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Original Research Article

# Transversus abdominis plane block with ropivacaine provides effective analgesiain patients undergoing total abdominal hysterectomy

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ABSTRACT

**Background**: Transversus abdominis plane (TAP) block provides a novel approach for analgesia in abdominal surgery by blocking the sensory nerve supply of the anterior abdominal wall. We evaluated the analgesic efficacy of TAP block with ropivacaine in patients undergoing total abdominal hysterectomy (TAH).

**Materials and Methods:** 60 adult patients of ASA Grade 1 and 2 undergoing elective TAH were randomized into two groups in this double blind study. All patients received a standard general anaesthetic and before the surgical incision, a bilateral TAP block using the landmark technique was performed with 15 to 20 mlof 0.375% ropivacaine (maximum dose 3mg/kg) (Group R) or saline (Group C). Assessment of hemodynamic parameters and requirement of vecuronium and opioids was noted intraoperatively. Postoperative assessment of pain was performed at regular intervals using visual analog scale (VAS) and categorical pain score (CPS), and total analgesics administered over 48 hrs were noted.

**Results**: Intraoperative hemodynamic parameters showed significantly lower mean values in the ropivacaine group till 50 minutes and from 80 to 120 minutes after the surgical incision. (p value<0.05). Duration of TAP block was significantly longer in the ropivacaine group (383 mins vs 221mins, p=0.000). Mean intraoperative requirement of fentanyl and vecuronium (p=0.000), and postoperative requirement of diclofenac at 24 hrs (p=0.004) and 48 hours (p=0.007) was significantly lower in Group R.VAS and CPS scores were significantly lower in the ropivacaine group till 2 hours postoperatively(p=0.000).

**Conclusion**: TAP block with ropivacaine provides effective intraoperative analgesia and decreases postoperative analgesic requirement till 48hours in patients undergoing total abdominal hysterectomy.



## 1. Introduction

Patients undergoing abdominal surgery suffer significant pain, a major component of which can be attributed to pain derived from incision on the anterior abdominal wall. A promising approach to providing analgesia during abdominal surgery is to block the sensory nerve supply of the anterior abdominal wall. The transversus abdominis plane (TAP) block is a simple approach based on the same. [1,2]

Skin, muscles and part of the peritoneum of the anterior abdominal wall are supplied by the six inferior thoracic nerves and the first lumbar nerve. These nerves can be blocked by the TAP block between the transversus abdominis and internal oblique muscles, before they pierce the anterior abdominal wall.TAP block can be performed after identification of the 'triangle of petit'(bounded anteriorly by external oblique, posteriorly by latissimus dorsi and base by iliac crest), using either the 'landmark technique' or under ultrasound guidance. [3,4]

Ropivacaine is a long-acting amide local anaesthetic which is structurally related to bupivacaine. Unlike

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bupivacaine which is a racemate, ropivacaine is a pure S enantiomer of propivacaine, and has been developed to reduce potential toxicity and improve relative sensory and motor block profiles as compared to bupivacaine.[5,6]

TAP block is an important part of a multi-modal regime, as it provides fast recovery and discharge in day care surgery. The purpose of this study was to evaluate the efficacy of TAP block using ropivacaine for providing intraoperative and postoperative analgesia in patients undergoing total abdominal hysterectomy (TAH)under general anaesthesia.

## 2. Materials and Methods

The study was conducted after written informed consent from patients and after being duly approved by the Institute Ethics Committee of Vardhman Mahavir Medical College and Safdarjung Hospital. Sixty adult female patients (18 to 65 years), with ASA physical status GradeI-II, scheduled to undergo TAH with duration ranging from 90 to 120 minutes, were included in this double blind study. Patients with history of drug allergy to local anaesthetics, medical therapy resulting in tolerance to opioids, coagulopathy and infection at the site of needle insertion were excluded from the study.

Patients were premedicated with oral alprazolam 0.25 mg the night before and 2 hours before surgery. In the operating room standard monitoring was established and preoperative vital parameters were recorded: heart rate (HR), systolic (SBP), diastolic (DBP) and mean (MAP) arterial pressure, oxygen saturation ($SpO_2$) and electrocardiogram (ECG).Anaesthesia was induced with fentanyl (2$\mu$g/kg) and propofol (till loss of verbal response) and the lungs were ventilated with oxygen ($O_2$), nitrous oxide($N_2O$) and isoflurane. Orotracheal intubation was facilitated with vecruonium (0.1mg/kg). After intubation, diclofenac 75 mg was added to the intravenous fluid (Ringer's lactate).Bilateral TAP block was performed after induction of anaesthesia and before the surgical incision.

Patients were randomized to one of two groups - Group C: control group, TAP block was performed bilaterally with 15 to 20 ml of 0.9% normal saline; and Group R: ropivacaine group, TAP block was performed bilaterally with 15 to 20 ml of 0.375% ropivacaine(maximum dose 3mg/kg). Randomisation was done by the second author using computer generated random numbers which were contained in a sealed envelope. This was handed over to another anesthesiologist drawing up the study drug in an unlabeled sterile syringe. TAP block and administration of the drug was done by the first author who remained blinded to its contents. Patient assessment and observations were recorded by the blinded researcher in the operation theatre as well as in the recovery room.

The triangle of petit was identified, and the puncture site was located just above the iliac crest and posterior to the mid axillary line within the triangle. Under all aseptic precautions, a 22G blunt tipped needle was inserted perpendicular to the skin. The 'first pop' was felt when the needle passed between the fascial layers of external oblique and internal oblique muscles. The needle was further advanced till a 'second pop' was felt, which indicated the fascial plane between internal oblique and transversus abdominis muscles. After aspiration to exclude vascular puncture, a test dose of 1-2 ml of normal saline was injected, and this was followed by full dose of the study drug. Resistance during injection of test dose indicated that the needle was not correctly positioned and it was repositioned appropriately. Surgical incision was allowed 10 minutes after the block.

Anaesthesia was maintained with $O_2$ in $N_2O$ and isoflurane, using a circle system. Intraoperative monitoring of HR, SBP, DBP, MAP, $SpO_2$, end tidal carbon dioxide ($ETCO_2$) and ECG was done. The measured variables were recorded at baseline (preoperative), 5 minutes after intubation (pre-block), 10 minutes after block (before incision), at the time of surgical incision (zero minute) and every10 minutes thereafter till the end of surgery. Additional requirement of vecronium and fentanyl was based on a 20% increase in HR or SBP from the baseline. Ondansetron 4 mg intravenous (IV) was administered 30 mins before the end of surgery. Residual neuromuscular block was antagonized with neostigmine (0.05mg/kg) and glycopyrrolate (0.01mg/kg).

Patients were assessed for the presence of pain at 0, 1, 2, 4, 12, 24 and 48 hours postoperatively. Severity of pain was measured using a 10 cm visual analog scale(VAS) and categorical pain scoring system (CPS:none = 0, Mild = 1, Moderate = 2, Severe = 3) at rest, and on movement (knee flexion). Patients were given a rescue analgesic when the VAS exceeded 4, and the time of administration of the first as well as subsequent analgesics in 48 hrs was noted. Duration of TAP block was taken from the time of intraoperative diclofenac injection till administration of the first rescue analgesic. If less than 8 hours had elapsed since intraoperative injection of diclofenac, IV tramadol 50 mg was given, and if more than 8 hours had elapsed, intramuscular (IM) diclofenac 75 mg was administered. Subsequent analgesia consisted of IM diclofenac, and if pain was uncontrolled, IV tramadol was given.

Presence of any other side effects like nausea and vomiting, sedation etc. were noted and site of injection of TAP block was inspected for hematoma or infection at 0,1, 2, 4, 12, 24 and 48 hours postoperatively.

Statistical analysis was performed with SPSS statistical software version 16. 0using duration of TAP block as the primary outcome. Data was collected on a standard proforma and tabulated on Microsoft Excel sheet. A sample of 30 patients per group was required to detect a difference in pain scores between the control and TAP block groups

(median of pain score in control group being two and in TAP block group being zero) with 80% power and two-sided alpha error of 0.05.

Data between the groups was compared using student t-test or non-parametric Wilcoxon's Signe test for continuous variables and chi-square or fischer exact test was applied for categorical variables. Repeated measurements (such as pain scores and sedation scores) were analyzed using analysis of variance. P value of less than 0.05 was taken to be statistically significant.

## 3. Results

Both the groups were comparable with respect to age, weight, height and body mass index.(Table 1)

**Table 1:** Patientcharacteristics

| | Group C (Control) Mean ± SD | Group R (Ropivacaine) Mean ± SD | 'p' value |
|---|---|---|---|
| Age (years) | 54.30±3.761 | 55.67±3.772 | 0.165 |
| Weight (kg) | 55.40±6.196 | 54.00±6.502 | 0.399 |
| Height (cm) | 155.53±4.24 | 153.67±3.960 | 0.083 |
| BMI (kg/m$^2$) | 22.84±1.69 | 22.79±1.71 | 0.909 |

Mean HR, SBP, DBP and MAP was found comparable between the groups at baseline and pre block. Mean HR and SBP was significantly lower in the ropivacaine group from 10 mins after giving the block (before incision) till 50 minutes, andfrom90 to 120 minutes after the incision (Figure 1).

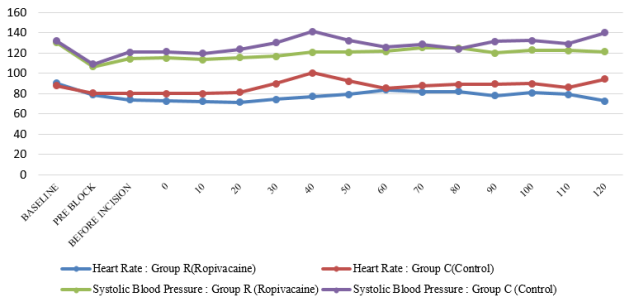


**Fig. 1:** Comparisonof intraoperative mean heart rate and systolic blood pressure

p values: Baseline (p=0.404), Pre block (p=0.343), Before incision (p=0.003)*, 0 min - At surgical incision(p=0.000)*, 10 mins after incision (p=0.001)*, 20 mins after incision (p=0.000)*, 30 mins after incision (p=0.000)*, 40 mins after incision (p=0.000)*, 50 mins after incision (p=0.000)*, 60 mins after incision (p=0.605), 70 mins after incision (p=0.055), 80 mins after incision (p=0.052), 90 mins after incision(p=0.000)*, 100 mins after incision(p=0.002)*, 110 mins after incision (p=0.016)*, 120 mins after incision (p=0.000)*

Mean DBP and MAP was significantly lower in the ropivacaine group at 10 mins after giving the block (before incision), from 10 to 50 minutes and at 80, 90 and 120 minutes after the incision, as compared to the control group (Figure 2).

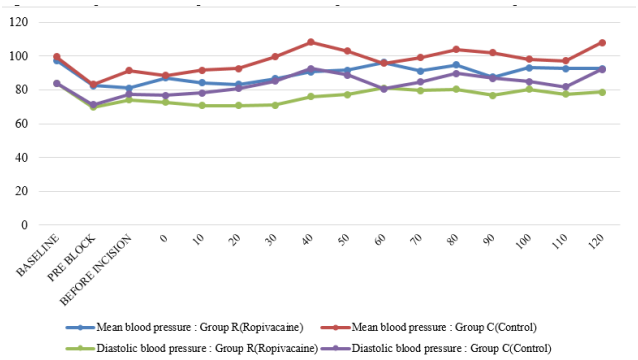


**Fig. 2:** Comparison ofintraoperative mean arterial pressure and diastolic blood pressure

P values- Baseline (p=0.317) , Pre block (p=0.654), Before incision (p= 0.016)*, 0 min: at surgical incision (p=0.716), 10 minutes (p=0.000)*, 20 minutes (p=0.009)*, 30 minutes (p=0.000)*, 40 minutes (p=0.000)*, 50 minutes (p=0.001)*, 60 minutes (p=0.901), 70 minutes (p= 0.076), 80 minutes (p=0.002)*, 90 minutes (p=0.000)*, 100 minutes (p=0.127), 110 minutes (p=0.051), 120 minutes (p=0.000)*, * p <0.05

The duration of TAP block was significantly longer with ropivacaine(383 mins vs 221mins, p<0.001). Mean requirement of fentanyl and vecuronium was significantly higher in the control group as compared to the ropivacaine group (p<0.001). Requirement of diclofenac was significantly higher in the control group both at 24 hrs (p=0.004) and 48 hours (p=0.007) postoperatively. There was no significant difference in the requirement of postoperative tramadol.(Table 2).

The mean VAS score both at rest and on movement was significantly lower in the ropivacaine group till 2 hours after surgery. Subsequently, the control group maintained a lower mean VAS from 4 to 24 hours postoperatively (Table 3).

On comparing the CPS scores, a greater number of patients in the ropivacaine group were found to have significantly lower scores at 0, 1 and 2 hours postoperatively. The CPS score was significantly lower in the control group at 4 hours and 24 hours. No significant difference in the CPS score was noted at 12 and 48 hours postoperatively.(Table 4)

There was no significant difference in the incidence of side effects between the two groups.

**Table 2:** Comparison of duration of block and analgesic requirement

| | | Group | Mean ±SD | 'p' value |
|---|---|---|---|---|
| Duration of block (mins) | | Group R | 383.17 ± 90.034 | <0.001 |
| | | Group C | 221.93 ± 50.416 | |
| Intraoperative Requirement | Fentanyl ($\mu$g) | Group R | 80.52 ± 25.084 | <0.001 . |
| | | Group C | 111.33 ± 22.164 | |
| | Vecuronium (mg) | Group R | 2.362 ± .8334 | <0.001 |
| | | Group C | 3.600 ± .6618 | |
| | Tramadol (mg) | Group R | 71.43 ± 25.35 | 0.84 |
| | | Group C | 70 ± 24.91 | |
| Postoperative Requirement | Diclofenac(mg) (24 hrs) | Group R | 73.15 ± 24.65 | 0.004* |
| | | Group C | 93.83 ± 34.42 | |
| | Diclofenac (mg) (48 hrs) | Group R | 176.83 ± 34.42 | 0.007* |
| | | Group C | 201.83 ± 35.65 | |

* p <0.05
Group R – Ropivacaine
Group C – Control

**Table 3:** Postoperative visualanalog scale

| Time (hrs) | Visual analog scale | Group R (Ropivacaine) Mean ± SD | Group C(Control) Mean ± SD | 'p' value |
|---|---|---|---|---|
| 0 | Rest | 0.33±0.711 | 1.77±0.817 | 0.000* |
| | Movement | 0.5±0.938 | 2.6±1.07 | 0.000* |
| 1 | Rest | 1.07±1.285 | 3.23±1.305 | 0.000* |
| | Movement | 1.53±1.306 | 3.93±1.552 | 0.000* |
| 2 | Rest | 2.07±0.98 | 3.63±1.691 | 0.002* |
| | Movement | 2.77±1.135 | 4.47±1.634 | 0.000* |
| 4 | Rest | 3.07±2.33 | 1.285±1.269 | 0.002* |
| | Movement | 3.93±1.413 | 2.73±1.53 | <0.001 |
| 12 | Rest | 1.47±0.629 | 0.87±0.571 | 0.001* |
| | Movement | 2.13±1.196 | 1.13±0.571 | 0.000* |
| 24 | Rest | 2.3±1.86 | 1.23±1.478 | 0.005* |
| | Movement | 2.73±2.033 | 1.33±1.583 | 0.001* |
| 48 | Rest | 1.47±0.819 | 1.27±0.583 | 0.319 |
| | Movement | 1.5±0.82 | 1.43±0.568 | 0.810 |

* p <0.05

**Table 4:** Postoperative categorical pain score

| | | Categorical Pain score (percentage of patients %) | | | | |
|---|---|---|---|---|---|---|
| Time (hrs) | | 0 | 1 | 2 | 3 | 'p' value |
| 0 | Group R | 70 | 23.3 | 6.7 | 0 | <0.001 |
| | Group C | 3.3 | 36.7 | 56.7 | 3.3 | |
| 1 | Group R | 33.3 | 60 | 3.3 | 3.3 | <0.001 |
| | Group C | 0 | 30 | 33.3 | 36.7 | |
| 2 | Group R | 3.3 | 60 | 33.3 | 3.3 | <0.001 |
| | Group C | 0 | 6.7 | 53.3 | 40 | |
| 4 | Group R | 0 | 20 | 63.3 | 16.7 | 0.0026* |
| | Group C | 0 | 53.3 | 36.7 | 10 | |
| 12 | Group R | 3.3 | 80 | 10 | 6.7 | 0.282 |
| | Group C | 6.7 | 90 | 3.3 | 0 | |
| 24 | Group R | 0 | 60 | 13.3 | 26.7 | 0.0036* |
| | Group C | 26.7 | 50 | 6.7 | 16.7 | |
| 48 | Group R | 6.7 | 80 | 13.3 | 0 | .096 |
| | Group C | 0 | 96.7 | 3.3 | 0 | |

Group R – Ropivacaine
Group C – Control

## 4. Discussion

Transversus abdominis plane block holds considerable benefit as part of a balanced multimodal analgesia in surgeries involving the anterior abdominal wall. We evaluated the efficacy of TAP block with ropivacaine for providing intraoperative and postoperative analgesia in patients undergoing total abdominal hysterectomy (TAH) under general anaesthesia. TAP block with ropivacaine provides haemodynamic stability, decreases intraoperative anaesthetic requirement, and reduces postoperative pain scores till 2hrs and analgesic requirement till 48hrs after surgery.

TAP block can be performed using the 'blind technique' after identification of the 'triangle of petit' or under ultrasound guidance.[2,7] The blind technique was first described by Rafi, and Mc Donnell and colleagues used this technique to supplement multi-modal analgesia in midline incision colonic surgery, abdominal hysterectomy and caesarean section.[8–10]

In our study, the intraoperative haemodynamic parameters like heart rate and systolic, diastolic and mean arterial pressures were significantly lower till 50 minutes after the surgical incision, in those patients who had received TAP block with ropivacaine. The difference in haemodynamic parameters was not significant between 60 to 80 mins. This may be attributed to additional requirement of muscle relaxant and opioids to counteract visceral pain associated with surgical manipulation in both the groups. Thereafter from 90 mins onwards, haemodynamic parameters remained lower in the ropivacaine group as compared with control. Kai Li et al reported lower heart rate and blood pressure using TAP block with ropivacaine as compared to the control group in patients undergoing open gastrectomy.[11]

Mean requirement of fentanyl and vecuronium was significantly less in patients who received TAP block with ropivacaine. This complies with several other studies.76% of patients who received TAP block with bupivacaine required only the induction dose of sufentanil, compared with the control group in which all the patients required additional intraoperative sufentanil, in patients undergoing laparoscopic cholecystectomy.[12] Similarly other studies have reported lower sufentanil requirement in patients receiving TAP block with ropivacaine as compared to control.[13,14]

In our study, the duration of TAP block was found to be significantly longer with ropivacaine (383 mins) as compared to control (221mins). Another study on TAP block in TAH reported a longer median time of 45 mins vs 12.5 mins in patients receiving ropivacaine or normal saline respectively.[15] In this study the time to first request for morphine was considered the duration of block, whereas in our study the duration of TAP block was taken from the time of intraoperative diclofenac injection till administration of the first rescue analgesic. A significant difference was reported in the meantime to first analgesic requirement in the TAP block group (183 minutes) vs the control group (26.4 minutes) in 50 patients undergoing TAH.[9] In this study they used15ml of 0.25%bupivacaine for TAP block. Various other studies have reported the median time to first analgesic to be longer with TAP block as compared to control.[10,16,17]

On assessment of postoperative pain we found that the visual analog scale and categorical pain scores were both significantly lower in the ropivacaine group till 2 hours after surgery. After 2 hours, VAS and CPS scores were lower in the control group, and this trend continued till 24 hours. This can be explained by the fact that patients in the control group had a shorter duration of block and received their first postoperative rescue analgesic earlier than the ropivacaine group. Therefore at 4 hours, majority of patients in the control group were pain free (53.3% of patients had no or mild pain), whereas majority of patients in the ropivacaine group (80% had moderate to severe pain) were beginning to experience postoperative pain. VAS did not exceed 4 in any of the groups at any point of time.

Belavy et al did not report any significant difference in VAS scores between patients receiving TAP block with 0.5% ropivacaine or normal saline.[16] This is in contrast to other studies which have reported lower VAS scores till 24 hours and 48 hours (Mc Donnell et al and Shin et al)[2,18] as well as lower CPS scores till 6 hours and 48 hours postoperatively (Mc Donnell et al) after TAP block.[8,10] Another study on 88 women undergoing elective caesarean delivery under spinal anaesthesia reported lower VAS scores in the TAP block group as compared to the control group at 3, 6 and 12 hours postoperatively.[19]

Requirement of diclofenac was significantly less in the ropivacaine group till 48 hours postoperatively. We did not find any difference in the requirement of tramadol between the groups. Carney et al reported a higher mean morphine consumption in the control group at 24 hours and 48 hours postoperatively as compared to the ropivacaine group. Various other studies showed similar results with decreased requirement of rescue analgesics in the TAP block group.[8,10,16,17,20]

We did not find any local complications related to TAP block such as infection or hematoma. This complies with El-Dawlatly et al's study, who too did not note any side effects related to TAP block after 2 hours and 24 hours of the block.[12]

In a study by Fuladi, mean duration of analgesia was 420.6 minutes with SD of +14.01 in Bupivacaine group and 2187 minutes with SD of +1011.09 in Ropivacaine group which was found to be statistically significant. In our study also the duration of TAP block was longer with ropivacaine(383 mins vs 221mins, p=0.000)than bupivacaine. The difference in the time with the other

study could be attributed to 0.375% ropivacaine used in our study as compared to 0.5% ropivacaine in their study. Hence ropivacaine provides longer duration of analgesia than bupivacaine when used in TAP Block on patients of lower abdominal surgeries.[21] A major limitation of our study was the inability to give TAP block under ultrasound guidance, due to its nonavailability. The success rate of the block performed by blind technique is influenced by the experience of the practitioner.

To summarize, TAP block with ropivacaine provides haemodynamic stability and decreases intraoperative requirement of opioids and muscle relaxant. It results in lower pain score still 2 hours and decreased analgesic requirement till 48 hours postoperatively in patients undergoing total abdominal hysterectomy.

TAP block is simple to learn and perform even by trainees, and is reliable and efficacious in the absence of ultrasound in the operating room, as is quite common in the developing world. It is not associated with any major side effects. We therefore recommend TAP block with ropivacaine as part of a balanced multimodal approach in patients undergoing total abdominal hysterectomy under general anaesthesia for providing adequate intraoperative and postoperative analgesia.

## 5. Source of Funding

None.

## 6. Conflict of Interest

None.

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