



Study to evaluate transversus abdominis plane (TAP) block with ropivacaine in appendectomy patients by total requirement of diclofenac as a postoperative analgesia drug

Ila Patel, MD¹, Rachana Gandhi, MD², Alka Shah, MD², Puskar Kumar³

ABSTRACT

Background and Aim: Transversus abdominis plane (TAP) block is a regional anesthesia technique that provides analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall. This prospective, randomized, double blind, controlled study was carried out in 60 ASA I and II patients, between 20 to 65 years of age who underwent appendectomy.

Methodology: Participants were randomly divided into two different groups. Study group (n=30) patients received TAP block with injection ropivacaine (0.5%) 20 ml and Control group (n=30) patients did not receive TAP block and were given injection diclofenac on demand for post-operative analgesia as per institute protocol for routine surgery. Assessment of motor and sensory block, pulse, blood pressure, requirement of postoperative diclofenac, and complications were done and recorded.

Results: This prospective study was carried out in 60 ASA I and II patients. No significant difference was observed between two groups in terms of demographic data. Sensory block [thoracic] was almost equivalent in both groups at the end of surgery or at time of the TAP block in both groups, T-8.2 ± 1.095 vs. T-7.867 ± 1.04 (p = 0.232) in Study and Control groups respectively.

VAS score was significantly higher in control group as compared to the study group at all times. First dose of rescue analgesia required was at 1140.66 ± 294.89 and 210.33 ± 92.45 min in study group and control group respectively. Total dose of diclofenac consumption was 82.5 ± 22.88 and 212.5 ± 34.58 mg respectively in study and control groups, which showed that Diclofenac consumption was significantly decreased in study group. Heart rates and mean BP were equivalent in both groups. There were no complications related to the TAP block in both of the groups.

Conclusion: The results of this study show that TAP block holds considerable promise for patients undergoing surgical procedures involving abdominal wall incisions as it provides analgesia to parietal peritoneum as well as skin and muscle of the anterior wall abdomen. It reduces pain (vas score), requirement of rescue analgesia and their side effect and provide better satisfaction to patient.

Key words: TAP block; Ropivacaine; Diclofenac; Regional anesthesia; Appendectomy

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¹Associate Professor;

²Assistant Professor;

³Resident

Department of Anesthesiology,
GMERS Medical College,
Sarkhej Gandhinagar Highway,
Sola, Ahmedabad – 380060
(India)

Correspondence:

Dr Ila B Patel, E-401, Setu
Vertica, B/H Vodaphone Tower
Nr Sayona Green Gota, Sg
Highway Ahmedabad-382481,
Gujarat, (India); E-mail:
drilapatel@gmail.com

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INTRODUCTION

Intra-abdominal surgeries cause many physiological and emotional disturbances. Pain following surgery is gargantuan and is one of the major factors responsible for the homeostatic disturbances. Studies have documented improved outcomes with adequate management of post-surgical pain.¹ Inadequate pain control, apart from being inhuman, may result in increased morbidity or cost. The advantages of effective postoperative pain management include patient comfort and satisfaction, earlier mobilization, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery with less likelihood of the development of neuropathic pain, and reduced cost of care.

The use of strong pain killing medications such as opioid based drugs which can have a detrimental effect on the post-operative recovery of bowel function and an increased risk of post-operative nausea and vomiting delaying discharge. Amongst options available, afferent neural blockade with local anesthetics seems to be the most effective analgesic technique followed by nonsteroidal anti-inflammatory agents and opioids.² Pain after surgery for acute appendicitis has two sources, namely the somatosensory pain originating from the surgical wound on the anterior abdominal wall and the visceroperitoneal pain due to the inflammation and infection of the appendix.

The transversus abdominis plane (TAP) block is a regional anesthesia technique that provides analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall. First described just a decade ago, it has undergone several modifications, which have highlighted its potential utility for an increasing array of surgical procedures. Despite a relatively low risk of complications and a high success rate using modern techniques, TAP blocks remain overwhelmingly underutilized.

In the last decade, a novel approach to block the abdominal wall neural afferents via the "lumbar triangle of Petit" has been described by Rafi in 2001³, known as TAP block. By introducing the local anesthetics into the transversus abdominis plane via the triangle of Petit, it is possible to block the sensory nerves of the anterior abdominal wall before they leave this plane and pierce the musculature to innervate the entire anterior abdominal wall (T7 to L1).

TAP blocks have been described as an effective component of multimodal postoperative analgesia for a wide variety of abdominal procedures including

open/laparoscopic appendectomy, hernia repair, large bowel resection, cesarean section,^{4,5} total abdominal hysterectomy, laparoscopic cholecystectomy, open prostatectomy,⁶ renal transplant surgery, abdominoplasty with / without flank liposuction, and iliac crest bone graft. Most reports demonstrate the efficacy of TAP blocks by highlighting some combination of reduced postoperative opioid requirement, lower pain scores, and/or reduction in opioid-related side effects.

Amongst various techniques of TAP block, landmark technique via the triangle of Petit seems to hold considerable promise for patients undergoing surgical procedures involving abdominal wall incisions.⁷⁻⁹

So, we hypothesized that TAP block could provide safe and reliable block for analgesia to the parietal peritoneum as well as the skin and muscle of the anterior abdominal wall pain after abdominal surgery as a part of multimodal analgesic technique. We selected open appendectomy for study as incision site in lower abdomen which can be blocked by TAP block with landmark technique.

METHODOLOGY

This prospective, randomized, double blind, controlled study was carried out in 60 ASA I and II patients, between 20 to 65 years of age who underwent appendectomy during the year 2015 after obtaining approval from the institutional Ethics Committee and written informed consent. Study was done at GMERS Medical College and Hospital, Sola, Ahmedabad. Participants were randomly divided into two different groups. Study group (n=30) patients received TAP block with injection ropivacaine (0.5%) 20 ml. Control group (n=30) patients did not receive TAP block and were given inj diclofenac on demand for post-operative analgesia as per institute protocol for routine surgery.

Patient refusal, patient allergic to local anesthetic, infection at puncture site, coagulation defects, surgery at injection site, presence of neurological deficit, psychiatric illness were exclusion criteria.

Patients were explained about visual analogue scale (VAS) score. All patients were nil per oral for 8 h preceding the surgery. All appendectomy cases carried out under spinal anesthesia were selected. On arrival to operation theatre, following insertion of 18 G venous cannula, all patients received 15 ml/kg of Ringer's Lactate solution before spinal anesthesia. Standard monitors like electrocardiography (ECG), noninvasive blood pressure (NIBP) monitoring and pulse oximetry were attached and the baseline

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parameters were recorded. With patient in sitting position, lumbar puncture was done at L3-L4 space through a standard 25 G Quincke spinal needle. Drug 0.5% hyperbaric bupivacaine 3.5 ml was administered intrathecally as a single dose in all patient. All patients received oxygen 5 L/min via a face mask throughout the procedure after approximating them to the surgical position.

Sensory block was assessed by sterile pin prick method in the mid-axillary line on both sides of chest. Immediately after sensory block assessment, motor block was assessed using a modified Bromage scale. The highest dermatomal level of sensory block and recovery times of both sensory and motor block were recorded. Recovery time for the sensory block was defined as two dermatome regression of anesthesia from the maximal level. Motor block duration was the time to return to grade 0 on the modified Bromage scale.

Highest dermatomal level of sensory block at the time of TAP block was recorded. Hypotension (defined by a decrease in MAP below 20% of baseline or systolic pressure < 90 mmHg) was treated with incremental doses of inj mephentermine 3 mg IV and additional lactated Ringer's solution as appropriate.

Bradycardia (HR < 50 beats/min) was treated with atropine 0.6 mg IV. To avoid masking of respiratory depression by administering supplemental oxygen, respiratory depression is defined as a respiratory rate < 12 breathes/min.

After completion of surgery, TAP block was performed on the same side of surgery by landmark technique in the study group. The landmark for palpation was the 'triangle of Petit' which lies above the pelvic rim in the mid-axillary line. The inferior border of the triangle is the iliac crest. The anterior border of the triangle is formed by the lateral edge of the external oblique muscle. The posterior border of the triangle is formed by the lateral edge of the latissimus dorsi muscle and floor of the triangle is formed by internal oblique muscle.

The puncture site was just above the iliac crest and just posterior to the mid-axillary line within the triangle of petit. A 23G blunt tipped 1.5 inch needle was inserted perpendicular to the skin, and a 'pop' was felt when the needle passed through the fascial extensions of the external oblique muscle. The needle tip was therefore between the fascial layers of the external and internal oblique.

With further advancement, a second 'pop' was felt when the needle passed through the internal oblique

muscle indicates that the needle had advanced into the fascial plane between internal oblique muscle and transversus abdominis muscle; and after aspiration, 20 ml of inj. ropivacaine (0.5%) was injected in study group. Patients were shifted to the post-anesthetic care unit after completion of surgery.

Postoperative pain was assessed by using the visual analogue scale. Patients with a VAS score of 4 or more received inj diclofenac sodium 75 mg intramuscularly. The time of first request for postoperative analgesia after surgery was recorded as duration of postoperative analgesia. Total dose of inj. diclofenac in 24 hr. was recorded. Vital signs, e.g. respiratory rate, SpO₂, heart rate (HR), blood pressure (MBP), VAS scores, total dose of diclofenac at 30 min, and then at 2, 4, 6, 12, 18 and 24 h postoperatively were recorded. Complications of TAP block were noted. All postoperative assessments were made by an investigator blinded to study group.

RESULTS

This prospective study was carried out in 60 ASA I and II patients. Majority of the patient were in age group of 20 to 40 in both group. Both groups were comparable in terms of age, weight and height. No significant difference was observed between two groups in terms of demographic data (Table 1).

Sensory block [thoracic] was almost equivalent in both groups at the end of surgery or at time of the TAP block in both groups, T-8.2 ± 1.095 vs. T-7.867 ± 1.04 (p = 0.232) in Study and Control groups respectively.

VAS score was significantly higher in control group as compared to the study group at all the time (Table 2).

First dose of rescue analgesia required in study group was at 1140.66 ± 294.89 min and in control group was 210.33 ± 92.45 min which was statistically significant (Table 3).

Total dose of diclofenac consumption in study group was 82.5 ± 22.88 mg and in control group it was 212.5 ± 34.58 mg, which showed that Diclofenac consumption was significantly decreased in study group (Table 3).

Hemodynamic Parameters:

Heart rate in both group (Table 4) were not significantly different at all the time (p > 0.05) except at the 2 h and 4 h where heart rate was significantly high in control group (*p < 0.05)

We observed that there was no significant difference

in MBP in both the group at all the time ($p > 0.05$) except at 2, 4 and 24h post-operatively, where MAB is significantly high in control group ($*p < 0.05$) (Table 5).

There were no observed complications related to the TAP block in both of the groups.

Table 1: Demographic data

Group	Study group	Control group	p value
Age (years)*	30.03 ± 10.33	30.87 ± 11.68	0.769
Weight (Kg)*	68.66 ± 11.35	68.5 ± 10.69	0.9554
Height (cm)*	172.13 ± 10.21	173.43 ± 8.82	0.5997
Male : Female	23 : 7	21: 9	0.7710

Statically significant difference at $p=0.05$

Table 2: Comparison of VAS score

Group	Preoperative	30 min*	2 h*	4 h*	6 h*	12 h*	18 h*	24 h*
Study	0	0.33 ± 0.47	0.866 ± 0.434	1.3 ± 0.466	1.6 ± 0.813	2.33 ± 0.884	2.76 ± 1.10	3.1 ± 1.09
Control	0	0.966 ± 0.55	2.33 ± 1.06	3.27 ± 1.17	2.7 ± 0.987	3.83 ± 0.83	3.03 ± 0.85	3.8 ± 0.76
p value	0	< 0.0001	< 0.0001	< 0.0001	< 0.0001	<0.001	0.2918	0.0055

Statically significant difference at $p=0.05$

Table 3: Time for first dose of rescue analgesia and total diclofenac consumption

Parameter	Groups		p value
	Study Group	Control Group	
Time for first dose of rescue analgesia (min)	1140.66 ± 294.89 min	210.33 ± 92.45 min	< 0.0001 (Highly significant)
Total diclofenac consumption in 24 hrs (mg)	82.5 ± 22.88	212.5 ± 34.58	< 0.0001 (Highly significant)

Table 4: Comparison of mean heart rate in both groups

Group	Preoperative	30 min*	2 h*	4 h*	6 h	12 h	18 h	24 h
Study	88.6 ± 7.16	76 ± 3.15	76.46 ± 3.22	77.76 ± 3.38	79.1 ± 3.58	80.6 ± 4.43	80.4 ± 4.37	80.8 ± 4.25
Control	89.53 ± 7.29	77.8 ± 5.28	79.53 ± 5.98	81.3 ± 5.72	80.33 ± 6.66	81.66 ± 5.94	80.26 ± 6.68	82.66 ± 6.04
p value	0.62	0.1142	0.0162	0.005	0.3766	0.4365	0.9238	0.1731

Statically significant difference at $p=0.05$

Table 5: Comparison of mean arterial blood pressure

Group	Preoperative	30 min*	2 h*	4 h*	6 h	12 h	18 h	24 h
Study	88.95 ± 5.57	89.53 ± 5.54	90.6 ± 4.85	92.35 ± 4.85	93.62 ± 5.33	96.31 ± 5.39	94.28 ± 5.21	95.24 ± 5.05
Control	88.25 ± 3.8	90.62 ± 4.75	93.93 ± 4.25	96.09 ± 5.05	94.93 ± 4.83	97.66 ± 4.13	96.24 ± 4.03	98.33 ± 4.31
p value	0.5718	0.4166	0.0064	0.0049	0.3226	0.2807	0.1086	0.0135

Statically significant difference at $p=0.05$

DISCUSSION

Inadequately controlled post-operative pain has undesirable physiological and psychological consequences such as morbidity, delayed recovery and patient dissatisfaction.

Open appendectomy is one of the most frequently performed surgical procedures in the population worldwide and is a cause of significant pain in the postoperative period.⁵

Acute appendicitis can occur at any age; however the peak incidence is in the second and third decades of life. Regardless of age, appendicitis has been reported to be 1.2 to 2.3 times more common in males than in females. This condition is most commonly seen in patients aged between early teens and late 40s. Effective analgesia has shown to reduce postoperative stress response and accelerate recovery from surgery.¹⁰

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Various methods and medications are used in postoperative pain management. The most common approach to post-operative pain relief is multimodal using NSAIDs, opioids and local infiltration of local anesthetic. Opioids are effective for treatment of postoperative pain but can cause adverse effects such as nausea, vomiting, decreased gastrointestinal motility, respiratory depression and sedation which further increase the morbidity of the patient.

Local anesthetic infiltration to the surgical wound can be an alternative to TAP block in patients undergoing open appendectomy; however, the duration of action is short-lived (2–6 h) and a systematic review has shown that there was no evidence for improved pain relief after appendectomy in adult patients.¹¹ Local infiltration does not relieve deep muscular pain and NSAID are nephrotoxic.

Abdominal field blocks in the form of local infiltration, ilioinguinal and iliohypogastric block have been used for postoperative analgesia since many years, however the clinical utility of current approaches to the blockade of these nerve afferents is limited, and the degree of block achieved can be unpredictable. A major reason for the relative lack of efficacy of these blocks is the lack of clearly defined anatomic landmarks, leading to uncertainty regarding the exact needle positioning, and the lack of a clear indication that the local anesthetic is being deposited in the correct anatomical plane.

TAP block is a novel approach to block the sensory nerve supply to the anterior abdominal wall. Hence we thought of an alternative technique in the form of unilateral TAP block with 0.5% of Ropivacaine at the end of surgery to evaluate whether it has any opioid sparing effect. In this study we decided to give TAP block by landmark technique after completion of surgery to prolong the analgesic effect as effect of spinal anesthesia wear off in 3 to 4 h.

The results of our study showed that patients who received TAP block with local anesthetic had 14 to 24-hour duration of analgesia, significantly less pain up to 24 hrs., prolonged time to first dose of rescue analgesic and significant reduction in diclofenac consumption in 24hrs. and the subsequent dose of diclofenac were required at longer time interval as compared to control group.

VAS Score:

The mean VAS score was higher in the control group as compared to the study group at all the time intervals, and it was significantly higher at 30 min, 4, 6, 12, and 24 h except at 18 h as shown in the Table 3.

Study performed by Niraj et al.¹² in 52 patients of open appendectomy with bupivacaine 0.5% (20 ml) also showed VAS score at rest and on coughing at 30 min and 24 h were comparatively lower in TAP block recipients than control. Neerja Bharti et al.¹³ in colorectal surgery also showed similar results.

Time to first dose of rescue analgesia (i.e. diclofenac) was statistically significantly prolonged in study group (1140.66 ± 294.8 min) compared to the control group (210.33 ± 92.45 min) (Table 4). Though different studies differ in type of local anesthetic drug used, their volume and concentration, most of the studies shows a statistically significant ($p < 0.05\%$) prolonged duration of requirement of first dose of analgesia in TAP group compared to control (Table 4).

This was similar to the study performed by Parikh B et al.¹⁴ in 60 patients undergoing laparoscopic donor nephrectomy given TAP block with 25 ml of inj. Bupivacaine (0.375%), TAP block group required analgesic at mean time of 9.1 h as compared to control group who required at around 1.7 h.

Other studies like O'Donnell B, et al.⁶ also demonstrated that a single shot TAP technique can produce effective analgesia for 36-48 h attributing it to relatively poor vascularized and therefore slow drug clearance.

Different studies selected used different analgesic drugs like, diclofenac, morphine, tramadol, paracetamol, fentanyl and other drugs. But the total requirements of Analgesic drugs were significantly higher in control group as compared to patients who were given TAP block. Our study results are comparable with Dawlatly et al.¹⁵ who showed 55% decrease in opioid requirement after USG guided TAP block in laparoscopic cholecystectomy. G. Niraj et al.¹² showed 45% decrease in opioid requirement with USG guided TAP block in open appendectomy.

From this study, it seems that TAP block holds considerable promise for patients undergoing surgical procedures involving abdominal wall incisions as it provides analgesia to parietal peritoneum as well as skin and muscle of the anterior wall abdomen. It reduces pain (vas score), requirement of rescue analgesia and their side effect and provide better satisfaction to patient.

Advantage of TAP block by landmark technique over USG guided are easy to perform, cost effective, less time required for preparation to give TAP block, can be used at peripheral health center, can be used in emergency surgery when USG not available, can be

given by anesthesiologist without expertise in USG guided block.

CONCLUSION

From above findings it was concluded that TAP block by landmark technique is Easy to perform, quick, safe and cost effective, effective as post-operative analgesic regimen for patient undergoing appendectomy when used as a part of multimodal analgesia as it reduces VAS score and increases duration of requirement of rescue analgesic drug, opioid sparing hence reduces opioid and NSAID requirement and their related side effects, associated with minimal chances of

complications and It can be performed in emergency cases and in remote areas, where facility and adequate technique for USG guided TAP block is not available.

Hence, TAP block is a promising new technique for postoperative pain management in surgery involving the anterior abdominal wall.

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