Original Research Article

Ultrasound Guided Transversus Abdominis Plane Block versus Intrathecal Morphine for Analgesia Post Caesarean Section: Which is Better?

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Abstract

The tranversus abdominis plane (TAP) block for postoperative analgesia after caesarean section may confer potential benefits comparable to that of intrathecal opioids. We compared postoperative analgesia, and the incidence of nausea, vomiting, pruritus and sedation between the TAP block and intrathecal morphine (ITM) in patients undergoing Caesarean section. This was a prospective, randomised clinical study. Fifty American Society of Anaesthesiologists physical status I or II patients, planned for elective caesarean section under spinal anaesthesia, were randomly allocated to the TAP group (patients receiving spinal anaesthesia with bilateral TAP block without ITM) or ITM group (patients receiving spinal anaesthesia with ITM without a TAP block). Assessment for pain, postoperative nausea and vomiting, pruritus and sedation was done upon arrival and discharge from recovery, and at 6, 12 and 24 hours, postoperatively in the post natal ward. Results were analysed using analysis of variance (ANOVA). There was no pain at rest in either groups. Both groups experienced pain on movement at the 12th ($p = 0.6$) and 24th hour ($p = 0.4$). None of the patients in the TAP group experienced nausea, vomiting, pruritus or sedation. However, these incidences were found to be significantly higher in the ITM group. Ultrasound guided TAP block provided comparable postoperative analgesia to ITM without the side effects of the latter.

Keywords: Intrathecal, morphine, nerve block, analgesia, Cesarean section

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Introduction

Effective postoperative analgesia after caesarean section (CS) is important to enable early recovery of the mother hence early bonding with her baby, whereby using a multimodal analgesic regimen with minimal side effects would be ideal (1). Common effective analgesic techniques include intravenously administered patient-controlled analgesia (PCA) with opioids, or single-shot neuraxial analgesic techniques using long-acting opioids such as intrathecal morphine (ITM). However, side effects such as nausea, vomiting and pruritus frequently occur, and this may result in reduced overall patient satisfaction (2,3,4,5,6). Additionally, the rostral spread of hydrophilic opioids such as morphine could result in late-onset maternal respiratory depression (5,7,8). The latter could be deleterious to an obese pregnant mother with a significant history of obstructive sleep apnoea (7). Furthermore, it is not always possible to administer ITM to just any patient due to logistic issues pertaining to close patient monitoring postoperatively, or the presence of medical contraindications (5,8). To avoid these undesirable sequelae, an approach which reduces postoperative opioid requirements may prove to be beneficial (1,9,10,11,12).

The trend of utilizing peripheral nerve blocks as part of the multimodal post operative analgesic regime has increased in the past two decades (1,9,11,13). Abdominal field blocks have been followed for many years and extensively used for pain management following abdominal surgeries such as laparotomies and appendicectomies (14,15). The blind transversus abdominis plane (TAP) block utilizes a landmark technique which has its entry point at the 'triangle of Petit'(14). The block anaesthetizes the T7 to L1 abdominal wall nerves, providing wide spread cutaneous analgesia of limited quality to the anterior abdominal wall (16). Traditionally, the block required multiple attempts as it was performed as a blind technique, resulting in unpredictable success rates (14). The use of ultrasound guided regional techniques have lead to the emergence of novel types of nerve blocks with new indications. In addition, real-time visualization of the block needle and local anaesthetic spread reduced risks of complications to the patient (17). The ultrasound guided TAP block has recently shown better localization and deposition of local anaesthetic resulting in improved success of the block (14).

A recent study showed better postoperative analgesia when TAP block was used as part of the multimodal analgesic regimen in CS, where it provided analgesia for up to 48 hours, postoperatively (1). Another advantage was the reduction in the incidence of sedation postoperatively in patients who received a TAP block and PCA morphine, compared to those who were only given PCA morphine (1,9,11). The present study was performed to compare postoperative analgesia and side effects between the TAP block versus ITM in patients undergoing CS.

Materials and Methods

This prospective, randomized clinical study was carried out following institutional ethics committee approval. Fifty term parturients of American Society of Anesthesiologists (ASA) physical status I or II, aged 19 years and above, planned for elective CS under spinal anaesthesia were recruited. Patients with any contraindications to spinal anaesthesia, a history of chronic opioid consumption or with known allergy to the study drugs were excluded. The patients were seen one day prior to the surgery and explanation about the study and written informed consent was obtained. The patients were fasted overnight and pre-medicated with 30 ml of oral sodium citrate 0.3 M and 150 mg of oral ranitidine prior to OT call, as standard acid aspiration prophylaxis.

In the operating theatres, the patients were randomly allocated using computer generated randomized numbers to the TAP group (patients who received spinal anaesthesia without ITM but with bilateral TAP blocks), or the ITM group (patients who received just spinal anaesthesia with ITM). An 18 G branula was inserted under local anaesthesia. Standard monitoring applied included the non-invasive blood pressure monitor, electrocardiography (ECG) and pulse oximetry. Patients were pre-loaded intravenously with 15 ml/kg of Ringer's lactate during the conduct of spinal anaesthesia which was performed under aseptic technique. All patients were given 1.8 ml of hyperbaric bupivacaine 0.5% and 20 μg fentanyl intrathecally at the L3-L4 interspace via a 27G Pencan spinal needle. Baseline haemodynamic parameters were recorded. Patients in the TAP group received TAP blocks with 2.5 mg/kg of 0.375% ropivacaine, to a maximum dose of 150 mg or 20 ml at each side of the abdomen at the end of surgery, before the dressing was applied to the surgical wound. Patients in the ITM group were given an additional 100 μg of ITM to the standardized spinal anaesthetic drugs as per protocol. Adequate anaesthetic level was confirmed before surgery was allowed to commence. Prophylactic anti-emetic consisting of intravenous (IV) dexamethasone 8 mg and IV ondansetron 4 mg were given to both groups intraoperatively, after delivery of the baby. All patients received rectal diclofenac 1 mg/kg to a maximum dose of 100 mg at the end of surgery.

Upon completion of surgery, the TAP group patients had their abdomens cleaned with povidone iodine and re-draped. The ultrasound probe was covered with a sterile plastic sheath. The TAP block was performed under ultrasound guidance using an M-Turbo™SonoSite Unit and a high frequency (7-10 MHz) linear array ultrasound probe. All blocks were performed by a single operator who was adequately trained in performing ultrasound guided regional blocks, with at least ten TAP blocks performed prior to the study. Viewing the patient's flank from the side and using the anterior superior iliac spine (ASIS) and the umbilicus as landmarks, the ultrasound probe was placed at the meeting point of two imaginary lines drawn perpendicularly from the ASIS horizontally and the umbilicus vertically. Thereafter, the external oblique, internal oblique and transversus abdominis muscles were identified. The transversus abdominis fascial plane lies in between the internal oblique and the transversus abdominis muscles. A 90 mm, 22 G, blunt insulated regional anaesthesia needle (Polymedic-ovalix) was introduced from the outer end of the ultrasound probe and advanced along the long axis of the probe parallel to the ultrasound beam (in-plane technique). Needle movement was observed in real time and advanced into the transversus abdominis fascia. Intravascular placement was excluded before a

test dose of 1 ml of local anaesthetic was injected to confirm needle tip placement within the fascial plane (evidenced by fascial plane separation on the ultrasound image). Then, the full dose of ropivacaine was injected and the TAP block repeated in a similar manner on the opposite side.

Assessment of pain, postoperative nausea and vomiting (PONV), pruritus and sedation was done by the obstetric analgesia acute pain service team who were blinded to the patient's group allocation. The patients were assessed upon arrival and discharge from recovery, and at 6, 12 and 24 hours, postoperatively in the post natal ward. The presence and severity of pain was assessed using the visual analogue scale (VAS) score, in which patients were shown a ruler calibrated from 0-10, where 0 represented no pain and 10, the worst imaginable pain. Pain scores at rest and with movement (knee flexion) were recorded. PONV and pruritus was assessed using a four point scale scoring system: 0 - none; 1 - mild; 2 - moderate; 3 - severe. IV ondansetron 4 mg was given to any patient with a PONV score of 3. Sedation level was assessed using the following sedation scale: 0 - awake and alert; 1 - awake but passive; 2 - asleep but easily aroused; 3 - deep sleep. In the ward, both groups were given a standardized postoperative analgesic regime of oral paracetamol 1 gm 6 hourly and oral diclofenac sodium 50 mg 8 hourly. Intravenous patient controlled analgesia (PCA) using morphine was given as rescue treatment for inadequate analgesia. This was programmed to deliver on-demand bolus doses of 1 mg morphine with a lock-out interval of 5 minutes and a 4 hourly maximum dose of 40 mg morphine.

A sample size of 50 patients inclusive of a 20% dropout rate was calculated using the PASS (Power Analysis & Sample Size System) software of Tests of Two Means in a Repeated Measure Design. The power of this study was 80% with a type 1 error of 0.05. The data was analysed using the SPSS (Statistical Package for the Social Sciences) version 19.0 software. Demographic data was analysed accordingly using either the student t-test or the Chi-square test. Repeated measures analysis of variance (ANOVA) was used to analyse pain scores, morphine consumption, PONV, pruritus and sedation scores whereby a p value of <0.05 was considered statistically significant.

Results

Fifty patients were recruited in the study. Their demographic data is shown in Table 1. There was no significant difference between the groups in terms of age, weight, height, body mass index (BMI), race and ASA classification.

At all assessment times, none of the patients in either groups complained of pain at rest. Pain score during movement was shown in Table 2. There was no significant difference between the groups in terms of pain on movement at the 12^{th} ($p = 0.6$) and 24^{th} hour ($p = 0.4$). The highest pain score in both groups was 2.

Table 3 showed that majority of the patients from both groups did not require rescue PCA morphine within the 24 hours post operatively. The highest morphine consumption was 6 mg in a patient in group ITM, due to minimal pain on movement, (VAS score of 1). Mean total morphine consumption within 24 hours for patients in the TAP block group was 0.32 ± 0.98 and in patients with ITM was 0.36 ± 1.25. There was no significant difference in the total requirement of rescue PCA morphine between both groups.

Figure 1 showed that all patients in the TAP group had no PONV at all points of assessment. The incidence of PONV was significantly higher (p = 0.001) in the ITM group at all points of assessment up to 12 hours post-operatively. The highest incidence of PONV was at 6 hours postoperatively where 17 patients in the ITM group had PONV. Of these, five of them had severe PONV, and at the 12^{th} hour postoperatively one patient had severe PONV. These patients were treated with IV ondansetron. At the 24^{th} hour, none of the patients in both groups had PONV.

Figure 2 showed that none of the patients in the TAP group experienced pruritus. The incidence of pruritus

Table 1: Demographic data. Values expressed in mean ± SD and numbers (%).

		TAP group (n =25)	ITM group (n =25)
Age (year)		31.2 ± 4.0	31.6 ± 5.3
Weight (kg)		77.9 ± 11.5	80.6 ± 12.2
Height (m)		1.6 ± 0.0	1.6 ± 0.4
BMI (kg/m^2)		30.2 ± 3.7	30.5 ± 4.1
Race	Malay	19 (76)	20 (80)
	Indian	4 (16)	5 (20)
	Chinese	2 (8)	0 (0)
ASA	I	13 (52)	19 (76)
	II	12 (48)	6 (24)

Table 2: Postoperative visual analog scale (VAS) score on movement. Values expressed as numbers and percentages.

		TAP Group		ITM Group	
	Pain score	**Frequency n = 25**	**Percentage %**	**Frequency n = 25**	**Percentage %**
Recovery-On Arrival	0	25	(100)	25	(100)
Recovery-On Discharge	0	25	(100)	25	(100)
At 6 Hours	0	24	(96)	24	(96)
	2	1	(4)	1	(4)
At 12 Hours	0	24	(96)	23	(92)
	1	1	(4)	2	(8)
At 24 Hours	0	20	(80)	23	(92)
	1	4	(16)	1	(4)
	2	1	(4)	1	(4)

TAP: transversus abdominis plane
ITM: intrathecal morphine

was significantly higher (p = 0.001) in the ITM group at all points of assessment, with a peak incidence at the 6th and 12th hour, postoperatively. These patients had mild to moderate pruritus. They were given explanation of the cause and reassurance, but no rescue treatment was required.

Figure 3 showed that all patients in the TAP group were awake and alert at all points of assessment. The ITM group had similar findings except at the 6th hour where the incidence of sedation (sedation score $\geq$ 2) was significantly higher (p = 0.001) in the ITM group compared to the TAP group.

Table 3: PCA morphine consumption within the 24 hours postoperatively. Values expressed in number (n) and percentage (%).

PCA morphine usage (mg)	**TAP group *n* = (25)**	**ITM group *n* = (25)**
0	22 (88)	22 (88)
1	1 (4)	1 (4)
2	0	1 (4)
3	1 (4)	0
4	1 (4)	0
6	0	1 (4)

Discussion

In our study, bilateral TAP block as part of the postoperative multimodal analgesic regime resulted in comparable analgesia to ITM. It provided effective analgesia (VAS score $\leq$ 2) for up to 24 hours postoperatively. Three studies by McDonnell et al. (1,11,18), reported effective analgesia up to 48 hours postoperatively, for various types of surgery, with a single-shot TAP block, in addition to oral and rectal analgesia, and rescue PCA morphine (1,9,11). The prolonged duration of analgesia following a TAP block may be related to the relatively poor vasculature of the TAP which possibly delays local anaesthetic clearance (1).

In contrast, McMorrow et al. (19) in their study, found that the TAP block did not provide comparable postoperative analgesia to ITM. They also showed that patients who received intrathecal fentanyl and bilateral TAP blocks had comparable postoperative analgesia to patients who were given intrathecal fentanyl and sham TAP blocks using saline. These findings may have been contributed by the fact that they had used the landmark technique, which is essentially a 'blind' approach to the TAP block. In contrast, the ultrasound-guided approach in our study allowed optimum placement of the local anaesthetic as its distribution could be visualized. This resulted in an effective TAP block which provided comparable postoperative analgesia to ITM. A recently published study by McDermott et al. (20), demonstrated a high incidence of inaccurate location of the TAP using the landmark technique, resulting in inappropriate needle placement in the peritoneum. Based on these findings, the authors strongly advocate that 'blind' approaches to the TAP block be abandoned and instead ultrasound guidance be employed to ensure safety and success of the block. However, one may argue that our results may have been confounded by the higher dose of intrathecal fentanyl used, 20 µg as opposed to 10 µg in McMorrow's study. Belzarena (21) had compared the

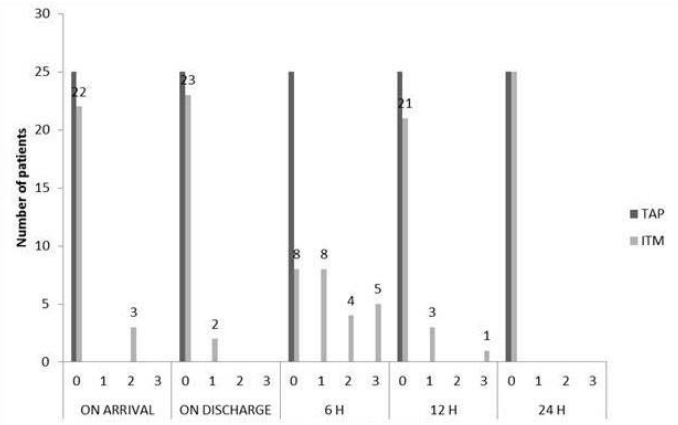

Figure 1: PONV score at time point assessment.

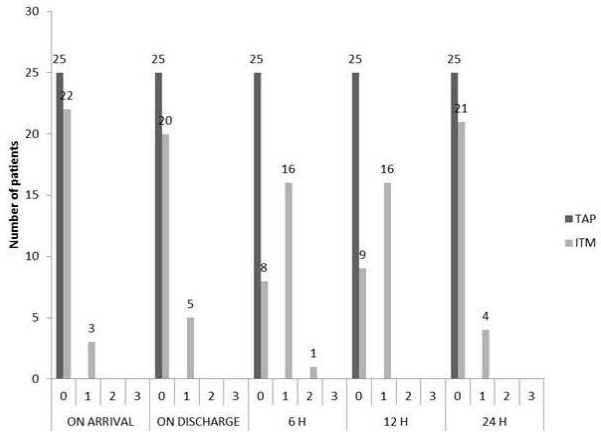

Figure 2: Pruritus score at time point assessment.

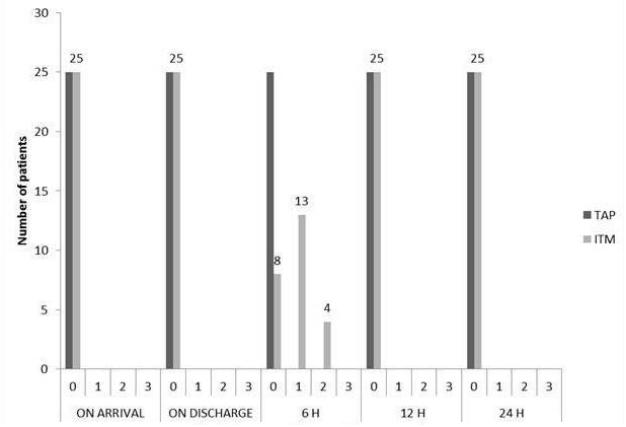

Figure 3: Sedation score at time point assessment.

effects of incremental doses of intrathecal fentanyl in spinal anaesthetics and showed that the dose of intrathecal fentanyl administered determined the effectiveness of postoperative analgesia. His study suggested that 20 µg of intrathecal fentanyl provided postoperative analgesia for a maximum duration of six hours. Therefore, the extended analgesia beyond 6 hours postoperatively in our TAP group might have been contributed by the TAP block.

In accordance to our study, McDonnell et al. (1) also found no PONV in patients who received bilateral TAP blocks. However, in other studies involving large bowel resection (9) and total abdominal hysterectomy (11), patients who received the TAP block experienced PONV. Nevertheless, the incidence was significantly lower compared to patients who received a sham TAP block, possibly due to the increased morphine requirement in the latter.

Pruritus is a known side effect of ITM, its incidence varying widely between 30-100% (8). In our study, the incidence of pruritus peaked in the ITM group at the 6^{th} (68%) and 12^{th} (64%) hour, postoperatively. Slappendel et al. (22) in their study also observed that pruritus peaked after the 6^{th} hour, and the severity and duration of pruritus was directly proportional to the morphine dose given intrathecally.

In our study, the incidence of sedation in the ITM group was comparable to results from previous studies, in which it was significantly higher at the 6^{th} hour, postoperatively (9). Pharmacological studies have shown that ITM exerted its peak effect of sedation and respiratory depression at the 6^{th} hour, which corresponded timely to the rostral migration of morphine within the cerebrospinal fluid (8). This could also account for the higher incidence of PONV and pruritus at the 6^{th} hour in our study. In contrast, sedation was not experienced in any of the patients in the TAP group. Review articles on the TAP block as part of the multimodal postoperative analgesia regime support this technique as it has advantages in terms of reducing opioid related side effects (1,11).

There were several limitations to our study. Firstly, we were unable to ascertain the exact duration of analgesia provided by the TAP block as we only assessed postoperative analgesia for the first 24 hours. Secondly, the analgesic effect of the TAP block may have also been masked by the multimodal analgesic regime that was provided as part of our standard protocol. Thirdly, the patients were not blinded to the analgesic technique as a sham block (with the inherent risks associated with a TAP block) was deemed unethical by our institutional ethics committees. Thus, the patients' response to the assessment of pain, nausea and pruritus may have been biased. Finally, our study was not powered to assess the safety issue of ultrasound guided TAP blocks. Marhofer et al. concluded that ultrasound guided TAP block was

relatively safe (13), but Lancaster and Chadwick (23) reported a case of liver trauma following ultrasound guided TAP block. We recommend that a study evaluating the safety of ultrasound guided TAP blocks be carried out in the future.

In conclusion, we found that the ultrasound guided TAP block was comparable to ITM in providing postoperative analgesia in patients undergoing CS. The use of ultrasound guided TAP block may be limited by the restricted availability of the ultrasound machine in some centres, and the experience of the anaesthetist. However, the ultrasound guided TAP block is easily learned (24), thus making it an attractive alternative to ITM in the future, as it confers the analgesic efficacy of ITM but spares the patient of opioid related side effects.

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