Original Article

Evaluation of postoperative analgesic efficacy of transversus abdominis plane block after abdominal surgery: A comparative study

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Abstract

Background: The transversus abdominis plane (TAP) block is an effective method of providing postoperative analgesia in patients undergoing midline abdominal wall incisions, by blocking the abdominal wall neural afferents via the bilateral lumbar triangles of Petit. We evaluated its analgesic efficacy in patients during the first 48 postoperative hours after abdominal surgery, in a randomized, controlled single-blind clinical trial. **Materials and Methods:** Sixty patients (mean age 36.2 ± 9.6 years) of either sex of ASA grade 1 and 2 who underwent major gynecological or surgical operation were randomized either to receive standard care, including patient-controlled tramadol analgesia ($n = 30$), or to undergo TAP block ($n = 30$) in addition to standard care. After completion of surgery, 20 ml of 0.375% levobupivacaine was deposited into the transversus abdominis neurofascial plane via the bilateral lumbar triangles of Petit. Each patient was assessed in the postanesthesia care unit and at 2, 4, 6, 12, 24, and 48 h postoperatively. **Results:** The TAP block reduced Visual Analog Scale pain scores at most (2, 4, 6, 12, 24 h), but not at all time (36, 48 h) points assessed. Patients undergoing TAP block had reduced tramadol requirement in 24 h (210.05 ± 20.5 vs. 320.05 ± 10.6; $P < 0.01$) and 48 h (508.25 ± 20.6 vs. 550.25 ± 20.6; $P < 0.01$), and a longer time to the first PCA tramadol request (in minutes), compared to the control group (178.5 ± 45.6 vs. 23.5 ± 3.8; $P < 0.001$). **Conclusion:** The TAP block provided highly effective postoperative analgesia in the first 24 postoperative hours after major abdominal surgery, and no complications due to the TAP block were detected.

Key words: Lumbar triangle of petit, neurofascial plane, transversus abdominis plane block, visual analog scale

INTRODUCTION

A major contribution to the pain experienced by a patient after an abdominal surgery is from the incision made in the abdominal wall.[1] Traditionally, analgesia for abdominal surgery is provided either by systemic drugs such as opioids, ketamine, nonsteroidal anti-inflammatory drugs, alpha-2 agonists, and paracetamol or by epidural anesthesia.[2]

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Peripheral nerve blockade is an alternative means of providing analgesia, by anesthetizing the sensory nerves.[3,4] The paired rectus abdominis muscles lie in the abdominal midline. On either side of the recti, the abdominal wall comprises three layers of thin muscle: from external to internal, they are external oblique, internal oblique, and transversus abdominis. Each muscle layer is surrounded by a sheath of connective tissue. Pain from the abdominal wall is transmitted by the anterior branches of seven spinal nerves[5] which travel in a plane between the internal oblique and transversus abdominis muscles known as the transversus abdominis plane (TAP) representing an anatomical potential space.[6] The nerves then leave the plane to innervate the abdominal muscles and overlying skin.[7] On the basis of anatomic studies, the lumbar triangle of Petit, a potential access point to this neurofascial plane, was identified.

This triangle is bounded posteriorly by the latissimus dorsi muscle and anteriorly by the external oblique, with the iliac crest forming the base of the triangle, and is a fixed and easily palpable landmark.[8] By introducing local anesthetics into the TAP via the triangle of Petit, it is possible to block the sensory nerves of the anterior abdominal wall before they pierce the musculature to innervate the abdomen. The degree of block achieved can be unpredictable mainly due to 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.

MATERIALS AND METHODS

Approval was obtained from the hospital ethical committee. Patients undergoing abdominal surgery at S. N. Medical College and Hospital, Agra, between June 2010 and May 2011, were included in the study. Sixty patients of either sex of ASA grade 1 and 2 who underwent major gynecological or surgical operation were enrolled for this study. Informed consent was obtained from all who agreed to participate in this study. The patients were randomly assigned into two groups. Each group had equal number ($n = 30$) of patients.

Group 1: Test group: Patients received TAP block.
Group 2: Control group: Patients received no TAP block

All the patients received a standard general anesthetic with standard monitoring. Anesthesia was induced by rapid sequence induction using thiopental 5 mg/kg and succinylcholine 2 mg/kg. Vecuronium was used for muscle relaxation. Anesthesia was maintained with oxygen, nitrou oxide and isoflurane. All patients also received fentanyl 1–2 mg/kg. At the end of the operation, patients were extubated after reversal with neostigmine and atropine. Standard monitoring, including electrocardiogram, non-invasive blood pressure (NIBP), arterial oxygen saturation, and end-tidal carbon dioxide monitoring, was done throughout, and patients were placed in supine position. Patients with hepatic and renal abnormalities, those who were hypersensitive to the drug, and those who were receiving medical therapies considered to result in tolerance to opiates were excluded from the study.

During preoperative visit, patients received a Visual Analog Scale (VAS) for pain, which was explained to them. The assessments ranged from 0 (no pain) to 10 (unbearable pain), and these assessments were performed in the postanesthesia care unit (PACU) and at 2, 4, 6, 24, and 48 h postoperatively. All patients were instructed about how to use the patient controlled analgesia PCA device during preoperative visit.

Technique

All patients randomized to undergo TAP block, had the block performed after completion of surgery. The iliac crest was palpated from anterior to posterior until the latissimus dorsi muscle could be felt.

The triangle of Petit was then located just anterior to the latissimus dorsi muscle [Figure 1]. Using a short bevel 24-G spinal needle, the skin was pierced just cephalad to the iliac crest over the triangle of Petit [Figure 2]. The needle was then advanced at right angles to the skin, in a coronal plane, until resistance was encountered. This resistance indicated that the needle tip was at the external oblique muscle.[9] Gentle advancement of the needle resulted in a "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.[10,11] After careful aspiration to exclude vascular puncture, 20 ml of 0.375% bupivacaine solution was injected through the needle. The TAP block was then performed on the opposite side, using an identical technique.[12] After completion of the procedure; patients were transferred to the PACU. PCA with tramadol was

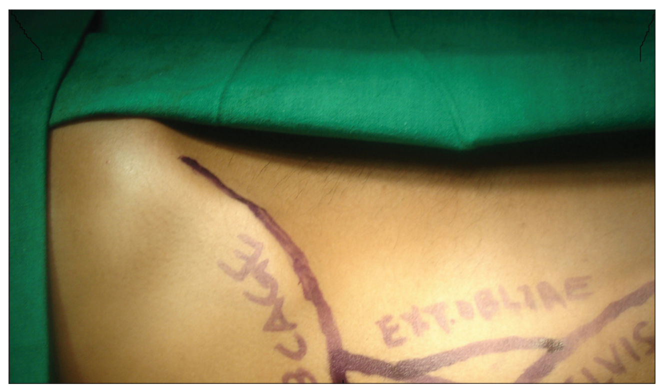

Figure 1: Surface anatomy of lumber triangle of petit

Figure 2: Site of needle insertion in lumber triangle of petit

started in the postoperative ward once the patient was fully conscious and oriented.

Loading dose/bolus of 2.5 mg/kg of tramadol was administered by slow intravenous injection before starting PCA. Tramadol solution was diluted to 10 mg/ml. The devices were set to deliver 10 mg i.v. bolus dose of tramadol with 10 min lockout time. All patients who had nausea or vomiting were treated with i.v. metoc1opramide 10 mg and those who had pruritus were treated with i.v. chlorpheniramine 10 mg.

Data collection

The presence and severity of pain, nausea, and sedation were assessed systematically. These assessments were performed in the PACU and at 2, 4, 6, 24, and 48 h postoperatively. All patients were asked to give scores for their pain at rest and on movement, and for the degree of nausea at each time point.

Pain severity was measured using both a VAS (0, no pain; 10, worst imaginable) and a categorical pain scoring system (none, 0; mild, 1; moderate, 2; severe, 3).

Nausea was measured using a categorical scoring system. Sedation scores were assigned by the blinded assessor, using a sedation scale (awake and alert, 0; quietly awake,1; asleep but easily roused, 2; deep sleep, 3).

Statistical analysis was done by a computer software SPSS, Windows version 11.5 (SPSS, Chicago, IL, USA). Statistical significance of parametric data was determined by Student's *t*-test and categorical data by Chi-square test.

RESULTS

Groups were compared in terms of age, weight, height, and history of abdominal surgery [Table 1].

In group 1 (test group) patients, the triangle of Petit was located easily on palpation, the transversus abdominis neurofascial plane localized after one to two attempts, and the block performed without complication.

Patients undergoing TAP block had reduced 48-h tramadol requirements and a longer time to the first PCA tramadol request, compared to group 2 patients (no TAP block group). The median time to first request for tramadol was significantly longer in patients who received a TAP block [Table 2]. Categorical pain scores were lower in patients who received the TAP block at 2, 4, and 6 h postoperatively.

Postoperative VAS pain scores at rest and on movement were reduced after TAP block at most, but not at all time points assessed [Table 3].

The TAP block significantly reduced the incidence of sedation in group 1. Postoperative sedation scores were reduced in patients who received the TAP block at 1 and 24 h postoperatively. There was no significant difference in the incidence or severity of nausea between groups [Table 4].

DISCUSSION

The benefits of adequate postoperative analgesia are clear, and include a reduction in the postoperative stress response, reduction in postoperative morbidity, and in certain types of surgery, improved surgical outcome. Effective pain control also facilitates rehabilitation and accelerates recovery from surgery.

Table 1: Baseline patient characteristics

Parameters	TAP block (group 1) (*n*=30)	No TAP block (group 2) (*n*=30)	*P* value
Age (years)	35.8±8.6	37.9±5.9	0.112
Sex ratio (M:F)	14:16	15:15	0.151
Weight (kg)	56.5±5.6	58.7±7.6	0.114
Duration of surgery (min)	155.6±9.5	150.9±6.8	0.132
Intraoperative fentanyl (μg/kg)	1.5±0.0	1.5±0.0	>0.05
Surgical procedure			
Exploratory laparotomy	15	16	
Abdominal hysterectomy	8	6	
Cesarean delivery	7	8	

Table 2: Postoperative pain scores and analgesic requirement

Parameters	TAP block (group 1)	No TAP block (group 2)	*P* value
Time to first request for tramadol (min)	178.5±45.6	23.5±3.8	<0.001
Mean 24-h tramadol requirement (mg)	210.05±20.5	320.05±10.6	<0.01
Mean 48-h tramadol requirement (mg)	508.25±15.6	550.25±20.6	<0.01
Categorical pain severity			
PACU	0 (0, 0)	2 (2, 2)	<0.001
2 h	0 (0, 0)	2 (2, 2)	<0.001
4 h	0 (0, 0)	2 (2, 2)	<0.001
6 h	1 (0, 1)	2 (2, 2)	<0.001
24 h	1 (0, 1)	1 (0, 1)	0.05
48 h	1 (0, 1)	1 (0, 1)	0.05

Table 3: Postoperative visual analog scale scores

Parameters	TAP block (group 1)	No TAP block (group 2)	*P* value
VAS score			
PACU	2 (0.5-2)	4 (3-6.75)	<0.001
2 h	2 (0.5-2)	5 (3.25-6)	<0.001
4 h	2 (0.5-2)	4 (2-5)	<0.001
6 h	2 (0-3.5)	3 (2-4.75)	<0.01
12 h	2 (0-3)	3 (2-4)	<0.01
24 h	1 (0-2)	3 (2-4)	<0.05
48 h	0 (0-2)	0 (0-2)	

Table 4: Postoperative sedation and nausea scores

Parameters	TAP block (group 1)	No TAP block (group 2)	*P* value
Sedation scores			
PACU	1 (1, 1.5)	1 (1, 1.5)	<0.01
2 h	0.5 (0, 1)	1 (1, 1.5)	<0.01
4 h	0 (0, 0.5)	1 (1, 1.5)	<0.01
6 h	0 (0, 0)	1 (1, 1.5)	
12 h	0 (0, 0)	0 (0, 0)	
24 h	0 (0, 0)	0 (0, 0)	
48 h	0 (0, 0)	0 (0, 0)	
Nausea scores			
PACU	0 (0, 0.5)	0 (0, 1)	<0.05
2 h	0 (0, 0)	1 (0, 1)	
4 h	0 (0, 0)	0 (0, 0)	
6 h	0 (0, 0)	0 (0, 0)	
12 h	0 (0, 0)	0 (0, 0)	
24 h	0 (0, 0)	0 (0, 0)	
48 h	0 (0, 0)	0 (0, 0)	

Other benefits of effective regional analgesic techniques include reduced pain intensity, decreased incidence of side effects from analgesics, and improved patient comfort.[1]

Direct blockade of the neural afferent supply of the abdominal wall, such as abdominal field blocks, ilioinguinal and hypogastric nerve blocks, has long been recognized as capable of providing significant postoperative analgesia in patients undergoing abdominal surgical procedures such as cesarean delivery[3] and inguinal herniorrhaphy.[4] However, the lack of clearly defined anatomic landmarks has meant that the full potential of abdominal wall blockade in patients undergoing major abdominal procedures remains to be realized. An alternative, simple, reliable, and effective regional analgesic technique is required.

The TAP provides a space into which local anesthetic can be deposited to achieve myocutaneous sensory blockade.[6-8] Deposition of the local anesthetic dorsal to the mid-axillary line also blocks the lateral cutaneous afferents, thus facilitating blockade of the entire anterior abdominal wall. The lumbar triangle of Petit offers an easily identifiable, fixed, and palpable landmark, and is located dorsal to the mid-axillary line.[12,13] The transversus abdominis neurofascial plane can easily be accessed via this triangle, and local anesthetic deposited into this plane, using the loss of resistance technique.

In this randomized, single-blind clinical trial, the TAP block produced effective and prolonged postoperative analgesia, when compared with standard therapy, in patients undergoing surgery via a midline abdominal wall incision. The TAP block reduced postoperative pain scores, both at rest and on movement, and reduced postoperative opioid requirements. Overall, during the first 24 postoperative hours, the TAP block reduced mean i.v. tramadol requirements by more than 70%. This reduction in opioid requirement resulted in fewer opioid-mediated side effects. The incidence of post operative nausea and vomiting PONV was reduced by more than half in the TAP block group. Sedation scores were also modestly reduced in the patients who underwent TAP blockade.

Thus, we conclude that the TAP block seems to hold considerable promise in producing effective and prolonged postoperative analgesia for patients undergoing surgical procedures involving abdominal wall incisions.

CONCLUSION

We conclude that the TAP block holds considerable promise as part of a multimodal analgesic regimen after abdominal surgeries. The TAP block was easy to perform, and provided reliable and effective analgesia in this study, and no complications due to the TAP block were detected.

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