**Conventional transversus abdominis plane block versus ultrasound Guided transversus abdominis plane block on Postoperative Analgesia: A Randomized Trial**

**Abstract**

**BACKGROUND:** The transversus abdominis plane (TAP) block is an effective method of providing postoperative analgesia in patients undergoing midline abdominal wall incisions. We evaluated its analgesic efficacy over the first 24 postoperative hours after cesarean delivery and total abdominal hysterectomy performed through a Pfannensteil incision, in a randomized, double-blind, clinical trial.

**METHODS:** sixty women undergoing elective cesarean delivery and total abdominal hysterectomy were randomized to undergo TAP block with conventional (landmark) tecknique (*n* = 30) versus ultrasound guided technique (*n* = 30), in addition to standard postoperative analgesia comprising on demand IV morphine analgesia and regular diclofenac and acetaminophen. All patients received a standard general anesthesia, and at the end of surgery, a bilateral TAP block was performed using 20 ml bupivacaine 0.25% by the conventional technique or ultrasound guided technique on each side. Each patient was assessed for morphine consumption, visual analogue pain score (VAS) at rest and on movement, vital signs and presence of complications (nausea, vomiting, sedation and pruritus) postoperatively by a blinded investigator: in the postanesthesia care unit (PACU) and at 2, 4, 8, 12 and 24 h postoperatively.

**RESULTS:** The TAP block with ultrasound guided technique compared with conventional technique reduced postoperative mean (±sd) total morphine requirements in the first 24 postoperative hours (30 ± 13 vs. 22 ± 4 mg, *P* < 0.005). There were no complications attributable to the TAP block.

**CONCLUSIONS:** The TAP block performed by the ultrasound guided technique provided superior analgesia when compared with TAP block performed by the conventional technique up to 24 postoperative hours after elective cesarean delivery and total abdominal hysterectomy.

**Keywords**: TAP block, Ultrasound guided,postoperative analgesia.

**Introduction:**

Cesarean delivery and total abdominal hysterectomy are major surgical procedures, after which substantial postoperative discomfort and pain can be anticipated.[**1**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P44)

The provision of effective postoperative analgesia is of key importance to facilitate early ambulation, infant care, (including breast feeding, maternal-infant bonding) and prevention of postoperative morbidity.[**1**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P44)These patients require a multimodal postoperative pain treatment regimen that provides high quality analgesia with minimal side effects. Opioids, such as morphine, remain the mainstay of postoperative analgesic regimens for patients post- abdominal surgery. However, the use of opioids can result in significant adverse effects, including sedation, nausea, and vomiting.[**1–3**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/12000/The_Transversus_Abdominis_Plane_Block_Provides.46.aspx#P42) An important component of the pain experienced by patients after abdominal surgery derives from the abdominal wall incision. The lateral abdominal wall consists of three muscle layers, the external oblique, the internal oblique and the transversus abdominis, and their fascial sheaths. The central abdominal wall also includes the rectus abdominis muscles and its fascial sheath. The nerves that supply the anterior abdominal wall course through the neurofascial plane between the internal oblique and the transversus abdominis muscles.[**2**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P45) TAP block was performed either by the conventional method where loss of resistance technique was used after palpation of the triangle of petit as an access point to this neurofascial plane.[**3**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P46)

Or by the ultrasound-guided technique where in-plane technique using broad linear array probe with an imaging depth of 4-6 cm was performed. By introducing local anesthetics into the transversus abdominis plane (TAP), 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.[**4**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P47)

The purpose of this study was to compare the TAP block using the conventional technique versus ultrasound-guided technique for postoperative analgesia in patients undergoing elective cesarean delivery and total abdominal hystererctomy via a Pfannenstiel abdominal wall incision.

**METHODS:**

After obtaining approval by the Benha university Hospital Ethics Committee, and written informed consent from the patient, we studied 60 ASA physical status I–III patients scheduled for cesarean delivery or total abdominal hysterectomy via a Pfannenstiel incision, in a randomized, double-blind, clinical trial. Patients were excluded if there was a history of relevant drug allergy.Patients were randomly allocated into two equal groups undergo conventional TAP block (cTAP group)) (*n* = 30) or ultrasound-guided TAP block (uTAP group) (n = 30) with 20 ml bupivacaine 0.25% per side. Randomization was done by online randomization program which used to generate random number list. Patient randomization numbers were concealed in opaque envelops which were opened by the study investigator. The patients, their anesthesiologists, and staff providing postoperative care were blinded to group assignment. All patients received a standard general anesthesia consisting of fentanyl 1-2 mcg/kg and propofol 1–3 mg/kg followed by rocuronium 0.6 mg/kg to facilitate endotracheal intubation. Fentanyl dose was hold for patients underwent Cesarean delivery until clamping the umbilical cord. Anesthesia was maintained with isoflurane 1.2% and rocuronium 0.15 mg/kg as a maintenance dose every 30 minutes till the end of the procedure.

At the end of the operation, bilateral transversus abdominis plane (TAP) block with Bupivacaine was placed right before tracheal extubation either by conventional or ultrasound guided technique according to the patient group.In cTAP groupLoss of resistance technique was used, the landmark for palpation is the triangle of petit which lies above the pelvic rim in the midaxillary line. The inferior border of the triangle is formed by 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. The puncture site is just above the iliac crest and just posterior to the midaxillary line within the triangle of petit. After skin disinfection A 24G blunt tipped 50 mm needle was attached with flexible tubing to a syringe filled with the study solution is inserted perpendicular to the skin, and a give or "pop" is felt when the needle passes through the fascial extensions of the internal oblique muscle. The needle tip is therefore between the fascial layers of the external and internal oblique. Further gentle advancement with a second "pop" indicates that the needle has advanced into the fascial plane above transversus abdominis and the needle tip is therefore between the fascial layers of the internal oblique and transversus abdominis muscles. In uTAP group A broad linear array probe is used, with an imaging depth of 4-6 cm. After skin disinfection and protection of the ultrasound probe and cable with a sterile ultrasound probe cover, the ultrasound probe is placed transverse to the abdomen (horizontal plane) in the midaxillary line between the costal margin and the iliac crest. Three muscle layers are clearly seen in the image. A 20 G 120 mm sharp ended spinal needle is used. The needle is inserted in a sagital plane approximately 3-4 cm. medial to the ultrasound probe (in-plane technique). The probe is moved slightly anterior to image the skin puncture and superficial course, then gradually posteriorly to the midaxillary line position, following the needle to the correct position in the transversus abdominis plane. A small volume of local anesthetic (1ml) will be injected to open the plane If the 1ml dose appears to be within muscle rather than between them, needle adjustment is required. The local anesthetic injectate appears hypoechoic on ultrasound imaging. When the needle tip is positioned correctly the injectate will be seen on ultrasound to spread out in the plane between the two muscles. In both groups 20ml of 0.25% bupivacaine was injected on each side.

After completion of the surgical procedure and block, postoperative analgesia was provided byIV acetaminophen 1 gm and ketorolac 30 mg, then regular oral acetaminophen 1 g four times a day and ketorolac 10 mg three times a day were continued for 24 h after the procedure. If Visual analogue pain score exceed 4, rescue analgesia in the form of intravenous morphine based on morphine titration protocol, 3 mg as a bolus dose which could be repeated every 5 minutes with a maximum dose 40 mg/4 hours.The criteria to stop morphine titration protocol were satisfactory pain control, Patient became sedated (Ramsay sedation scale > 2), Respiratory rate < 12 / min, Oxygen saturation < 95% or development of serious adverse effects (allergy, severe vomiting, hypotension).

Morphine consumption and the presence and severity of pain, nausea, vomiting, sedation and pruritus were assessed systematically by an investigator. These assessments were performed in the PACU and at 2, 4, 8, 12, and 24 h after TAP blockade. All patients were asked to give scores for their pain at rest and on movement (knee flexion) and for the degree of nausea at each time point. Pain severity was measured using visual analog scale (VAS, 10 cm unmarked line in which 0 cm = no pain and 10 cm = worst pain imaginable). Nausea was measured using a categorical scoring system (none = 0; mild = 1; moderate = 2; severe = 3). Nausea was defined as a nausea score >0 at any postoperative time point. Sedation scores were assigned by the investigator using a Ramsay sedation scale(If Awake; *Ramsey 1:* Anxious, agitated, restless, *Ramsey2:* Cooperative, oriented, tranquil, *Ramsey 3:* Responsive to commands only. If Asleep; *Ramsey 4:* Brisk response to light glabellar tap or loud auditory stimulus, *Ramsey 5*: Sluggish response to light glabellar tap or loud auditory stimulus) the presence of sedation was defined as a sedation scale > 2 at any postoperative time point. Rescue antiemetics were offered to any patient who complained of nausea or vomiting. The study ended 24 h after TAP blockade.

The primary outcome measure in this study was 24 h morphine consumption. Secondary outcome measures included VAS scores, and side effects associated with morphine consumption.

Statistical analyses were performed using a standard statistical program (SPSS version 16). Quantitative data was presented as mean ± Standard deviation, Qualitative data was presented as numbers and percentages, Quantitative data was analyzed by using unpaired student t-test, Quantitative data in the same group was analysed by using repeated measure ANOVA test, Qualitative data was analyzed by using Chi-square test and Z test, P – Value < 0.05 was considered statistically significant, P – Value < 0.01 was considered statistically highly significant.

**RESULTS:**

Sixty patients were entered into the study. 30 were randomized to undergo TAP blockade with conventional technique, and 30 were randomized to undergo TAP blockade with ultrasound-guided technique.

Groups were comparable in terms of age, weight, height and type of surgery ([Table 1](javascript:void(0);)). TAP block was performed either by conventional or ultrasound-guided technique according to the patient group, and the block performed without complication.

**Table 1**

*Patient Characteristics*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | | **Group I (cTAP)**  **(n=30)** | **Group II (uTAP)**  **(n=30)** |
| **Age(years)** | | | 37.46± 13.29 | 35.73 ± 14.21 |
| **Weight(Kg)** | | | 72.13 ± 11.07 | 73 ± 10.37 |
| **Height(Cm)** | | | 160.4± 5.66 | 159.93 ± 6.12 |
| **ASA Status** | | **I** | 6 | 4 |
| **II** | 21 | 24 |
| **III** | 3 | 2 |
| **type of surgery** | **caesarean section** | | 17 | 16 |
| **total abdominal hysterectomy** | | 13 | 14 |

*Results are expressed as means ± sd or numbers of patients. There were no significant differences between groups. uTAP: ultrasound-guided transversus abdominis plane, cTAP: conventional transversus abdominis plane, ASA: American Society of Anesthesiologists*.

Patients undergoing ultrasound-guided TAP block had reduced 24 h morphine requirements compared with patients undergoing conventional TAP block ([Table](javascript:void(0);) 2). The ultrasound-guided TAP block reduced interval postoperative morphine consumption compared with conventional TAP block at 2, 4, 8, 12, and 24 h postoperative but not at the post anesthesia care unit (Figure 1). Postoperative VAS pain scores at rest and on movement (knee flexion) were lower but not significantly reduced after ultrasound-guided TAP block compared with conventional TAP block at all, time points assessed (Figure 2)(Figure 3).

**Table 2**

*24 hours morphine consumption*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Group I (cTAP)** | **Group II (uTAP)** | **Test of significance** | **P Value** |
| **Total 24 hours morphine consumption (mg)** | 33.1±14.45 | 22.8±9.1 | t= 3.3037 | p= 0.0016 |

*Data was presents as mean ± sd. There was significant difference between groups. uTAP: ultrasound-guided transversus abdominis plane, cTAP: conventional transversus abdominis plane.*

**Figure 1**

*Comparison between both groups as regards interval morphine consumption*

*Group I: conventional transversus abdominis plane, Group II: ultrasound-guided transversus abdominis plane, PACU: post anesthesia care unit.*

**Figure 2**

*Comparison between both groups as regards VAS at rest*

*Group I: conventional transversus abdominis plane, Group II: ultrasound-guided transversus abdominis plane, VAS: visual analogue scale.*

**Figure 3**

*Comparison between both groups as regards VAS on movement*

*Group I: conventional transversus abdominis plane, Group II: ultrasound-guided transversus abdominis plane, VAS: visual analogue scale.*

The ultrasound-guided TAP block non-significant reduced; nausea 5 patients (16%), vomiting no patient (0%), pruritus no patient (0%) and sedation 2 patients (6%) as compared to conventional TAP block group; nausea 9 patients (30%), vomiting 3 patients (10%), pruritus 1 patient (3%) and sedation 7 patients (23%)**.**

**DISCUSSION**

Cesarean delivery and total abdominal hysterectomy are major surgical procedures, after which substantial postoperative discomfort and pain can be anticipated.[**1**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P44) The analgesic regimen should provide safe, effective analgesia, with minimal side effects.

A multimodal analgesic regimen is most likely to achieve these goals. However, the optimal components of this regimen continue to evolve. Although single-shot neuraxial analgesic techniques using long-acting opioids, or patient-controlled epidural opioid administration, produce effective analgesia, they are associated with a frequent incidence of side effects, particularly nausea, vomiting, and pruritus, which reduce overall patient satisfaction.[**1**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P44) In addition, there is a risk of delayed maternal respiratory depression due to rostral spread of hydrophilic opioids such as morphine.[**5**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P50) Furthermore, it is not always possible to provide neuraxial opioid analgesia due to logistic issues and/or the presence of medical contraindications.[**6, 7**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P51) Although IV morphine has a potent analgesic effect, the analgesia produced is often incomplete, and opioid-mediated side effects remain common.[**1**](http://journals.lww.com/anesthesia-analgesia/Fulltext/2008/01000/The_Analgesic_Efficacy_of_Transversus_Abdominis.35.aspx#P44) Given these issues, there is considerable potential for a regional technique such as TAP blockade to comprise an effective component of a multimodal regimen after abdominal surgeries.

Our study demonstrates that the ultrasound-guided TAP block reduced overall postoperative morphine requirements as compared with conventional TAP blockade in the first 24 postoperative hours morphine-sparing effect of the ultrasound guided TAP block. Morphine sparing effect of the ultrasound guided TAP block indicates a higher failure rate with the conventional TAP block technique. The incidence of sedation, nausea, vomiting, and pruritus was reduced in the ultrasound guided TAP block group, a finding consistent with a morphine-sparing effect of the ultrasound guided TAP block.

This study in line with many other studies which concluded that TAP block can reduce postoperative 24 hour morphine consumption.9, 10 Also this study goes with McDermott et al. study who concluded that the needle and local anesthetic placement using the standard landmark-based approach to the TAP block is inaccurate, and the incidence of peritoneal placement is unacceptably high.11

There are a number of limitations to this study. First, the study limited assessment of postoperative analgesia to the first 24 postoperative hours. However, other studies demonstrated that TAP block may result in effective pain control up to 48 hours.8 Second, there are difficulties in adequately blinding these types of studies, given that the TAP block produces loss of sensation of the abdominal wall. Although patients and the investigator conducting the postoperative assessments were technically blinded to group allocation, true blinding may not have been possible. Third, there was no control group to assess the efficacy of the TAP block in reducing morphine consumption in the control group. There is a risk of inadvertent peritoneal puncture with conventional block technique. Although the incidence is not known, if the conventional block is performed as described, the risk of peritoneal puncture is likely to be low and this risk can be avoided by the use of ultrasound technique to confirm needle position. A further limitation is that we did not assess the success rate of the block or the extent of abdominal wall sensory blockade. This was done to preserve blinding of the assessor. Future studies to determine the success rate of the block, particularly when performed by less experienced users, are required

We conclude that the ultrasound-guided TAP block as part of a multimodal analgesic regimen for post abdominal incision analgesia is effective and potentially more safe than conventional TAP block.

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