The use of ultrasound-guided transversus abdominis plane blocks for total abdominal hysterectomy: a double-blind, controlled trial

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Abstract

Objectives: This study investigated the postoperative analgesic efficacy of bilateral ultrasound-guided transversus abdominis plane (TAP) blocks, in patients undergoing total abdominal hysterectomy.

Design, setting and subjects: This was a prospective, randomised, double-blind, controlled study. Thirty patients were allocated to two groups; a TAP block group (n = 15) and a placebo group (n = 15). The TAP blocks were performed with 0.25% bupivacaine. The placebo group received sham blocks with normal saline, post induction of anaesthesia. Postoperatively, patients received patient-controlled intravenous morphine for analgesia.

Outcome measures: The primary outcome was morphine consumption during the first 24 hours postoperatively. Secondary outcomes were adequacy of pain relief, as assessed by pain scores at 0, 6 and 24 hours postoperatively, and side-effects.

Results: Our study showed a significant between-group difference in morphine requirements (5.2 ± 3.9 vs. 9.7 ± 4.3 mg, p = 0.007, and 12.9 ± 8.9 mg vs. 25 ± 12.1 mg, p = 0.006) for the TAP group, compared with the placebo group at six and 24 hours, respectively. There were no significant between-group differences in pain scores. There were no complications with any of the blocks.

Conclusion: Bilateral ultrasound-guided TAP blocks significantly reduced postoperative morphine consumption in a multimodal postoperative analgesia regimen for abdominal hysterectomy.

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Introduction

Patients who undergo a total abdominal hysterectomy experience a significant amount of pain postoperatively. Several multimodal pain regimes have been used in the past. Usually, neuraxial anaesthesia is not a feasible option in these cases because of the risks involved and limited resources in terms of postoperative high care beds. Effective analgesia includes both improved comfort and decreased opioid side-effects, which should permit earlier mobilisation.

A number of studies have investigated transversus abdominis plane (TAP) blocks after various abdominal surgical procedures, and data suggest that they cause a significant improvement in pain scores, as well as a reduction in postoperative morphine requirements.[1] Most of these studies were carried out with the landmark or blind "pop" technique via the so-called "triangle of Petit".[2] The TAP block is generally safe, but there are potential complications, particularly when using the blind technique. Risks include bleeding, perforation of abdominal organs, or a failed block due to injecting the local anaesthetic in the wrong anatomical site. An ultrasound-guided technique has been described as making the block safer and more reliable.[3]

In view of the paucity of available data on the efficacy of the TAP block post elective abdominal hysterectomy, we undertook a randomised double-blind controlled trial of patients receiving either Pfannenstiel or midline abdominal incisions. We employed patient-controlled intravenous morphine postoperatively, and examined the efficacy of TAP blocks in the reduction of postoperative morphine

requirements. In addition, pain scores were measured and compared, in order to assess whether or not adequate and equivalent pain relief was achieved in each group.

Method

After approval from the University of Cape Town Human Research Ethics Committee (491/2011), the trial was registered with the South African National Clinical Trial Register (DOH-27-0212-3945) and the South African National Human Research Ethics Council. Data are presented in accordance with the Consolidated Standards of Reporting Trials statement.

We recruited 30 patients who were scheduled for elective total abdominal hysterectomy for benign disease, via Pfannenstiel or midline abdominal incision under general anaesthesia. Patients aged 20-65 with an American Society of Anesthesiologists score of I-III were included in a prospective, randomised double-blind controlled trial after obtaining written informed consent on the day before the operation. Patients were excluded if they were allergic to either of the study medications (morphine or bupivacaine), had a history of opioid addiction, coagulation disorders, required surgery for malignant disease, or were unable to give informed consent. During the preoperative visit, patients received instructions on the function of their patient-controlled analgesia (PCA) pump. In addition, the use of the visual analogue pain score was explained. The universal pain assessment tool was used. Recruitment and explanations were performed by the same investigator in all cases. The patients were randomised to two groups of 15. Allocation was determined by envelopes that had been sealed and shuffled. If a patient did not proceed to total abdominal hysterectomy, the same envelope was resealed and used for the next recruited patient. The investigators remained blinded to its contents.

After establishment of intravenous access in the operating theatre, routine monitoring was applied, and patients received a standard general anaesthetic. The TAP block group then received bilateral blocks with 20 ml 0.25% bupivacaine on each side. The placebo group received bilateral sham injections with 20 ml normal saline. The principal investigator who recruited and evaluated the patients postoperatively, the study coordinator, as well as the patients, were blinded to the group allocations. The study drug was drawn up by an anaesthesiologist who was not involved in the study. The blocks were performed by a single anaesthetic consultant, experienced in ultrasound-guided blocks. An aseptic technique was used with an anterolateral approach to identify the external oblique, internal oblique and transversus abdominis muscles, and thus the TAP. A SonoSite S-Nerve® ultrasound machine with a linear array transducer probe was used (SonoSite, Bothell, USA). The probe was placed superior to the iliac crest. A Vygon Echoplex® needle was inserted and advanced (Viking Medical & Surgical, Modderfontein, South Africa). The needle and tip were identified with an in-plane technique until it reached the TAP, between the transversus abdominis and the internal oblique muscles. After negative aspiration, 1-2 ml sterile water was injected to confirm the plane with hydrodissection. The study drug was then slowly injected under real-time ultrasound imaging, while observing the spread of the study drug. The same process was repeated on the opposite side, after which the patient was prepared for surgery and the operation commenced.

The conduct of the general anaesthetic was at the discretion of the attending anaesthesiologist. Intraoperative opioid and antiemetic use were not part of our study protocol. Patients received up to 0.1 mg/kg of morphine and 1-2 µg/kg of fentanyl. A standard postoperative multimodal analgesia regimen was prescribed. Patients received oral paracetamol 1 g six hourly, indomethacin 100 mg 12 hourly per rectum, and an antiemetic (prochlorperazine 12.5 mg intramuscularly) as needed. Each patient received morphine via a PCA pump. A Vygon® Freedom 5 disposable PCA device (Viking Medical & Surgical) was used with morphine 1 mg/ml and droperidol 0.1 mg/ml boluses with a seven-minute lockout time. The bolus consisted of 1 ml, and no background infusion was used. The PCA pump was connected to a dedicated intravenous line.

Patients were taken to the recovery room after the operation, where the baseline assessment was performed. Thereafter, they were discharged to the gynaecology ward, where they were assessed by the same investigator at six and 24 hours postoperatively. The primary outcome variable was morphine requirements at six and 24 hours. Morphine requirements were assessed by inspecting the PCA pumps. As a secondary outcome, a visual analogue scale was used to assess pain at rest, as well as with a standardised movement (hip flexion). Further secondary outcomes (nausea, vomiting and pruritis) were assessed by direct questioning to ascertain the presence or absence of the symptom. Lastly, a note was made with every assessment as to whether or not the patients received the pain regimen as prescribed in the ward. Assessments were carried out by the primary investigator, who was blinded to group allocation.

The null hypothesis was that ultrasound-guided TAP blocks do not provide enhanced postoperative pain relief in elective total abdominal hysterectomy patients when used as part of a multimodal analgesia regimen. A power calculation with an α value of 0.05 and a β value of 0.9, based on morphine consumption of 30 mg in the control group, and 15 mg in the trial group (a 50% reduction), with a standard deviation of 12 mg, would require a sample size of 15 patients per

group. Therefore, the study sample size of 15 patients per group was adequately powered to answer the question. Statistical analyses were performed using Statistica® version 10. Continuous data (postoperative morphine consumption) were analysed using Student's t-test after confirming normalcy of distribution. Pain scores were evaluated using the Mann-Whitney U test. The descriptive statistics were reported as mean and standard deviation. A p-value < 0.05 was considered to be statistically significant.

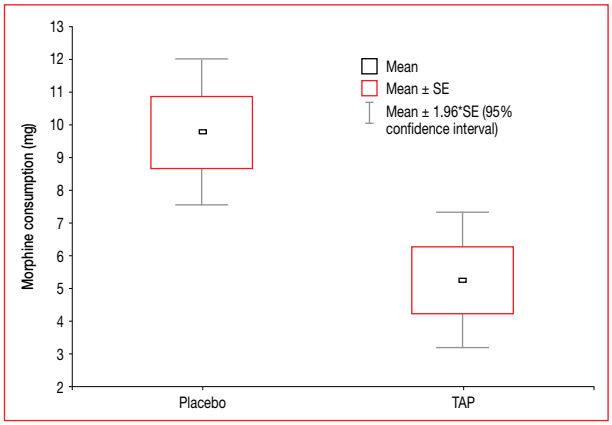
Results

Thirty patients were randomly allocated to two groups of 15. There was one reallocation of a patient in whom the hysterectomy was cancelled for surgical reasons after randomisation and induction of anaesthesia. One patient in the TAP block group was excluded from the study after the six-hour postoperative observation because she had intra-abdominal bleeding that required surgical re-exploration. This was unrelated to the TAP block. Another patient in the TAP block group had to be excluded from the 24-hour observation, because the morphine PCA pump was accidentally removed during the night. A protocol violation occurred with one of the patients in the placebo group, in that the analgesia regime was altered, and the patient received additional intravenous paracetamol postoperatively. Thus, the final analysis included 14 patients in the TAP block group for the six-hour analysis and 13 patients for the 24-hour analysis. The placebo group consisted of 15 patients for all of the postoperative analyses. The demographics of the two groups were similar. The patients' age, height, weight, body mass index and surgical incision were compared. There were no significant between-group differences (Table I). There was a significant between-group difference in morphine requirements at both measurement times (Table II, and Figures 1 and 2). There were no significant between-group differences in pain scores at rest or during movement (Table III). There were no complications with any block.

Table I: Patient demographic data

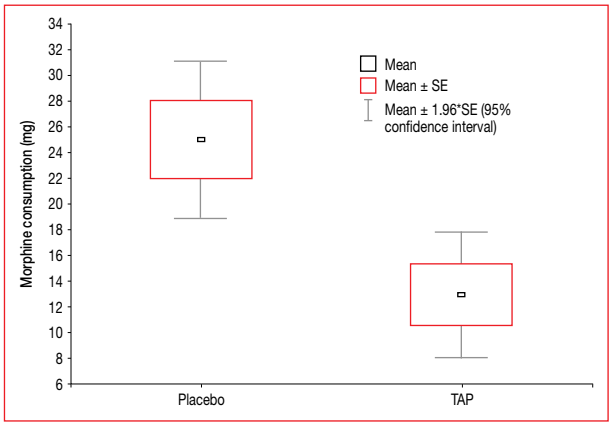
Demographic data	Mean (SD) (placebo)	Mean (SD) (TAP)
Age (years)	48 (6.7)	46.6 (4.7)
Height (m)	1.63 (0.06)	1.62 (0.04)
Weight (kg)	74.4 (17.8)	65.8 (12.4)
Body mass index (kg/m^2)	27.9 (6.6)	25.0(5.3)

SD: standard deviation, TAP: transversus abdominis plane



SE: standard error, TAP: transversus abdominis plane

Figure 1: Box-and-whisker plot of postoperative morphine consumption at six hours



SE: standard error, TAP: transversus abdominis plane

Figure 2: Box-and-whisker plot of postoperative morphine consumption at 24 hours

Four patients (two in the placebo group and two in the TAP block group) complained of nausea, but none of them required rescue antiemetics. Three of these patients complained of nausea in the recovery room, directly after their operation. None of the patients complained about pruritus on direct questioning.

Discussion

We conducted a prospective randomised, double-blind, controlled trial to evaluate whether or not bilateral ultrasound-guided TAP blocks decrease morphine requirements and improve postoperative pain in patients undergoing elective total abdominal hysterectomy for benign disease. Our study showed that ultrasound-guided TAP blocks significantly reduced postoperative morphine requirements compared

Table II: Postoperative morphine consumption

Morphine consumption	Mean (placebo)	Mean (TAP)	p-value	SD (placebo)	SD (TAP)
Morphine consumption at 6 hours (mg)	9.7	5.2	0.007	4.3	3.9
Morphine consumption at 24 hours (mg)	25.0	12.9	0.006	12.1	8.9

SD: standard deviation, TAP: transversus abdominis plane

Table III: Pain scores

Pain	Mean (placebo)	Mean (TAP)	p-value
Pain at rest (0 hours postoperatively)	4.2	4.3	0.87
Pain during movement (0 hours postoperatively)	4.6	4.9	0.75
Pain at rest (6 hours postoperatively)	2.4	2.3	0.87
Pain during movement (6 hours postoperatively)	2.8	2.8	0.98
Pain at rest (24 hours postoperatively)	1.4	1.1	0.61
Pain during movement (24 hours postoperatively)	2	1.4	0.18

TAP: transversus abdominis plane

with placebo, to a clinically relevant degree. There were no significant between-group differences in pain scores because of the effective use of patient-controlled intravenous analgesia. There was a low incidence of nausea, but the study was not powered to detect differences in side-effects. There were no complications in relation to the TAP block.

The TAP block via the so-called "triangle of Petit" was described by Rafi[2] in 2001. It provides enhanced pain control by blocking the peripheral nerves that provide sensory supply to the anterior abdominal wall from level T9-L1. The nerves pass through the TAP in the fascial sheath between the internal oblique and transversus abdominis muscles in the lateral aspect of the abdominal wall between the costal margin and the iliac crest. By identifying this plane with ultrasound, the needle tip can be seen, and the real-time spread of local anaesthetic confirmed. TAP blocks have been studied in a number of contexts, including limited data post total abdominal hysterectomy.[1] These studies have demonstrated a marked reduction in morphine requirements when a TAP block is included in the analgesia regimen.

Limited research has been published on TAP blocks in abdominal hysterectomy for benign disease. Carney et al[4] used 0.75% ropivacaine with a blind "pop" technique. They showed a reduction in postoperative pain scores, as well as the mean total morphine requirement in the first 48 hours postoperatively. Atim et al[5] performed a prospective, double-blind randomised controlled trial in which they evaluated the efficacy of bilateral ultrasound-guided TAP blocks for total abdominal hysterectomy, compared with subcutaneous bupivacaine infiltration. They found that both groups had decreased pain scores compared to a control group, but the lowest scores were found in the TAP block group at six and 24 hours. Postoperative tramadol consumption was compared between the groups. The TAP block group also required less tramadol than the infiltration and control groups. However, both the infiltration and TAP block group required rescue analgesia. It was concluded that ultrasound-guided TAP blocks are superior to skin and subcutaneous bupivacaine infiltration. In the latter study, only Pfannenstiel incisions were performed.

Another study was recently published by Gasanova et al[6] on the same subject. They compared pain scores, opioid consumption and the occurrence of opioid-related side-effects in three groups of patients undergoing total abdominal hysterectomy. This was not a double-blind, randomised controlled trial. The first group received a TAP block and ketorolac. The second group received a TAP block only, and the last group, only ketorolac. Patients received intravenous PCA morphine for 24 hours. They concluded that the combination of a TAP block with a multimodal analgesia regime provided less variability in the dynamic pain scores than either treatment alone. However, opioid consumption and the occurrence of opioid-related side-effects were similar in all of the groups.

Therefore, our study is one of a few randomised, double-blind controlled studies that have employed ultrasound-guided TAP blocks for post-hysterectomy pain relief. It differs from previous trials in that patients with midline and Pfannenstiel incisions were included, sham blocks were used, and postoperative morphine consumption studied as part of a multimodal analgesic regimen.

The surgeons were experienced consultants, either performing the surgery themselves or supervising senior registrars. Three consultants were involved in total. The duration of surgery was similar between the groups. By chance, there were more patients with midline incisions in the TAP block group than the sham block group (8/14 versus 2/15). A recent publication suggests that there is no difference in the analgesic requirements for the two types of incisions.[7]

It is clear that ultrasound-guided TAP blocks are safer and more reliable than the standard landmark technique. McDermott et al[8] had to terminate their study early owing to incorrect needle tip placement and intraperitoneal injection in 76% of their cases where TAP blocks were performed with the double "pop" technique. In 2009, Belavy et al[9] improved on the classic landmark technique by carrying out the blocks for Caesarean section, with ultrasound guidance. They found that TAP blocks were associated with a 40% reduction in morphine requirements. A recent editorial called for the use of ultrasound guidance as the

standard of care for TAP blocks during Caesarean section.[10] Basem et al[11] published a meta-analysis in 2012 on the use of TAP blocks in Caesarean section delivery, and concluded that the use of this block improved postoperative analgesia. Intrathecal morphine provides more effective analgesia, but this is at the expense of an increased incidence of side-effects.

Limitations in our study include the fact that it was not powered to assess differences in opioid-related side-effects, or overall safety. The issue of potential local anaesthetic toxicity was not specifically addressed, but all doses were within the recommended range. We only assessed patients for the first 24 hours, and although it has been suggested that TAP blocks are beneficial even after 48 hours,[4,12] we did not extend our monitoring period owing to limited resources.

The final outcome of this trial was that the performance of bilateral ultrasound-guided TAP blocks in women undergoing total abdominal hysterectomy is a useful addition to a multimodal analgesia regimen, resulting in a significant reduction in postoperative morphine requirements.

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Declaration

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Conflict of interest

There was no conflict of interest to disclose.

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