Original Article

Comparison of ultrasound-guided transversalis fascia and posterior transversus abdominis plane block for postoperative analgesia following caesarean delivery: A double-blinded randomised controlled trial

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Submitted: 15-Nov-2022
Revised: 21-Aug-2023
Accepted: 23-Aug-2023
Published: 16-Oct-2023

Access this article online

Website: https://journals.lww.com/ijaweb

DOI: 10.4103/ija.ija_931_22

Quick response code

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ABSTRACT

Background and Aims: Posterior–transversus abdominus plane (TAP) block and transversalis fascia plane (TFP) block have been used for postoperative analgesia following caesarean delivery. We compared the analgesic efficacy of the TAP vs TFP plane blocks in patients undergoing elective caesarean delivery. **Methods:** We randomised 90 women undergoing caesarean delivery under spinal anaesthesia to receive either a posterior-TAP (Group-TAP), TFP (Group-TFP) or no block (Group-C) postoperatively. The primary objective was the postoperative analgesic requirements. Secondary objectives were duration of analgesia, pain scores and infra-umbilical sensory loss, which were recorded at specific intervals for 24 h. Statistical analysis was carried out using Statistical Package for Social Sciences version 16.0 software. **Results:** The patients requiring one, two or nil rescue analgesics were comparable between the interventions and the control ($P = 0.32$). The duration of analgesia was longer in Group-TAP when compared to Group-C, 4.76 (1.2) vs. 6.89 (2.4); $P < 0.001$, whereas Group-TFP, 5.64 (2.1) h, was not significantly different from Group-C. The static pain score in Group-TAP was significantly less than that in Group-C at 4 h and beyond 12 h ($P < 0.001$), whereas Group-TFP was comparable with Group-C at all time points except at 4 h and 24 h ($P = 0.002$). Only Group-TAP demonstrated midline infraumbilical sensory loss. **Conclusion:** TAP and TFP blocks did not decrease the rescue analgesic requirement compared with the control group. The posterior-TAP block prolonged the duration of analgesia by 2 h, maintained the median static pain score at 0 beyond 12 h, and demonstrated sensory loss at the infraumbilical dermatomes.

Key words: Analgesia, caesarean section, delivery, nerve blocks, posterior-transversus abdominus plane, transversalis fascia plane, ultrasonography

INTRODUCTION

The posterior–transversus abdominus plane (TAP) and transversalis fascia plane (TFP) blocks provides good somatic analgesia of the lower abdomen by blocking the L1 segmental nerve, which is spared with a lateral-TAP block.[1] Several studies have reported TAP block as beneficial in decreasing the opioid requirements following caesarean delivery, although not as effective as intrathecal morphine.[2–5]

How to cite this article: Sripriya R, Janani G, Sivashanmugam T. Comparison of ultrasound-guided transversalis fascia and posterior transversus abdominis plane block for postoperative analgesia following caesarean delivery: A double-blinded randomised controlled trial. Indian J Anaesth 2023;67:893-900.

TFP block is a fascial plane block that has been successfully used for iliac bone harvesting and is being explored for use in caesarean delivery patients but does not have the same level of scrutiny as the TAP block for post-caesarean delivery analgesia.[1,6] We planned this study with the primary objective of comparing the ultrasound (US)-guided TFP block and posterior-TAP block to decrease the rescue analgesia requirement for 24 h following caesarean delivery. Secondary objectives were to determine the duration of analgesia, postoperative static and dynamic pain scores, and sensory loss in the anterior lower abdominal dermatomes and to compare the above findings with the control group.

METHODS

This randomised controlled trial was approved by the institutional human ethics committee (vide approval number MGMCRI/Res/01/2020/09/IHEC/277) and registered with the Clinical Trial Registry-India (CTRI/2021/06/034221, https://www.ctri.nic.in). The study was performed from July 2021 to November 2021 and followed the principles laid down in the Declaration of Helsinki. 2013. Ninety parturients scheduled for elective caesarean delivery under spinal anaesthesia were enrolled in the study. Parturients between 18 and 45 years, American Society of Anesthesiologists physical status II, body mass index (BMI) of 18–35 kg/m^2 who gave written informed consent for participation in the study and use of the data for research and educational purposes were included. Those with a history of local anaesthetics (LA) allergy, seizure disorders, or any pregnancy complications requiring conversion to general anaesthesia or intraoperative opioid supplementation for inadequate anaesthesia were excluded.

Block randomisation was performed using the 'Permuted block' feature of the 'Statistics and Sample Size' Android app, version 1.0 (Truc TT, Ho Chi Minh City, Vietnam), with a pre-defined block size of nine. The randomisation sequence was generated by a resident doctor not involved in the study and handed over to the investigators in sealed opaque sequentially numbered envelopes containing the allocated group: Control group: Group-C; posterior-transverses abdominus plane block: Group-TAP; and transversalis fascia plane block: Group-TFP. The patients were blinded to the allocated group.

All patients were premedicated with oral pantoprazole 40 mg, metoclopramide 10 mg the night before and at 6:00 a.m. on the day of surgery. The patients were explained about the numeric rating scale (NRS) used for pain assessment in the postoperative period. On arrival at the operating theatre, non-invasive blood pressure, electrocardiogram and pulse-oximetry monitoring were attached, and an 18-gauge intravenous (IV) cannula was inserted. All patients received intrathecal 2 mL of 0.5% hyperbaric bupivacaine using a 25-G Quincke spinal needle in a lateral position. A spinal anaesthesia level of T6 was considered adequate. During skin suturing, IV paracetamol 1 gm was administered and continued as oral paracetamol 650 mg at six-hour intervals for postoperative analgesia. The duration from skin incision to suturing was noted as the surgical duration.

After the dressing application, the sealed envelopes were opened to determine the allocated group, depending on which the patients received posterior-TAP block, TFP block or no block. The block was performed bilaterally in the flank by investigators with 1-year experience in ultrasound-guided blocks and blinded to the data collection until study completion. The anaesthesia screen was left in place during the block. As the blocks were performed under the effect of spinal anaesthesia, the patients were also blinded to the allocated group. Both the US-guided interventions were performed under aseptic precaution using a Sonosite X porte (Sonosite, Bothell, WA) ultrasound system, with multi-beam (compound imaging) capability and a high-frequency linear array transducer (HFL50x, 15-6 MHz) was used to perform the ultrasound scan and guide the needle to the target site. The probe was placed transversely at the level of the umbilicus in the midaxillary line. The external oblique, internal oblique and transversus abdominis muscles were identified and traced posteriorly till the transversus abdominis tailed off to become aponeurotic. All blocks were performed using 25-G Quincke's spinal needle inserted in-plane from anterior to posterior. A 100-cm pressure monitoring line was connected to the needle and primed with normal saline taken in a 10 mL syringe for hydro-dissection.

In Group-TAP, the needle tip was navigated to the most posterior end of TAP; in Group-TFP, the needle tip was navigated to the plane beneath the transversus abdominis aponeurosis [Figure 1]. The planes were identified by hydrodissecting with 0.5 mL boluses of normal saline. Once the proper needle tip position was confirmed, 20 mL of 0.25% bupivacaine was injected. Transverse and longitudinal scans confirmed the

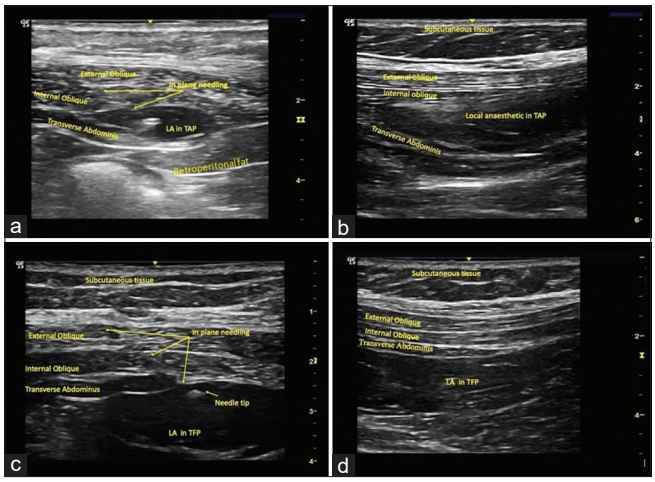

Figure 1: Ultrasound guided TAP and TFP plane blocks - Transverse (a) and longitudinal spread (b) of local anaesthetic following posterior-TAP block. Transverse (c) and longitudinal (d) spread of local anaesthetic following TFP block. LA = local anaesthetic, TAP = transversus abdominus plane, TFP = transversalis fascia plane)

horizontal and vertical spread of the LA in the respective planes. The same was repeated on the other side.

Pain scores were assessed postoperatively by an independent observer blinded to the study group at two-hour intervals for the first 12 h and then at four-hour intervals up to 24 h. Dynamic pain scores were assessed by asking the patient to turn lateral to one side and flex the legs. The blinded observer recorded the pain relief on the NRS scale at rest and the two specific movements and took no further part in the study. Whenever the patient demanded analgesia, the ward staff nurse administered the rescue analgesics on a two-step ladder. IV ketorolac 30 mg was administered as the first rescue analgesic, and the time was noted. The pain score on-demand for rescue analgesia was noted. After 30 min, if the patients continued complaining of pain, the second rescue analgesic, IV tramadol 1 mg/kg, was administered. If the patient continued complaining of surgical site pain even after both rescue analgesics, the call was escalated to the hospital's acute pain service team. The time gap between the spinal and the first rescue analgesia was considered the duration of analgesia. At the end of 24 h, the blinded observer noted the total doses of rescue analgesia administered to each patient.

Loss of sensation to cold and touch was assessed using a 3-point qualitative pain scale (0: touch +, cold +; 1: touch +, cold -; 2: touch -, cold -) in the midline (dermatomes supplied by the anterior cutaneous/terminal branch) and the mid-clavicular line (for testing the infraumbilical lateral dermatomes) on either side of the abdomen. The umbilicus and pubic symphysis were assessed for the T10 and L1 dermatomes, respectively. The umbilicus to pubic symphysis distance was split equally by two horizontal lines, representing the T11 and T12 dermatomes. The anterior aspect of the thigh was assessed for the L2 dermatome. The sensory assessment was performed at the same time points when the pain scores were evaluated. The time the patient could perceive both touch and cold sensations in the L2 dermatome was considered spinal regression time. Any other block-related complications, such as bowel injury, liver injury or femoral nerve palsy, were also recorded.

'Statistics and Sample Size' android app, version 1.0 (Truc TT, Ho Chi Minh City, Vietnam), was used for calculating the sample size. Neither block has an effect on visceral pain and hence cannot abolish the requirement of rescue analgesics but can decrease the number of doses required. Kiran *et al*.[7] have reported that with TAP block, 57% of patients required only one dose of rescue analgesic. We hypothesised that a similar effect would be observed only in 15% of patients with a TFP block. Anticipating a difference of 42% with 80% power and a 5% allowable margin with Bonferroni's correction for multiple comparisons, the sample size was estimated as 30 in each group. A P value less than 0.008 was considered significant following Bonferroni's correction.

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) version 16.0 (IBM SPSS, US) software. One-way analysis of variance (ANOVA) was used for age, BMI, duration of surgery, spinal regression time and duration of analgesia. The Chi-square test was used to compare gravida, the number of doses of rescue analgesia and the percentage of patients requiring rescue analgesia. Kruskal–Wallis test was used to compare the median pain scores between the three groups.

RESULTS

Ninety patients completed the study [Figure 2]. The demographic parameters of the three study groups were comparable [Table 1]. The number of patients requiring one, two or nil rescue analgesics was similar between the interventions (TAP and TFP) and the control group, $P = 0.32$ [Figure 3].

The mean (standard deviation [SD]) duration of analgesia in the Group-TAP, 6.89 (2.4) h, was statistically

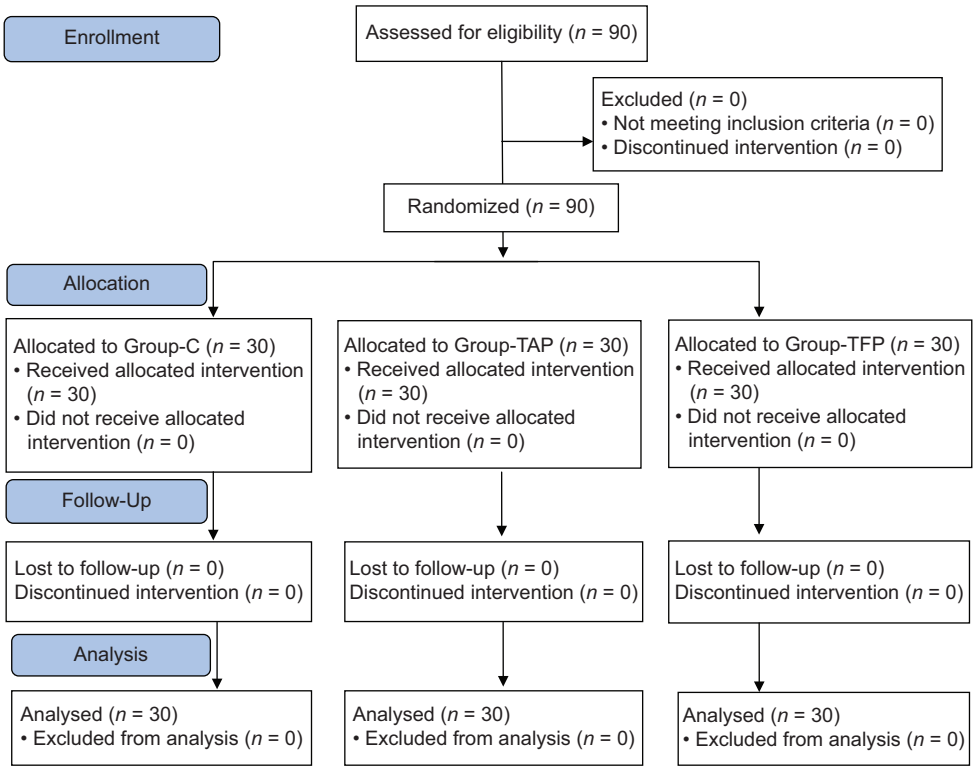

Figure 2: Consolidated standards of reporting trials flow diagram

Table 1: Demographic data

Variables	Group C (*n*=30)	Group TAP (*n*=30)	Group TFP (*n*=30)
Age (years)	27.6 (3.7)	28.33 (3.5)	28.03 (4.0)
Body mass index (kg/m^2)	26.4 (1.9)	27.23 (2.9)	26.67 (2.8)
Duration of surgery (min)	88.7 (16.8)	87 (17.4)	81 (14.1)
Gravida			
• Primi	13	4	10
• G 2	8	16	16
• G 3	8	7	4
• G 4	1	2	0
• G 5	0	0	0
• G 6	0	1	0
Time taken for block (min)	NA	22.83 (7.4)	21.0 (7.1)
Spinal anaesthesia to spinal regression time (h)	3.46 (0.431)	3.34 (0.72)	3.27 (0.452)

Data expressed as mean (standard deviation) or numbers. NA=Not applicable, G=Gravida

significant ($P < 0.001$) when compared to the Group-C; 4.76 (1.2) h but comparable to the Group-TFP; 5.64 (2.1) hours ($P = 0.030$). The mean (SD) duration of analgesia in the Group-TFP was not significantly different from Group-C ($P = 0.051$) [Figure 3]. The median (interquartile range [IQR]) pain score on demand for rescue analgesia was 4 (4–5), irrespective of the group.

The median (IQR) static pain score in Group-TAP was significantly less, $P < 0.001$, beyond 12 h when compared to the Group-C (0 [0-0] vs. 2 [2-2], respectively), and at 12, ($P = 0.002$) and 16 h, ($P < 0.001$) when compared to Group-TFP. However, the median (IQR) static pain score in Group-TFP did not make any continued difference (at more than two consecutive assessment intervals) from that of the control group. Among the two movement-related pain, turning lateral was associated with higher dynamic pain score ratings compared to the flexion of hips. However, both interventions (TAP and TFP) did not provide any better dynamic pain relief ($P > 0.008$) when compared with the control group [Figure 4].

Spinal anaesthesia regressed (sensory level below L2) by 4 h in all patients. After regression of spinal anaesthesia, only the TAP group demonstrated midline sensory loss at T-10 (17%), T-11 (77%) and L-1 (17%) dermatomes, which regressed over the next four hours [Figure 5]. None of the patients in any group had a loss of sensation in the midclavicular line in the T–10 to L–1 dermatome on either side.

No block-related complications were noted in any patients in either group.

DISCUSSION

Our results showed that in patients undergoing caesarean delivery, TFP block has no benefit over

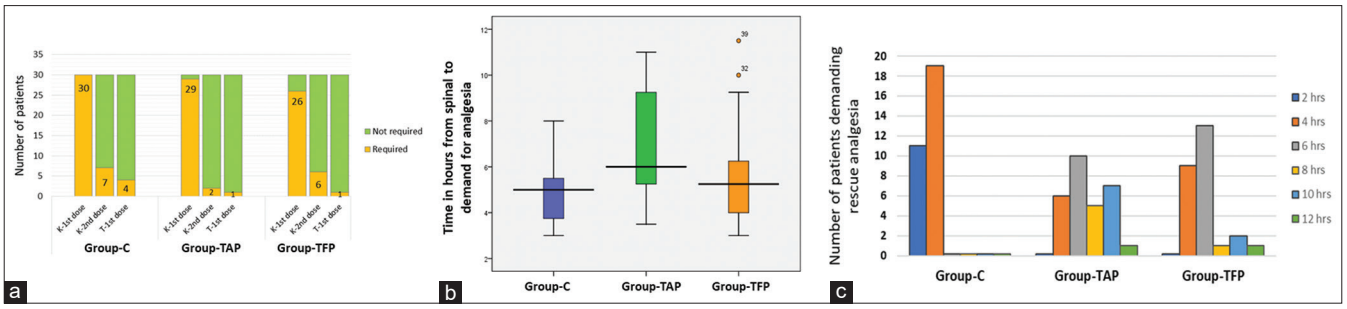

Figure 3: (a) Requirement of rescue analgesics in the three groups. (b) Duration of analgesia. The difference was significant ($P < 0.001$) between Group-C and Group-TAP. (c) Number of patients who demanded rescue analgesia at different time points postoperatively in the three groups. K = ketorolac, T = tramadol

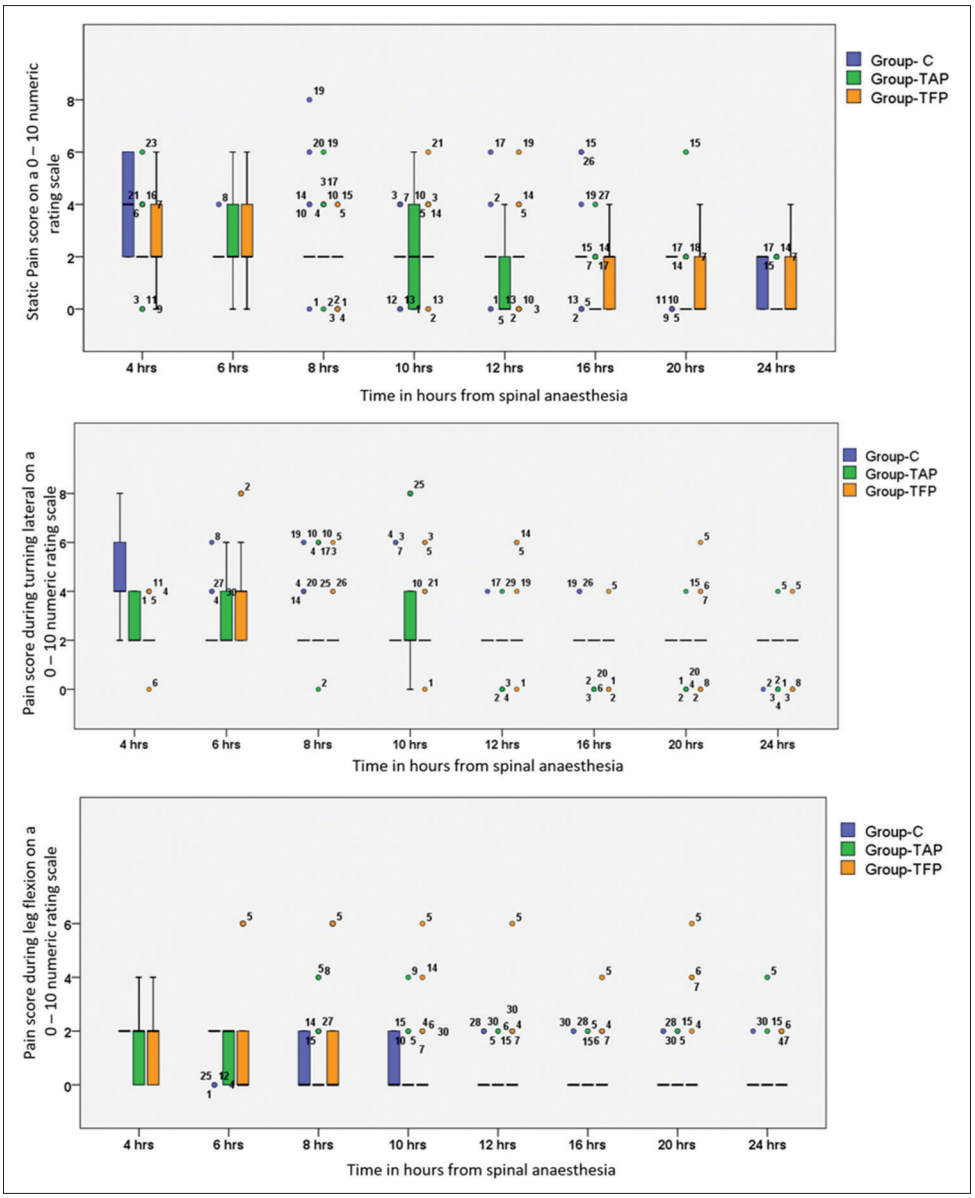

Figure 4: The box-whisker plot displays the median (interquartile range) static and dynamic pain scores on 0 to 10 numerical rating scale in the three groups at the various time points until 24 h post-surgery. '0 h' refers to the administration of spinal anaesthesia

the control group regarding the need for rescue analgesia, duration of analgesia, postoperative pain score or dermatomal sensory blockade. Posterior-TAP block prolongs the duration of analgesia by 2.13 h

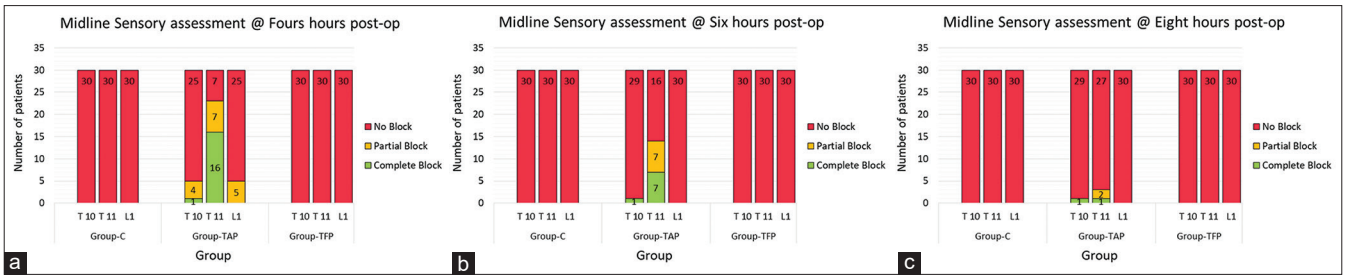

Figure 5: Midline sensory assessment of the T 10, T 11 and L1 dermatomes on the anterior abdominal wall at (a) 4 h, (b) 6 h and (c) 8 h postoperatively. post-op=postoperative, T=thoracic, L=lumber

and provides dermatomal sensory loss but with no difference from the controls in the requirement of rescue analgesia. When considered in terms of 'minimal clinically important difference' (MCID) in the duration of analgesia or the median pain score (difference in NRS of 2) from the control group, the effect is, however, clinically not significant.[8,9] The wide dispersion (±2.4 h) in the analgesia duration decreases the block's predictability.

Irrespective of the group, the demand for analgesia was for generalised abdominal pain (visceral pain) rather than the incision site pain, indicating that neither block had any effect. The control group enabled us to understand the baseline analgesia requirement following caesarean delivery in our cohort, providing a criterion for comparison of the analgesic efficacy of the blocks. Spinal anaesthesia itself provides early postoperative analgesia. Most patients, even in the control group, demanded only a single dose of rescue analgesia and rarely required mild opioids [Figure 2].[10,11] The use of 40 mL of LA for briefly prolonging analgesia by 2.13 h, although statistically significant, may not be clinically relevant when a longer duration of 6 to 8 h of analgesia can be easily achieved with the use of parenteral non-steroidal anti-inflammatory drugs conventionally administered before the regression of spinal anaesthesia and continued round-the-clock.

The usefulness of the TAP block in reducing the intensity of somatic pain can nevertheless be employed advantageously as a pre-emptive measure or for providing early postoperative analgesia in patients undergoing caesarean delivery under general anaesthesia. Further, it is notable that TAP group patients had a median (IQR) pain score of 0 (0) beyond 12 h. Whether this contributes to the prevention of central sensitisation and, thereby, the development of chronic post-surgical pain has to be determined prospectively.

The comparison of the 'time to first analgesia' with those in other studies posed difficulty due to the differences in the LA used, the concentration of LA used, and the baseline analgesia provided.[2,12-16] Some studies have reported a prolonged duration of analgesia of several hours with these blocks, even in the absence of background analgesia, which was contradictory to our findings.[16,17] Unlike our observations, a prolonged duration of analgesia of 10.77 (1.39) h and 17.4 (1.25 h) have been reported with TFP by Chilkoti *et al*.[18] and Aydin *et al*.,[12] respectively. Although Chilkoti *et al*.[18] used 20 mL of 0.375% ropivacaine; the same LA used in our study was used by Aydin *et al*.[12] Aydin *et al*.[12] also observed lower pain scores and a 50% decrease in morphine requirement with TFP, which contradicts our results. The time to request analgesia in their control group (5.3[0.8]) h was similar to our observations.[12]

On comparing TAP with TFP, Rahimzadeh *et al*.[14] concluded that TFP provided pain control similar to TAP. Although statistically insignificant, their findings show better analgesic effects with TAP in terms of longer duration of analgesia, total analgesic use, and the percentage of patients not requiring rescue analgesia, which are similar to our observations. Similar to our observations, Serifsoy *et al*.[10] also report no decrease in pain scores between TFP and controls. However, they observed higher tramadol consumption in the control group, which may partly be attributed to the fact that no background analgesia was used in their study.

We preferred to analyse the analgesia consumption in terms of the number of analgesic doses consumed by individual patients, as the drugs used in our study were administered as bolus doses and not continuous infusions. The summarising of the analgesics administered as bolus doses using mean (SD) averages the value across all patients and obscures the variability in the number of doses required by individual patients.[14] This particularly hinders the understanding of the block outcomes with fascial plane blocks.

The outcomes of the fascial plane blocks of the trunk are controversial.[12,13,19-22] One of the reasons is that these blocks are not targeted to the nerves but involve a sonographically guided deposition of LA in the planes along which the nerves travel, the pathway and anatomy (the point of branching of the lateral cutaneous branches [LCB]), of which can widely vary. Unlike that for peripheral nerves, there is no clear-cut segmental demarcation of the truncal myotomes and dermatomes, and further complexities are added by the neural inter-communications in the fascial planes. The pain from the trunk also has an additional visceral component carried by the autonomic nervous system, the blockade of which is difficult to quantify and assess.

Very few previous studies have performed sensory assessments following the performance of the block. Our findings in Group-TAP were similar to those of Støving *et al*.,[23] where 75% seemed to have a blockade of the region corresponding to midline T11 dermatome, an absence of blockade along the mid-clavicular line in a majority of the patients, and no consistent or predictable block pattern. Likewise, Nielsen *et al*'s[24] cutaneous mapping following TFP also shows no blockade of the lower anterior abdominal dermatomes.

Wide variability in dermatomal blockade with these blocks leads us to consider that the pathways taken by the nerves in the abdominal fascial planes may be diverse and not just limited to the TAP plane. The complex interconnections of the thoracolumbar nerves in the fascial planes may be another cause for the inability to obtain a consistent surface area/dermatomal block, which has to be determined by future studies.

Our study has a few limitations. Patient-controlled analgesia is a superior method of quantifying the efficacy of an analgesic technique; however, it was not employed due to cost constraints. The sterile incision dressing was not disturbed, so the midline T12 dermatome was not assessed.

CONCLUSION

Both the interventions, TAP and TFP, did not decrease the rescue analgesic requirement compared to the control group. The posterior-TAP block prolonged the duration of analgesia by 2 h, maintained the median static pain score at 0 beyond 12 h and demonstrated sensory loss at the infra umbilical dermatomes. However, in the light of 'minimal clinically important difference', none of these findings are clinically significant.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval as per the authors' Institution policy.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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