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ORIGINAL RESEARCH

Technology or tradition? Transversus abdominis plane block versus wound infiltration for postoperative analgesia after lower abdominal surgeries

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Background: A transversus abdominis plane (TAP) block is a fascial plane block performed to provide analgesia after surgeries with lower abdominal incisions. Ultrasound guidance has increased the success of TAP blocks. Our study compared wound infiltration, a time-tested method, with a TAP block for postoperative analgesia in lower abdominal surgeries.

Methods: In this prospective, randomised double-blind study, 100 female patients undergoing lower abdominal surgeries with a transverse incision under spinal anaesthesia received either wound infiltration (group A) or bilateral ultrasound-guided (USG) TAP block (group B) with 30 ml of 0.75% ropivacaine after the surgery. A visual analogue scale (VAS) was used to assess analgesia at 0, 2, 4, 6, 12 and 24 h and patient satisfaction was assessed at 0 and 24 h postoperatively. We recorded the total amount of analgesic consumed in 24 h postoperatively as well as complications.

Results: There was significantly longer duration of analgesia in group B (19.12 ± 1.92 vs 3.02 ± 1.16 h; $p < 0.001$), and higher patient satisfaction at 24 h (7 [5–8] vs 6 [5–8]; $p < 0.001$). The VAS score for pain was lower in group B at 2 h (0 [0–0] vs 1 [0–5]; $p < 0.001$), 4 h (0 [0–1] vs 3 [2–4]; $p < 0.001$), 6 h (0 [0–1] vs 3 [2–5]; $p < 0.001$) and 12 h (1 [0–2] vs 3 [2–4]; $p < 0.001$). However, the scores were similar at 0 and 24 hours. The total amount of analgesic consumed in group A was significantly higher than group B. Postoperative nausea and vomiting (PONV) was the most common event seen.

Conclusion: USG TAP block reduces both postoperative pain scores and the amount of analgesic consumed while providing a longer duration of analgesia and better patient satisfaction compared with wound infiltration.

Keywords: TAP block, ropivacaine, postoperative analgesia, hysterectomy, wound infiltration, lower abdominal surgeries

Introduction

The transverse incision for lower abdominal surgeries transgresses a limited number of dermatomes providing a good chance for nerve blocks.[1,2] The nerves supplying the anterior abdominal wall do not travel in a closed compartment or form a plexus, thus, entailing injection of large volumes of local anaesthetic (LA) in the fascial plane.[3] Complications analogous with this fascial block such as bowel haematoma, organ laceration, etc., have led to the infrequent use of such techniques.[4] There is a need for an effective method for postoperative analgesia after intra-abdominal procedures without significant systemic effects.[5,6] Infiltration of the surgical wound with LA is a commonly used technique to ensure relief of immediate postoperative pain and has been in practice for decades.[7] This technique calls for cooperation of and care from the surgeons to include all anatomical layers. The advent of ultrasonography has increased the efficacy of a transversus abdominis plane (TAP) block.[8] A TAP block has been compared with various other techniques providing postoperative analgesia after abdominal surgeries and with various approaches to a TAP block itself, to determine the spread, volume and amount of drug required. These studies demonstrate the need for more evaluation of a TAP block.[9,10] Moreover, there is no convincing data available comparing these two techniques head-to-head to establish superiority beyond doubt. We compared analgesic efficacies and postoperative patient satisfaction of these two techniques among patients undergoing lower abdominal surgeries. The primary objective was to ascertain and compare the duration of postoperative analgesia of these two techniques, while determining total analgesic consumption in the first 24 h and patient satisfaction at 24 h postoperatively were secondary outcomes.

Methods

This study was carried out at a tertiary care teaching hospital from August 2012 to October 2014. After obtaining Institutional Ethics Committee clearance, 100 adult female patients classified as American Society of Anesthesiologists (ASA) physical status I, II or III who were scheduled to undergo lower abdominal surgeries with a transverse incision under spinal anaesthesia were enrolled for the study. The patients were thoroughly evaluated, and informed consent was obtained. Participating patients were briefed on the visual analogue scale (VAS) for pain and satisfaction, kept nil per oral for 8 hours for solids and 2 hours for clear liquids preceding surgery. All patients were premedicated with tablet diazepam (5 mg for patients less than 50 kg and 10 mg for patients more than 50 kg) and tablet ranitidine (150 mg) at bedtime and two hours prior to surgery. The following patients were excluded from the study: refusal to participate, history of

sensitivity and contraindications to drugs used, coagulopathy, infection at the block site, neurological deficits, chronic analgesic consumption, psychiatric illness, and failure of spinal anaesthesia requiring supplemental general anaesthesia.

Participants were randomised into two groups using a computer-generated random number table to receive either wound infiltration (group A) or bilateral ultrasound-guided (USG) TAP block (group B). A screen was used so that both the patient and the observer were not able to see and know the technique performed, and they were not aware of the group allocation of participants. The observers were the postoperative ward team, and they were given a standardised form to complete. The data obtained from the observers were analysed by the authors of the paper. After moving the patient to the operation theatre, intravenous (IV) access was secured, and crystalloid infusion was started. Monitoring included electrocardiogram, noninvasive blood pressure (NIBP) and oxygen saturation (SpO_2). After recording the baseline values for heart rate, blood pressure and SpO_2, the patient underwent spinal anaesthesia with 3.5 ml of 0.5% bupivacaine (hyperbaric) in the L_3–L_4 space in lateral position with a 25 G Quincke-Babcock needle. Towards the end of the surgery, group A received wound infiltration before skin closure with 30 ml of 0.75% ropivacaine to all the layers of the abdominal wall at the incision site, while group B received bilateral USG TAP block with 15 ml of 0.75% ropivacaine on each side. The authors performed both the procedures.

For the TAP block, the ultrasound probe was placed on the lateral abdominal wall between the iliac crest and costal margin in a transverse position. The probe was slid and tilted as necessary until a clear view of all three abdominal muscle layers was obtained. A needle was advanced from an anteromedial position in a posterolateral direction using an in-plane technique, with the entry point in the skin being separated from the probe to improve needle visibility in the long axis. The LA injection was observed in real-time across the neuro-fascial plane between the internal oblique and transversus abdominis muscles.[11]

The presence and severity of pain were assessed at 0, 2, 4, 6, 12 and 24 h postoperatively. Pain severity and patient satisfaction both directly after surgery and at 24 h were measured using a VAS. IV tramadol 50 mg was used as a rescue analgesic in both groups whenever VAS > 3 was indicated. The time and amount of analgesic consumed were recorded. Only tramadol was used as a rescue analgesic, as a single analgesic would be a better indicator of total analgesic consumed. NIBP, heart rate and SpO_2 were continuously measured after participants arrived in the postoperative unit. The values at 0 h and then at 2, 4, 6, 12 and 24 h were specifically noted. Other side effects like nausea, vomiting, dysrhythmia, urinary retention, and signs and symptoms of LA toxicity were noted and treated accordingly. Intralipid 20% (Fresenius Kabi India Pvt. Ltd) was always available in the postoperative crash cart.

Statistical analysis

The sample size was calculated by using the formula for the prevalence of pain, based on:

$$n = \frac{Z^2(p)\,(1-p)\,N}{(N.e^2) + Z^2(p)(1-p) - e^2}$$

Where n = sample size, p = prevalence, e = margin of error, N = population size, Z = confidence level at 95%. Data were

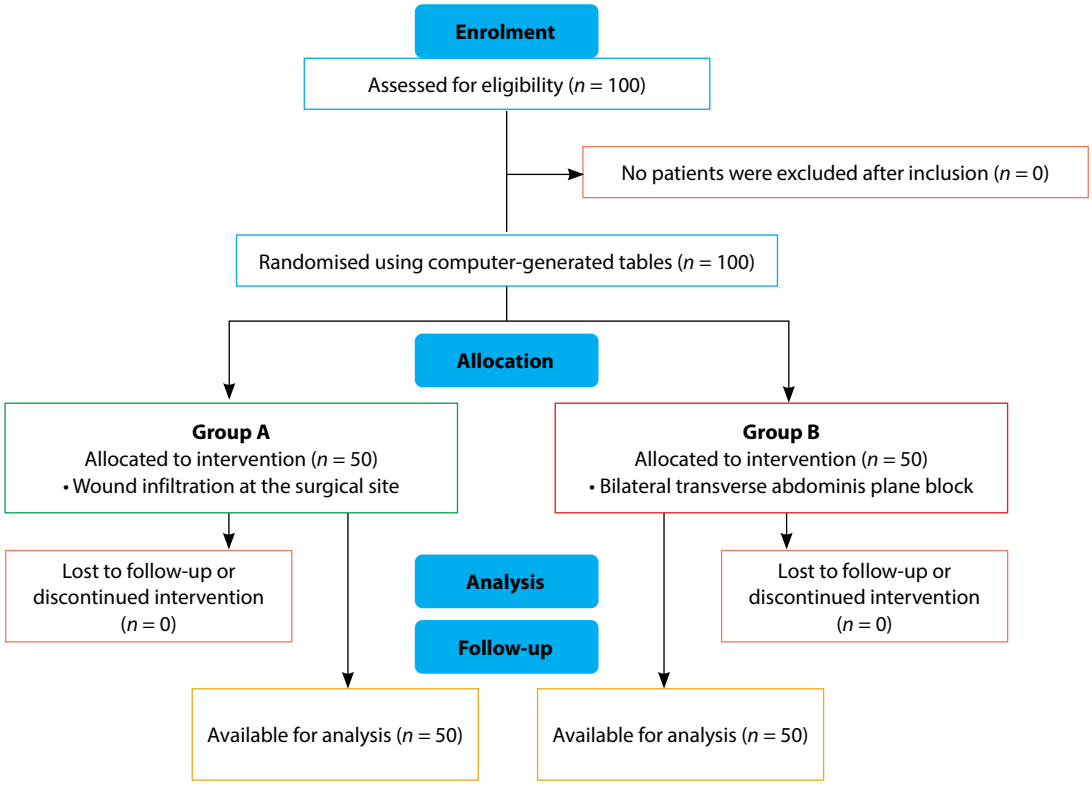

Figure 1: CONSORT flow chart for recruitment of study participants

compiled using Microsoft Excel 2007 and analysed using IBM SPSS Statistics for Windows (Version 20.0; Armonk, NY: IBM Corp). The student *t*-test was used for age, weight and duration of surgery and the chi-square test was used for distribution of types of surgery and postoperative complications. VAS scores for pain and satisfaction were analysed using the Wilcoxon signed-rank test and the Mann–Whitney U test. *P*-values < 0.05 were considered significant, while *p*-values < 0.001 were considered highly significant.

Results

All participants completed the study and were available for analysis. The Consolidated Standards of Reporting Trials (CONSORT) flow chart for recruitment of study participants is shown in Figure 1. Both groups were similar demographically (Table I), including the type of procedure participants underwent ($p = 0.904$) (Table II).

Duration of analgesia (Table III): The duration of analgesia was significantly longer in group B (TAP block) (19.12 ± 1.92 h) compared to group A (wound infiltration) (3.02 ± 1.12 h; $p < 0.001$).

Total amount of analgesic consumed in 24 hours (Table III): The total amount of tramadol (in mg) consumed for achieving adequate postoperative analgesia in the first 24 h was significantly more in group A (412 ± 52.06 vs 61 ± 20.9; $p < 0.001$).

VAS scores for pain (Table IV): The VAS scores for pain were comparable in the immediate postoperative period and at 24 h. However, the scores were clinically and statistically lower in group B at 2 h (0 [0–0] vs 1 [0–5]; $p < 0.001$), 4 h (0 [0–1] vs 3 [2–4]; $p < 0.001$), 6 h (0 [0–1] vs 3 [2–5]; $p < 0.001$) and 12 h (1 [0–2] vs 3 [2–4]; $p < 0.001$) postoperatively.

VAS scores for satisfaction (Table V): The VAS scores for patient satisfaction were comparable in the immediate postoperative period. However, the scores were clinically and statistically significantly higher in group B at 24 h (7 [5–8] vs 6 [5–8]; $p < 0.001$).

Postoperative adverse effects: The incidence of postoperative nausea and vomiting (PONV) in group A was 24% which was significantly higher compared to 4% in group B; Chi-square – 8.31 ($p = 0.003$). No complications relating to LA toxicity due to ropivacaine were encountered. In our study, no severe adverse effects of tramadol were noted.

Table I: Demographic profiles

Sl no	Parameter	Group A ($n = 50$)	Group B ($n = 50$)	*t*	*p*
1.	Age (yr)	49.96 ± 7.68	48.86 ± 7.362	0.731	0.466
2.	Weight (kg)	48.7 ± 7.274	50.2 ± 7.835	-0.992	0.324
3.	Duration of surgery (h)	1.96 ± 0.3476	1.98 ± 0.3637	-0.281	0.779
4.	Time to sensory regression to L2 (min)	158.2 ± 11.551	159.2 ± 11.753	-0.429	0.669

Note: numbers ± standard deviation

Table II: Distribution of types of surgical procedures between the groups

	Group A	Group B	Chi-square test	*p*-value
Hysterectomy	38	38	0.2019	0.904
Myomectomy	9	8		
Ovarian cystectomy	3	4		

Table III: VAS score for pain at various intervals

Time	Group	Min.	Max.	25th perc.	Median	75th perc.	IQR	*p*-value*
VAS score 0 h	A	0	0	0	0	0	0	1
	B	0	0	0	0	0	0	
VAS score 2 h	A	0	5	1	1	2	1	**< 0.001**
	B	0	0	0	0	0	0	
VAS score 4 h	A	2	4	2.75	3	3	0.25	**< 0.001**
	B	0	1	0	0	0	0	
VAS score 6 h	A	2	5	3	3	3	0	**< 0.001**
	B	0	1	0	0	1	1	
VAS score 12 h	A	2	4	2.75	3	3	0.25	**< 0.001**
	B	0	2	0	0	1	1	
VAS score 24 h	A	2	4	2.75	3	3	0.25	0.642
	B	2	4	2	3	3	1	

Min – minimum, Max – maximum, Perc. – percentile, IQR – inter quartile range, VAS – visual analogue scale
*Mann–Whitney U test was used

Table IV: Duration of analgesia and total amount of analgesic consumed in 24 hours

	Group	*N*	Mean	SD	*t*	df	*p*-value
Duration analgesia (hrs)	Group A	50	3.02	1.116	-51.2	78.615	< 0.001
	Group B	50	19.12	1.923			
Amount of tramadol consumed (mg)	Group A	50	412	52.06	44.236	64.427	< 0.001
	Group B	50	61	20.923			

N – number of patients, SD – standard deviation, df – degree of freedom

Table V: VAS score for satisfaction

	Mann–Whitney U	Wilcoxon W	Z	Exact Sig. (2-tailed)
VAS satisfaction after surgery	1 024	2 299	-1.69	0.095
VAS satisfaction 24hrs	746	2 021	-3.76	**< 0.001**

Z – confidence interval, VAS – visual analogue scale

Discussion

A TAP block is a well-known technique used to provide good postoperative analgesia following lower abdominal procedures. We compared it with wound infiltration, which is still a commonly used technique for providing postoperative analgesia in scarce resource settings. The study population was comparable demographically across both groups.

Duration of analgesia

Our results reinforced that wound infiltration with LA provides satisfactory analgesia though the duration is noticeably short (3.02 ± 1.12 h). The effect of the subarachnoid block (SAB) on the outcomes is ruled out as regression to L2 dermatome was much shorter (about 40 minutes in the postoperative period) than the need for rescue analgesia. Time to first rescue analgesic was significantly longer in group B (19.12 ± 1.92 h). Several reports indicate a variable duration of analgesia following a TAP block (45 minutes to 12 h),[12,13] and the current study has the longest duration of analgesia. This can be because of a higher amount of analgesic administered along with the commonly used volume to ensure involvement of the intended dermatomes.[3] Smaller quantities (to a maximal dose of 150 mg) of ropivacaine in a similar concentration (0.75%) produced a shorter duration of postoperative analgesia (45 minutes [26–116]).[14] However, the authors did not specify the duration of the surgical procedure. Larger amounts of the LA have been shown to produce a longer time to rescue analgesia (7.1 ± 4.6 h).[15] A modified technique of TAP block using laparoscopic guidance is reported to be more effective than port site infiltration following laparoscopic surgeries.[16]

VAS scores for pain

The VAS scores for pain immediately after the surgery and at 24 hours were comparable between the groups. After the surgery, effect of spinal anaesthesia had not regressed. At 24 h the effect of the TAP block and wound infiltration were absent. However, at 2, 4, 6 and 12 h the VAS scores in group A were significantly higher in the current study ($p < 0.001$), demonstrating the effectiveness of the TAP block in providing postoperative analgesia. Earlier studies demonstrated a similar trend in VAS scores, where the scores were similar at 24 h between the TAP and control groups.[14,16,17] However, a meta-analysis reported the prolonged analgesic effect of TAP block beyond 24 h.[18]

Total amount of tramadol (analgesic) consumed in 24 h

The total amount of tramadol consumed in the 24 h postoperative period was significantly less in group B (412 ± 52.06 vs 61 ± 20.923 mg; $p < 0.001$) with a mean difference of 351 mg (morphine equivalent of 35.1 mg). A meta-analysis showed that overall pooled mean difference in morphine consumption at 24 h favoured the TAP block by 11.76 mg.[17] The opioid-sparing effect seen in the current study is consistent with the findings of other studies, thereby establishing analgesic efficacy of the TAP block for postoperative analgesia in lower abdominal procedures.[6,16,17,19,20] Contradictory to this outcome, a meta-analysis found that there was no difference in morphine consumption between the TAP block group and wound infiltration group over 24 h. However, the authors did not report the drug volume, concentration and timing of block.[18]

Postoperative satisfaction

Patient satisfaction is a comprehensive qualitative measure of effective healthcare delivery. Patient satisfaction in the immediate postoperative period reflects the adequacy of analgesia and overall comfort of the patient. The satisfaction scores taken immediately after the surgery were comparable between the groups. This may be explained by the presence of the residual effect of spinal anaesthetic at the time of measurement. The care provided was the same between the two groups perioperatively. The average time to regression of the spinal block to L2 was 158 ± 11 minutes, while the total duration of surgery was 116 ± 20 minutes. Thus, not exposing any patient to pain at the time of measurement. Patient satisfaction was assessed at 24 h post-surgery and showed significantly higher scores in group B ($p < 0.001$). This may be attributed to two factors: better postoperative analgesia and lesser side effects due to rescue analgesic (like PONV). Interestingly, despite good evidence of improved patient satisfaction for analgesia with a TAP block,[16,19,20] a meta-analysis found that a TAP block had no effect on patient satisfaction at 24 h.[17]

Dosage and volume of local anaesthetic used

In the current study, 30 ml of 0.75% ropivacaine, which amounts to 225 mg (4.5 mg/kg on average) of ropivacaine was used. This is higher than the recommended upper limit for ropivacaine for major nerve blocks without adrenaline.[21] However, none of the patients experienced any adverse effects regardless of the dosage used. We observed a prolonged duration of analgesia. Deposition of the drug into the facial plane, which is relatively avascular, delaying its systemic absorption could explain the extended analgesia in group B. In group A, no reason could be found to explain this outcome. Different concentrations and volumes of LA solutions have been used for TAP blocks, with variable durations of analgesia.[12-15,22,23] A dose of 3 mg/kg or 200 mg did not produce any symptoms, though the plasma levels were above the prescribed limit.[23,24] Ræder et al.[25] used 40 ml of 0.75% ropivacaine or 300 mg in axillary brachial plexus blocks and have not documented any adverse effect of ropivacaine toxicity. More studies are needed that closely monitor blood levels and toxic manifestations to advocate the use of higher quantities of LA for a TAP block using ultrasound guidance.

Postoperative adverse effects

The incidence of PONV in group A was more (24% vs 4%; p = 0.003), which can be attributed to higher amounts of tramadol consumed. Reports suggest a higher incidence of PONV, sedation, pruritus or even respiratory failure with the control group when compared to the TAP block group.[19,24,26,27] But there is no homogeneity among these. Superior analgesia, need for less opioids or early mobility may be the reasons for these observations. Even though the dosage of ropivacaine used was more than 3 mg/kg in some patients, no signs and symptoms of LA toxicity were observed. The amount of tramadol consumed by some patients in 24 h was more than the recommended dose. Patients did not experience any severe side effects despite the elevated dose of tramadol.

Strength of the study

The strength of this study includes adequate sample size, randomised double-blinding to avoid bias, and appropriate use of technology to ensure success of the block. All participants completed the study and there was no block failure. Only female patients were enrolled as the transverse incision is commonly used for obstetric and gynaecological procedures.[28] Patient satisfaction was recorded soon after the procedure, which was similar between the groups, to rule out possible influence due to the intraoperative events. To rule out the effect of the residual subarachnoid block, regression of spinal analgesia to L2 was noted. Therefore, the outcomes of this study are robust and generalisable.

Limitations of the study

Postoperative sedation was not assessed. Therefore, another adverse effect of systemic analgesics which might have occurred in group A was missed. The concentration of ropivacaine used (i.e. 30 ml of 0.75%, which amounts to 225 mg) was higher than the safe upper limit of 3 mg/kg for most of the participants. Even though no side effects were seen, estimation of plasma concentrations would have revealed peak levels and added to the information regarding its safety profile. Patient-controlled analgesia could have been used to provide postoperative rescue analgesic so that we would have had a more accurate estimate of analgesic consumed. The total amount of tramadol consumed in 24 h for postoperative analgesia exceeded the recommended dosage in some of the patients, which was not anticipated, and came to light only during analysis. None of the patients experienced serious adverse effects. The severity of pain was assessed only during rest. VAS scores for pain during movement would have provided better information regarding the efficacy of the TAP block for postoperative analgesia and enhanced the comparability with other studies.

Conclusion

A TAP block provides a longer duration of analgesia, reduces the amount of analgesic consumed in the postoperative period and provides better patient satisfaction with lesser adverse effects than wound infiltration after lower abdominal surgeries.

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Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

This study was approved by the KS Hedge Medical Academy Institutional Ethics Committee clearance [INST.EC/E.C/20/2012-13].

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