer generated random allocation sequence. Group allocation was concealed in sealed, opaque envelopes, which were not opened until patient consent was obtained. The patients and the anaesthesiologist observing the outcome data were blinded to group assignment. Venous access was established (if not in situ) on the dorsum of non dominant hand with 16 G intravenous (IV) cannula under local anaesthesia and lactated ringer's solution was infused. In the operation theatre, non-invasive blood pressure (NIBP) cuff, electrocardiogram (ECG) leads and pulse oximetry (SpO_2) probe were attached to the patient and baseline NIBP, respiratory rate (RR), heart rate (HR) and SpO_2 were recorded.

All the patients received a standardized rapid sequence induction of anaesthesia. After pre oxygenation for three minutes, anaesthesia was induced with inj. propofol 1.5-2.5 mg/kg IV. Cricoid pressure was applied immediately after induction and inj. succinylcholine 1-1.5 mg/kg IV was administered for facilitation of laryngoscopy and intubation. The trachea was intubated after 60 s of succinylcholine administration. Anaesthesia was maintained using 1-1.5 minimum alveolar concentration of isoflurane in oxygen and inj. vecuronium bromide 0.1-0.12 mg/kg IV. All patients also received inj pethidine 1 mg/kg IV before the surgical incision. The TAP block was performed using an 18 gauge epidural needle just before surgeon closed the abdomen using the landmark technique described by McDonnel JG et al.[4] All blocks were performed by anaesthesiologist experienced in the technique. The iliac crest was palpated from anterior to posterior until the latissimus dorsi muscle was felt. The triangle of Petit was then located just anterior to the latissimus dorsi muscle. The skin was pierced just cephalad to the iliac crest over the triangle of Petit. The needle was then advanced at right angle to the skin, in a coronal plane, until resistance was encountered. This resistance indicated that the needle tip was at the external oblique muscle. Gentle advancement of the needle resulted in a first "pop" sensation as the needle entered the plane between the external and internal oblique fascial layers. Further gentle advancement of the needle resulted in a second pop, which indicated entry into the transversus abdominis fascial plane. While performing the block the operating surgeon checked the site of needle tip through the surgical incision. After careful aspiration to exclude vascular puncture, 20 mL of 0.5% bupivacaine or placebo was injected through the needle ipsilateral to the appendectomy side. All patients also received one gm of paracetamol infusion intraoperatively.

After completion of the surgical procedure residual effects of the muscle relaxants were reversed by using combination of standard doses of neostigmine and glycopyrrolate. After emergence from anaesthesia, patients were transferred to the recovery room. The assessment of the patients were performed at 30 minutes in the recovery area; and at 6,12 and 24 hr after the operation in the surgical ward. A standard postoperative analgesic regimen consisting of IV paracetamol 15 mg/kg was infused 6 hourly in both the groups. All patients were asked to give scores for their pain at rest and on coughing; and for the degree of nausea at each time point. Pain severity was measured using VAS score. Nausea was scored using a categorical scoring system (none-0, mild-1, moderate-2, severe-3). Injection ondansetron 4 mg IV was used as rescue antiemetic. If the severity of the pain became more than 4 in the scale or the patient complained of pain and asked for analgesia, injection tramadol 50 mg was given IV slowly as a rescue analgesic and was repeated every 6 hourly if required.

Time of administration of rescue analgesic was noted and total amount of drug consumed during the study period was also noted.

The time of first administration of initial dose of rescue analgesic was considered as the time of termination of postoperative analgesic effect of TAP block. The duration of postoperative analgesia attained in the study groups was the main outcome variable of the study along with the level of analgesia in VAS experienced by the patients. Other outcome parameters observed included postoperative 24 h tramadol consumption as well as any complication attributable to TAP block. The patients were also asked whether they were satisfied with the post operative pain relief or not after 24 h of the block.

For sample size estimation finding of a similar previous study was used,[1] which showed a mean VAS of 3.1 in the control group and 1.7 in the study group with a common standard deviation of 1.5. Accepting an α error of 0.05 and β error of 0.2, the estimated sample size per group was 19. To minimize any effect of possible data loss, we elected to recruit 20 patients per group into the study.

Data was entered in excel filtered coded and further analysed by SPSS version 17. The normality of data was checked with Saphiro-Wilk test, histogram and Q-Q plot. Chi-square, Fischer's exact and independent t test were applied for baseline characterisics comparison. Data that were not normally distributed were analysed using non-parametric Mann-Whitney U test to see the differences between the groups. The significance level was set at 5% for all tests.

RESULTS

The gender, age, American Society of Anesthesiologists Physical Status (ASA-PS), height and weight distribution of the patients as well as duration of operations in both the groups were comparable. (Table 1)

Table 1. Baseline patient characteristics

Characteristic		Group		p-value
		A (n=20)	B (n=20)	
Gender	M	11(57.9%)	8(42.1%)	0.342
	F	9(42.9%)	12(57.1%)	
ASA-PS	I	12(46.2%)	14(53.8%)	0.429
	II	8(57.1%)	6(42.9%)	
Age (years)		44.50±16.09	44.45±16.43	0.992
Height (m)		1.57±0.56	1.58±0.79	0.128
Weight (Kg)		60.25±5.69	60.55±5.01	0.268
Duration of operation(min)		75.75±12.06	72.75±15.25	0.098

VAS scores at rest at 0, 30 min and at 24 h postoperatively were statistically comparable. However, at 6 h and 12 h postoperatively VAS scores were significantly less in group A.(p=0.001) (Table 2)

Table 2. Comparison of VAS score for pain at rest before and after administration of block between the two groups.

VAS score at rest	Group		p-value
	A (n=20)	B (n=20)	
At 0 min	4.20±1.10	4.30±1.08	0.247
At 30 min	0.65±0.93	0.90±1.11	0.583*
At 6 h	1.50±0.76	2.90±0.78	0.001
At 12 h	2.60±0.59	3.80±0.41	0.001
At 24 h	3.50±0.76	3.85±0.36	0.082

* Mann-Whitney U test

Similarly VAS scores on coughing at 0,30 min and 24 h postoperatively were comparable. However, at 6 and 12 h postoperatively VAS scores were significantly less in Group A. (p=0.001) (Table 3)

Table 3. Comparison of VAS score for pain on coughing before and after administration of block between the two groups.

VAS score on coughing	Group		p-value
	A (n=20)	B (n=20)	
At 0 min	5.20±1.15	5.20±0.89	0.200
At 30 min	2.10±0.91	1.75±1.16	0.461*
At 6 h	1.95±0.68	3.50±0.82	0.001
At 12 h	3.35±0.75	4.15±0.48	0.001
At 24 h	3.90±0.71	3.95±0.39	0.786

*Mann-Whitney U test

None of the patients in any of the groups at 30 min had VAS score of four or more at rest. At 6 h none and at 12 h only one patient in group A had VAS score of four or more at rest. As compared to group A, 16 patients in group B had VAS score of 4 or more at rest at 12 h postoperatively. (Fig. 1)

At 30 min two patients from groups A and one patient from group B had VAS score of 4 or more on coughing. Twelve patients from group B and none of the patients of group A had VAS score of four or more on coughing at 6 h. At 12 h, 10 patients of group A and 19 patients from group B had VAS score of four or more on coughing. (Fig. 2)

There was a significantly longer duration of analgesia in group A compared to group B (724 min vs 168 min) with less consumption of rescue analgesics in group A (42 mg vs 120 mg). Fourteen patients (70%) in group A expressed satisfaction with the pain relief technique during first 24 hours postperatively while only 10 (50%) expressed satisfaction in group B. (Table 4)

Four patients in the group B developed mild nausea compared with 2 in group A. However, there was no significant difference in the incidence of nausea or distribution of nausea scores between the two groups at any point.

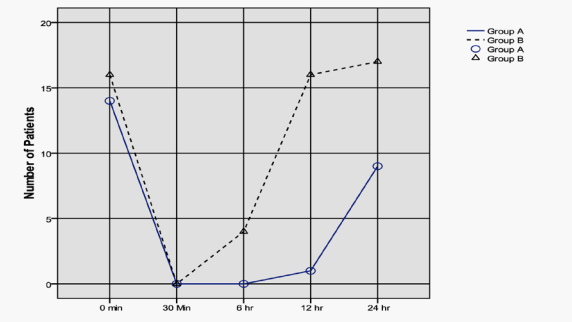

Figure 1. **Number of patients with VAS 4 or more at rest before and after administration of block.**

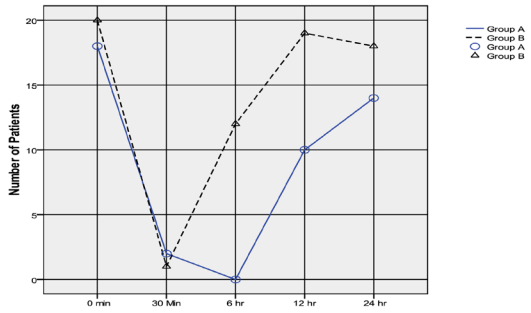

Figure 2. **Number of patients with VAS 4 or more on coughing before and after administration of block.**

Table 4. **Comparison of duration of analgesia and total consumption of tramadol and satisfaction between the groups.**

Characteristics	Group		p-value
	A (n=20)	B (n=20)	
Duration of analgesia (min)	724.00±299.07	168.25±55.18	0.001
Total tramadol consumption (mg)	42.50±37.25	120.00±37.69	0.001
Satisfaction Yes/No	6(30%)	10(50%)	0.167
	14(70%)	10(50%)	

DISCUSSION

The present study has found that the TAP block with landmark technique effectively reduces pain in patients undergoing open appendectomy. In our study, TAP block was associated with prolonged analgesia, lower VAS and lower analgesic requirement.

TAP block with bupivacaine significantly reduced VAS at 6 and 12 h postoperatively at rest and on coughing. Similar findings have been reported by other researchers demonstrating TAP block to provide excellent pain relief in patients undergoing appendectomy.[2,3,5] Comparable VAS at 30 min (0.65±0.93 and 0.90±1.11) postoperatively in both the groups in our study is most likely due to the residual effect of intraoperatively administered pethidine and paracetamol.

Our study has shown more than three times longer mean duration of analgesia i.e. time to first analgesia (724.00±299.07 vs 168.25±55.18 min) with the TAP block

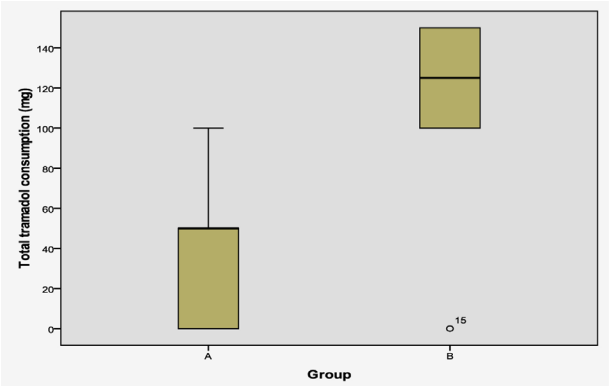

Figure 3. **Box plot showing median comparison of total tramadol consumption between the group A and B.**

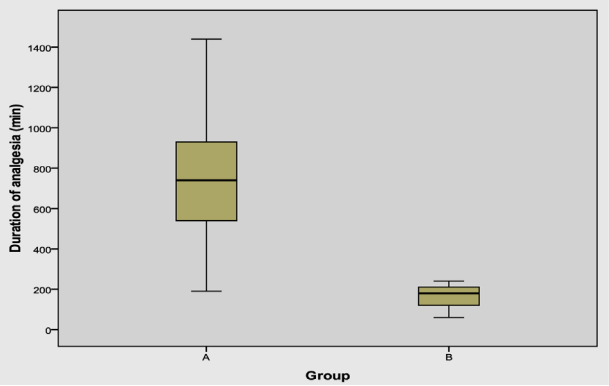

Figure 4. **Box plot showing median comparison of total duration of analgesia between the group A and B.**

with bupivacaine compared to the control. This finding is further supported by two third reduction in tramadol requirement (42.50±37.25 mg) in patient receiving bupivacaine for TAP block. The precise mechanism of prolonged analgesic effect of local anaesthetics in TAP block is not clear but it is assumed that the TAP is poorly vascularized space and the drug clearance is therefore delayed.[6] Owen and colleagues in their study have also observed a longer time to first request for morphine (790±62.8 min) in women undergoing cesarean section and receiving surgical TAP block with 20 ml of 0.25% bupivacaine.[7] Total consumption of tramadol during 24 hr postoperatively as rescue analgesic in patients receiving TAP block was significantly low (42.50±37.25 mg vs. 120.00±37.69 mg) in the present study Sharma et al. have also reported reduction in tramadol requirement and lower VAS following TAP block.[8] In their study they evaluated and compared the postoperative analgesic efficacy of TAP block after abdominal surgeries and found reduced VAS score for pain and requirement of tramadol (210.05±20.50 mg vs. 320.05±10.60 mg) using patient controlled analgesia (PCA) pump in the postoperative period in patients receiving TAP block. Niraj et al. used 0.5% bupivacaine for ultrasound guided TAP block for appendectomy and they found significantly reduced in pain scores and consumption of morphine as rescue opioid analgesic in the first postoperative 24 hours.[2] McDonnell and colleagues in their study have shown reduction in

pain scores and consumption of opioids in 24 hours after resection of bowel by TAP block using 0.75% ropivacaine.[1]

Opioids are regarded effective in managing postoperative pain but are not free of unwanted effects like respiratory distress, nausea-vomiting, pruritus and urinary retention. So, elderly patients, obese patients with history of obstructive sleep apnea may benefit more with TAP blocks as it provides opioids sparing effects. In our study, we did not encounter any complication related to the block technique like in the study of Owen and colleagues where also block was performed in an open abdomen.[7] Inadverent peritoneal puncture and visceral injury are likely complications of this block and have been encountered in some studies.[9,10]

Interestingly the incidence of nausea in the TAP block with bupivacaine was less which may be due to less use of opioids in this group postoperatively. The incidence of nausea in our study is consistent with the findings of other studies as well.[8,11]

There are few limitations of our study. First, we limited the observation for postoperative analgesic effect of TAP block for 24 hours only, however, it has been demonstrated that the clinical analgesic effect of TAP block for 48 hours.[12] Second, we did not use USG guidance due to unavailability, which could have expectedly increased the block efficacy. Third, the use of PCA pump in the postoperative period would have given better idea regarding opioids consumption.

CONCLUSION

Ipsilateral TAP block using landmark technique in appendectomy with the abdomen open as a component of multimodal analgesia provides effective postoperative analgesia and opioids sparing effect. This technique is devoid of major procedure related complications.

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