# The Analgesic Efficacy of Transversus Abdominis Plane (TAP) Block after Total Abdominal Hysterectomy: A Randomized Controlled Trial

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## Abstract

***Objective:*** To assess the effectiveness of surgical TAP block in providing post-operative analgesia in women undergoing total abdominal hysterectomy through supra pubic transverse incision under general anaesthesia

***Design:*** A randomized controlled study

***Setting:*** Professorial Unit, Colombo South Teaching Hospital, Kalubowila

***Population:*** A total of forty women scheduled to undergo total abdominal hysterectomy for benign conditions

***Methodology:*** Women were randomized and the intervention arm received TAP block. Both arms received standard analgesia. The pain was assessed by visual analogue pain score at specific time intervals.

***Main outcome measure:*** Requirement of pethidine for pain relief for 24 hours and assessment of post-operative pain using a visual analogue scale at specific intervals up to 24 hours

***Results:*** Compared to controls, in women who received TAP block, there was a statistically significant reduction in pain at 30 minutes (pain score 4.5+1.3 vs. 5.4+1.0, p=0.02), at 1h (4.4±1.0 vs. 5.2±0.7, p=0.01), at 2h (4.0±0.9 vs. 4.8±0.7, p=0.01), at 3h (3.6±0.8 vs. 4.3±0.7, p=0.01), at 6hrs (2.8±0.9 vs. 3.0±0.7, p=0.001), and at 12hrs (2.1±1.0 vs. 3.0±0.9, p=0.01). At 24hrs, there was no significant difference in pain reduction. (1.4±0.5 vs. 1.8±0.7, p=0.11). The cumulative morphine requirement was also significantly less in the TAP group at all the time points.

***Conclusion:*** The TAP block provided highly effective postoperative analgesia following total abdominal hysterectomy and the cumulative morphine requirement was also significantly less in the TAP group at all the time points. It should be considered as part of a multimodal approach to anaesthesia and enhanced recovery in patients undergoing abdominal surgery.


***Keywords:*** Abdominal hysterectomy, transversus abdominis plane block, local anaesthetic, postoperative analgesia, rescue analgesia.

## INTRODUCTION

Adequate postoperative pain relief modifies the surgical stress response, aids recovery and leads to a better outcome following surgery[1,2]. A significant component of pain following abdominal surgery is attributed to parietal pain inflicted by the surgical incision[3].

Local anaesthesia techniques, and particularly abdominal wall field blocks, have long been recognized as an effective analgesic strategy that may be used to counteract postoperative wound pain[4]. The transversus abdominis plane (TAP) local anaesthetic block is an analgesic technique that has become increasingly popular over the last decade and involves the infiltration of local anaesthetic in the plane between the internal oblique and transversus abdominis muscles[5]. The anterior abdominal wall (skin, muscles, parietal peritoneum) is innervated by the anterior rami of the lower[6] thoracic nerves (T7 to T12) and the first lumbar nerve (L1) and are the therapeutic target of local anaesthetic to provide analgesia for the abdominal surgical incision. Terminal branches of these somatic nerves course through the lateral abdominal wall within a plane between the internal oblique and transversus abdominis muscles (figure 1). This inter muscular plane is called the transversus abdominis plane (TAP).

TAP block is first described by Rafi[6] in 2001 as a landmark-based technique where the needle puncture is performed subcutaneously with a series of 'fascial clicks' within the ilio-lumbar triangle of Petit. Since then, a number of variations of delivering local anaesthetic into this anatomical plane have been described, including a 'subcostal block' used for upper abdominal operations which involves

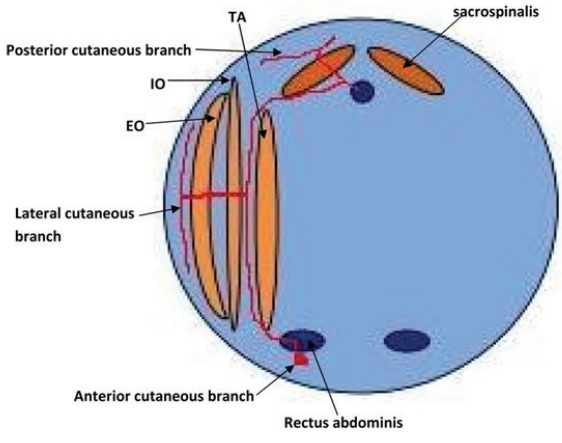


**Figure 1**

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subcutaneous needle puncture below the costal margin[7,8]. Additional adjuncts include catheters placed within the correct plane, which provide a longer-lasting infusion of local anaesthesia[9]. This blind technique is difficult in obese patients and carries potential risk of peritoneal puncture and possible visceral injury[10]. To minimize these complications this technique is later carried out under ultra sound guidance[11,12]. More recently, open 'surgically placed' TAP blocks have been described, with local anaesthetic infiltration under direct vision in the TAP through the incision at the time of surgery[13,15]. This has been shown to reduce all the possible complications described above[16].

The benefits of TAP block include the avoidance of neuraxial analgesic techniques and their associated risk, as well as a reduction in opioid consumption. As the side-effects of opioids are dose dependent, reducing postoperative opioid requirements could significantly reduce the incidence of opioid-related problems, such as sedation, nausea, vomiting, urinary retention, respiratory depression, delayed recovery of colonic mobility, and prolonged postoperative ileus[17, 18].

The primary outcome of this study is to assess whether there is a significant difference in opioid usage in the first 24 hours after abdominal hysterectomy with or without a TAP block. Secondary outcome include the assessment of the severity of pain in the two groups by utilizing visual analogue scales (VAS).

## METHODOLOGY

After approval from the institutional ethical committee and written informed consent was obtained from the patients, we studied 40 ASA physical status I-III patients aged 18-89 years scheduled for abdominal hysterectomy via supra pubic transverse incision. Patients were excluded if there was a history of relevant drug allergy, or they were receiving medical therapies considered to result in tolerance to opioids. Patients were randomized, by sealed envelopes, to undergo TAP block (n=22) or to receive standard care (n=18). Patients, the anaesthesiologists, and the staff providing postoperative care were blinded to group assignment. All patients received a standardized general anaesthetic. Standard monitoring, including electrocardiogram, arterial blood pressure, arterial oxygen saturation, and end-tidal carbon dioxide monitoring were used throughout, and patients were placed in the supine position. All patients also received pethidine 50-75 mg, rectal diclofenac 50-100 mg immediately before surgical incision. All patients randomized to undergo TAP block had the block performed either by the consultant, senior registrar or registrar and the technique was mastered by preliminary cadaveric studies.

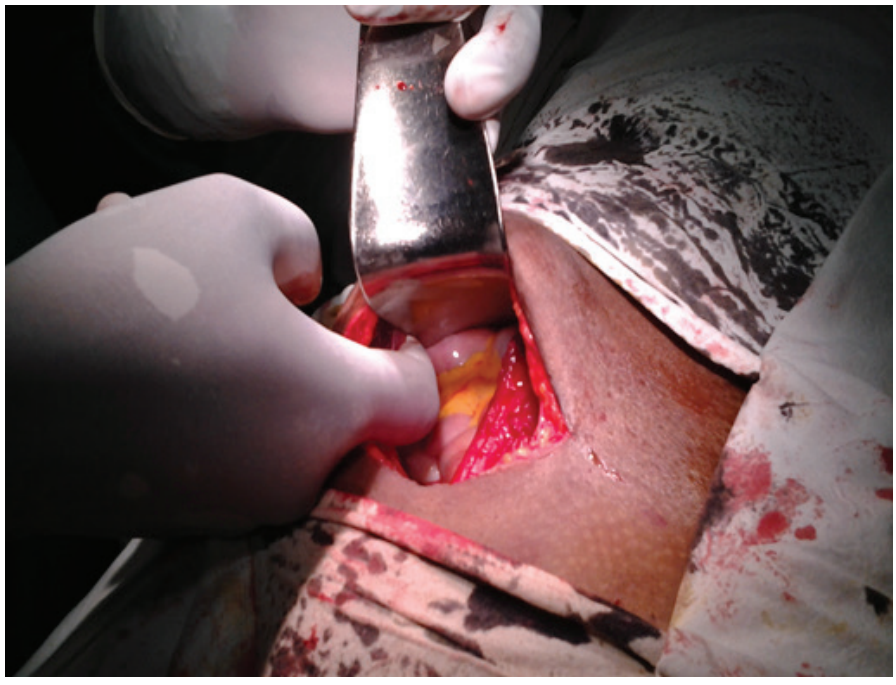

**Figure 2: Surgeon palpates the lateral border of the rectus muscle to locate the inferior epigastric vessels,**

Following the induction of general anaesthesia, in the study arm intra operative TAP block is performed after making the abdominal incision. Once the peritoneal cavity is opened into, the rectus muscle is gently elevated superiorly using a retractor and the surgeon palpates its lateral border (figure 2), indirectly locating the inferior epigastric vessels, which ascend between the rectus abdominis muscle and posterior lamella of its sheath. Care was taken to avoid any damage to these vessels.

The nerves that supply the abdominal wall travel the anterior abdominal wall through the neuro-fascial plane between internal oblique and transversus abdominis muscles. Safe access to this plane is achieved by inserting a blunted needle (Blunted needle 18G) through the parietal peritoneum and with further gentle advancement there is an appreciable loss of resistance ('one pop') and the correct plane is entered. After careful aspiration, to ensure no vascular injury has occurred, 20 ml 0.25% bupivacaine is injected slowly. (figure 3)

The surgeon will feel the expansion of this plane after significant volume is injected with very little resistance. As with the conventional method, the anaesthetist will monitor closely for signs of toxicity. The surgical TAP block is then performed on the opposite side using an identical technique after the surgeon, move to the other side of the operating table.

The surgeon is able to maintain clear vision of the site of injection throughout, thereby ensuring that there is no inadvertent damage to viscera. Following the TAP block the surgical procedure will be carried

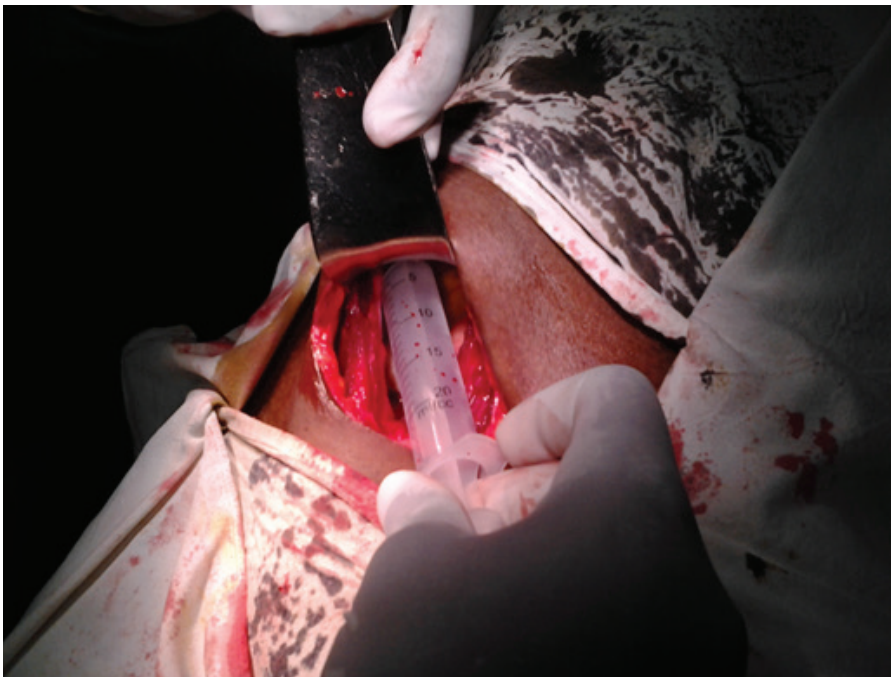

**Figure 3: After careful aspiration, to ensure no vascular injury has occurred, 20 ml 0.25% bupivacaine is injected slowly**

out in usual manner and rectus will be closed with vicryl and skin with monocryl sutures. The TAP block is performed at the beginning of the procedure since it takes 45 minutes for the onset of its action. In the non-intervention arm, no additional intervention is done apart from normal anaesthesia. Each woman was also given 100 mg diclofenac rectally and prescribed regular oral diclofenac (50 mg every 8 hours) and paracetamol (1 g every 6 hours) in line with our standard postoperative analgesic regimen. All women were prescribed intramuscular pethidine (75-100 mg) as required.

Data were collected by three medical officers who are blinded to the procedure using a pre tested questionnaire. Demographic data were collected at the time of recruitment of the study which includes age, parity, weight and height, whether previous surgery is being done and the indication and the duration of abdominal hysterectomy and any complications were recorded. Postoperative pain was assessed using a visual analogue scale (VAS) of 0 to 10 where 0 is no pain and 10 is the maximum pain. Pain score is assessed at 30 min, 1 hour, 3 hours, 6 hours, 12 hours and 24 hours and opioid requirement was assessed after 24 and 48 hours of surgery in women in both arms.

Sample size is calculated using following equation;

$n \geq ((2k\sigma^2)/d^2)$

n – Sample size in our group

k – 7.8 for 80% power and 0.05 for two sided significant level

σ – Standard deviation of variable of interest

d – Clinically worthwhile reduction expected

For the purpose of sample size calculation to determine the number of subjects in one group the variable considered is the 24 hour requirement of pethidine. If clinically important mean reduction in 24 hour pethidine was taken as 10 mg, was arrived after perusal of similar studies published. It is below 40 total and 20 in each arm. Statistical analyses were performed using a standard statistical programme (SPSS version 20.0, Chicago, IL). Demographic data were analysed using ANOVA test. Normally distributed data are presented as means ± of the mean and categorical data are presented as raw data and as frequencies. The α level for all analyses was set as $P < 0.05$.

## RESULTS

Forty patients were entered into the study. Twenty two were randomized to undergo TAP blockade with bupivacaine and 18 were randomized to receive standard care. All patients underwent abdominal hysterectomy through supra pubic transverse incision under general anaesthesia. Both groups were comparable in age, weight, height, duration of surgery and the size of the incision (Table 1). In all patients randomized to receive TAP block, the blocks were performed without complication.

Two groups were comparable with respect to demographic data, incision size and duration of surgery.

Patients undergoing TAP block had reduced 24 hour cumulative postoperative pethidine (7.5 mg + 23.1 and 37.5 mg + 51.6 in the TAP group and control group respectively p=0.02) consumption compared to the control group (Table 2).

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Postoperative VAS pain scores were reduced after TAP block at most, but not at all time points assessed (Table 3).

**Table 1: Demographic Data**

| Variables | TAP group | Control group | P value |
|---|---|---|---|
| Age (y) | 49.3±10.8 | 49.3±6.6 | p=0.27 |
| Weight (Kg) | 56.7±8.3 | 50.7±6.9 | p=0.33 |
| Height (m) | 2.4±0.2 | 2.3±0.1 | p=0.47 |
| Duration of surgery (min) | 50.5±4.0 | 50.3±3.8 | p=0.97 |
| Incision size (cm) | 7.3±1.8 | 7.9±0.5 | p=0.07 |

| Table 2: Postoperative Pethidine Requirement | | | | | |
|---|---|---|---|---|---|
| | TAP Block | | Control | | Significance (t-test, p-value) |
| | Mean | sd | Mean | sd | |
| Mean 24-hour pethidine requirement (mg) | 7.5 | 23.1 | 37.5 | 51.6 | t=2.37 , p=0.02* |
| Continuous variables are presented with mean. | | | | | |

| Table 3: Mean and Standard Deviation (Sd) of Visual Analogue Scale (VAS) scores by study group | | | | | |
|---|---|---|---|---|---|
| Time duration (t-test , p-value) | TAP Block | | Control | | Significance |
| | Mean | Sd | Mean | Sd | |
| 30 Min | 4.5 | 1.3 | 5.4 | 1.0 | t=2.27 , p=0.02* |
| 1h | 4.4 | 1.0 | 5.2 | 0.7 | t=2.75 , p=0.01* |
| 2h | 4.0 | 0.9 | 4.8 | 0.7 | t=3.15 , p=0.01* |
| 3h | 3.6 | 0.8 | 4.3 | 0.7 | t=3.00 , p=0.01* |
| 6h | 2.8 | 0.9 | 3.7 | 0.7 | t=3.51 , p=0.001** |
| 12h | 2.1 | 1.0 | 3.0 | 0.9 | t=2.72 , p=0.01* |
| 24h | 1.4 | 0.5 | 1.8 | 0.7 | t=1.65 , p=0.11 |
| Total | 2.4 | 0.79 | 3.2 | 0.42 | t=3.72 , p=0.001** |
| *Significant at 0.05 level **significant at 0.001 level | | | | | |

Categorical pain scores were reduced in patients who received TAP block at 30 minutes, 1, 2, 3, 6, 12 hours postoperatively when compared with the control group but at 24 hours there is no significant difference in the pain score (Figure 3 and Figure 4).

Mean postoperative visual analogue scale (VAS) pain scores at rest in each group over the first 24 postoperative hours, indicates significantly (P _ 0.05, t-test after ANOVA) higher VAS score when compared with the transversus abdominis plane (TAP) block group.

## DISCUSSION

The benefits of adequate postoperative analgesia are clear, and include a reduction in the postoperative stress response[19], reduction in postoperative morbidity19and in certain types of surgery, improved surgical outcome 1. Effective pain control also facilitates rehabilitation and

accelerates recovery from surgery [19,20]. Other benefits of effective regional analgesic techniques include reduced pain intensity, decreased incidence of side effects from analgesics, and improved patient comfort[20].

This randomized, double-blind, controlled trial demonstrates that TAP block provides effective analgesia, when used as part of a multimodal analgesic regimen, in patients undergoing TAH. The TAP block reduced postoperative pethidine consumption and improved pain scores. The current regimen for the provision of postoperative analgesia after TAH at our institution consists of pethidine in combination with regular non-steroidal analgesics and acetaminophen.

Patients generally require pethidine for up to 48 h, after which they are converted to oral analgesic drugs. Although pethidine provides satisfactory analgesia in patients after TAH, it is associated with adverse effects, such as sedation[21] nausea, and vomiting[22,23].

The effectiveness of the TAP block in reducing postoperative pain and reducing pethidine consumption after TAH via a transverse lower abdominal incision is first demonstrated by J. Carney et al[24]. This was carried out via the abdominal wall before the surgical incision and the needle is inserted through the triangle, using the loss-of-resistance technique. Inadvertent peritoneal puncture is a complication of this procedure and an ultrasound guided insertion of the needle will facilitate the identification of the needle tip and therefore reduce this risk particularly in obese patients[25].

A surgical TAP block, much simpler and theoretically superior to conventional TAP technique has been described during caesarean section. TAP block by employing an intra-abdominal approach; asepsis is more easily attained, visible and tactile confirmation of correct placement may be achieved with no risk of damage to viscera and avoidance of the inferior epigastric vessels is ensured[12].

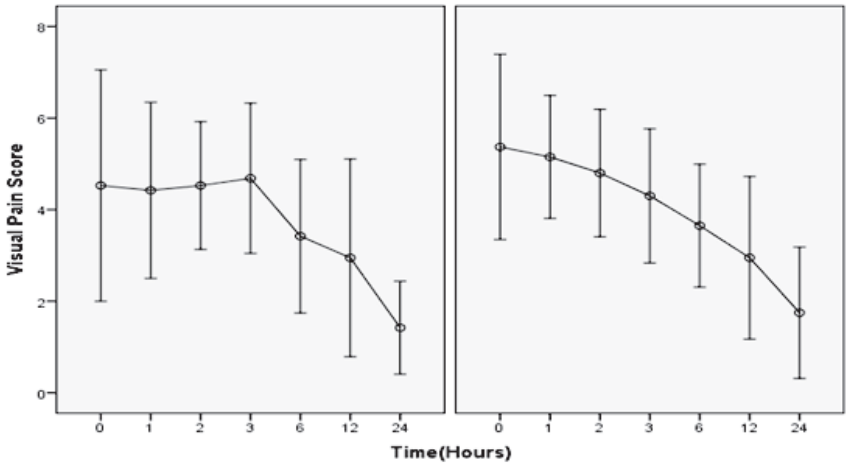


**Figure 3: Mean Visual Pain Score (VPS) at rest in each group over the first 24 postoperative hours. *Indicates significance (P<0.05, t-test is used VPS score when compared with the transversus abdominis plane (TAP) block group**

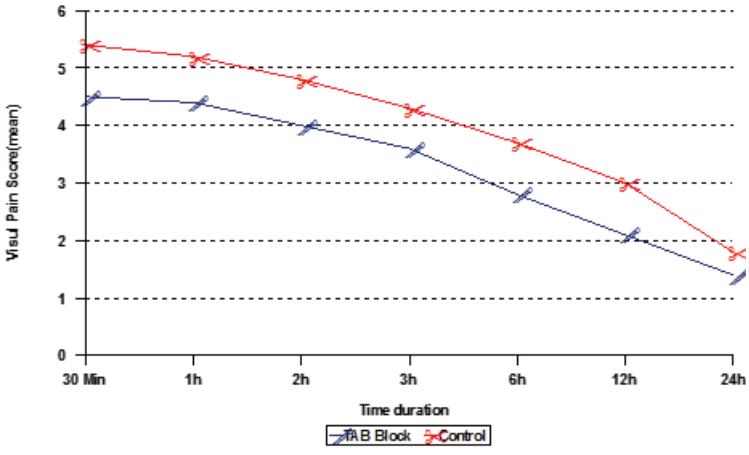


**Figure 4: Mean distribution of Visual Pain Score by time period**

Reduction of 24 hour pethidine requirement in our study demonstrates that a single-shot TAP technique can produce effective analgesia. The reasons for the prolonged duration of analgesic effect after TAP block are not entirely elucidated. However, this may relate to the fact that the TAP is relatively poorly vascularised, and therefore drug clearance may be slowed[3].

Most reports limit the use of this technique to lower abdominal surgery, with a success rate of approximately 85% in experienced hands[26-28]. It provides analgesia for skin muscles and parietal peritoneum of the anterior abdominal wall, but pain in pelvic and abdominal visceral sites is not covered.

## CONCLUSION

We conclude that the TAP block holds considerable promise as part of a multimodal analgesic regimen after TAH. This easily performed technique, provided reliable and effective analgesia in this study, and no complications due to the TAP block were detected. It should be used more often in everyday practice. ■

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