

COMPARISON OF ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK AND LOCAL WOUND INFILTRATION FOLLOWING CAESAREAN DELIVERY USING IMMEDIATE POSTOPERATIVE ANALGESIC OUTCOMES: A PROSPECTIVE RANDOMISED COMPARATIVE STUDY

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Received : 26/08/2026
Received in revised form : 18/09/2026
Accepted : 01/10/2026

Keywords:

Transversus abdominis plane block; wound infiltration; caesarean delivery; postoperative analgesia; bupivacaine; ultrasound guidance.

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DOI: 10.47009/jamp.2026.8.5.90

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (5); 574-580



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ABSTRACT

Background: Pain after caesarean delivery delays mobilisation and early care of the newborn. Transversus abdominis plane (TAP) block and local wound infiltration are two abdominal wall techniques used when intrathecal morphine is not given. This study compared the two techniques for immediate postoperative analgesia. **Materials and Methods:** Sixty parturients undergoing caesarean delivery under spinal anaesthesia were randomly allocated to two groups of 30 using a computer-generated sequence. Group T received a bilateral ultrasound-guided TAP block with 20 mL of 0.25% bupivacaine on each side after skin closure. Group W received local wound infiltration with 40 mL of 0.25% bupivacaine by the surgeon before closure. Pain was scored on a visual analogue scale (VAS) at rest and on coughing for 24 hours. The primary outcome was time to first rescue analgesic. Secondary outcomes were total tramadol use, time to ambulation, procedure time, patient satisfaction and adverse effects. **Results:** Time to first rescue analgesic was longer in Group T than in Group W (7.6 ± 2.1 vs 4.3 ± 1.5 hours; $p < 0.001$). Group T needed less tramadol in 24 hours (75.0 ± 41.0 vs 126.7 ± 45.0 mg; $p < 0.001$). VAS scores at rest and on coughing were lower in Group T from 2 to 12 hours. At 24 hours, pain scores were similar. Women in Group T walked earlier (10.4 ± 2.2 vs 12.6 ± 2.6 hours; $p < 0.001$). The block took longer to perform. Adverse effects did not differ between groups, and no block-related complication was seen. **Conclusion:** In caesarean delivery under spinal anaesthesia, ultrasound-guided TAP block was associated with a longer time to first rescue analgesia and lower rescue analgesic use than local wound infiltration using the same dose of bupivacaine.

INTRODUCTION

Caesarean delivery is one of the most common major operations performed in women, and its rate continues to rise in many countries. Most women have moderate to severe pain in the first 24 to 48 hours after the operation. The pain is present at rest, but it is worse on coughing, turning in bed and getting up to walk. A new mother must care for her baby and start breastfeeding within hours of surgery. Poor pain control makes these early tasks harder. It also delays mobilisation, which raises the risk of venous thromboembolism. Good analgesia after caesarean

delivery should therefore keep the mother alert and mobile and limit drug transfer into breast milk.^[1]

The effects of poorly treated pain may last beyond the hospital stay. Severe acute pain after surgery is a known risk factor for persistent postsurgical pain. In a cohort study of women followed after childbirth, persistent pain was more common after caesarean section than after vaginal birth, and some women still reported pain a year later.^[2] Control of acute pain in the first postoperative day is therefore part of routine clinical care.

Pain after caesarean delivery has two parts. The somatic part comes from the skin incision and the

anterior abdominal wall. It is carried by the anterior rami of the lower thoracic nerves (T10 to T12) and the first lumbar nerve. The visceral part comes from the uterine incision and the handling of the peritoneum and bowel. The somatic part makes up a large share of the pain felt on movement and coughing. Techniques that target the abdominal wall can therefore reduce pain scores and the need for systemic drugs.

Systemic opioids have long been the basis of pain relief after caesarean delivery. They work well, but they cause nausea, vomiting, itching and sedation, and they pass into breast milk in small amounts. Intrathecal morphine gives long-lasting analgesia. However, it needs monitoring for delayed respiratory depression, and many centres do not use it routinely. Current practice favours a multimodal approach. The PROSPECT working group reviewed the evidence for elective caesarean section. It recommended spinal anaesthesia with intrathecal morphine, regular paracetamol and non-steroidal anti-inflammatory drugs. When intrathecal morphine is not given, it suggested local anaesthetic wound infiltration or a truncal block such as the transversus abdominis plane (TAP) block.^[3]

The TAP block targets the nerves of the anterior abdominal wall where they run between the internal oblique and transversus abdominis muscles. Local anaesthetic placed in this plane spreads to block the T10 to L1 segmental nerves. The block was first done with a landmark technique through the lumbar triangle of Petit. An ultrasound-guided approach was later described, in which the needle tip and the spread of drug can be seen in real time.^[4] Ultrasound guidance helps place the drug in the correct plane and lowers the risk of needle entry into the peritoneum. The block is usually given at the end of surgery, while the spinal anaesthetic is still working. It adds a few minutes to theatre time. It also needs an ultrasound machine and an anaesthetist trained in the technique. Local wound infiltration is a simpler option. The surgeon injects local anaesthetic into the layers of the wound during closure. It needs no extra equipment and takes very little time. It acts only on the nerve endings at the wound, so its spread and duration may be limited. A Cochrane review looked at local anaesthetic wound infiltration and abdominal nerve blocks during caesarean section. Both methods reduced opioid use after surgery, but the trials were few and small, and the review could not say which method was better.^[5]

The choice between TAP block and wound infiltration therefore remains open. Each method has practical costs. The TAP block needs ultrasound, extra time and a skilled operator. Wound infiltration is quick and cheap but may give shorter pain relief. In many hospitals in low- and middle-income settings, intrathecal morphine is not used routinely after caesarean delivery. In this setting, the abdominal wall technique carries a larger share of the analgesic load. A direct comparison of the two methods under local conditions can help guide

practice. Few prospective studies have compared them in women having caesarean delivery under spinal anaesthesia without intrathecal morphine, and their results differ.

We therefore designed this prospective randomised comparative study. We compared bilateral ultrasound-guided TAP block with local wound infiltration, using the same drug and the same dose, in women undergoing caesarean delivery under spinal anaesthesia. The primary outcome was the time to first rescue analgesic. Secondary outcomes were pain scores at rest and on movement over the first 24 hours, total rescue analgesic use, time taken to perform the assigned technique, time to first ambulation, patient satisfaction and adverse effects.

MATERIALS AND METHODS

This prospective randomised comparative study was carried out in the Department of Anaesthesiology of a tertiary care medical institute. The duration of the study was 2 years. Written informed consent was obtained from all participants. Sixty parturients of American Society of Anesthesiologists (ASA) physical status II, aged 18 to 40 years, with a term singleton pregnancy and scheduled for elective or non-urgent emergency caesarean delivery through a Pfannenstiel incision under spinal anaesthesia were enrolled. Women were excluded if they refused consent or had a contraindication to spinal anaesthesia, allergy to local anaesthetics, coagulopathy, infection at the block or puncture site, body mass index above 40 kg/m², pre-eclampsia, or chronic opioid use. Women whose anaesthesia was converted to general anaesthesia were also excluded. Participants were randomly allocated to two equal groups of 30 using a computer-generated randomisation sequence. Group T received a bilateral ultrasound-guided TAP block. Group W received local wound infiltration. The observer who recorded postoperative outcomes was not involved in giving the block or the infiltration and did not know the group allocation.

Standard monitoring was applied. Spinal anaesthesia was given in the sitting position at the L3–L4 interspace with a 25-gauge Quincke needle, using 2.2 mL of 0.5% hyperbaric bupivacaine. No intrathecal opioid was used. Surgery started once a sensory level of T6 was reached.

In Group T, the block was performed after skin closure. A linear ultrasound probe (6–13 MHz) was placed transversely in the mid-axillary line between the costal margin and the iliac crest. A 22-gauge, 80 mm short-bevel needle was inserted in-plane into the plane between the internal oblique and transversus abdominis muscles. After negative aspiration, 20 mL of 0.25% bupivacaine was injected on each side (total 40 mL, 100 mg). In Group W, the operating obstetrician infiltrated 40 mL of 0.25% bupivacaine before skin closure: 20 mL below the rectus sheath and 20 mL into the subcutaneous tissue along both

sides of the incision. The time taken to perform each technique was recorded.

All women received intravenous paracetamol 1 g every 8 hours. Pain was assessed on a 10 cm visual analogue scale (VAS; 0 = no pain, 10 = worst imaginable pain) at rest and on coughing at 0 (arrival in the recovery room), 2, 4, 6, 12 and 24 hours. Intravenous tramadol 50 mg was given as rescue analgesia when the VAS at rest was 4 or more, or on patient request, with at least 4 hours between doses. The primary outcome was the time from the end of the block or infiltration to the first rescue dose. Secondary outcomes were VAS scores, number of tramadol doses and total tramadol use in 24 hours, time taken to perform the assigned technique, time to first ambulation, and patient satisfaction at 24 hours on a four-point scale (excellent, good, fair, poor). Nausea, vomiting, sedation (Ramsay score of 3 or more), pruritus, block-site haematoma and signs of local anaesthetic toxicity were recorded. Ondansetron 4 mg was given for nausea or vomiting. Data were analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous data are

shown as mean $\pm$ standard deviation and were compared with the independent samples t-test. Categorical data are shown as number (percentage) and were compared with the chi-square test or Fisher's exact test, as appropriate. Repeated VAS measurements were summarized at each prespecified time point and compared between groups with independent-samples t-tests; these time-point comparisons were treated as secondary exploratory analyses, and no adjustment for multiple comparisons was applied. A p-value below 0.05 was taken as statistically significant.

RESULTS

All 60 women completed the study, and their data were analysed. No participant was excluded after allocation. Most women in both groups were aged 18 to 30 years. The mean age was 27.4 ± 4.6 years in Group T and 27.9 ± 4.9 years in Group W, with no difference between the groups ($p = 0.685$) (Table 1).

Table 1: Age distribution of the study population (n = 60). Data are n (%) or mean $\pm$ SD

Age group (years)	Group T (n = 30)	Group W (n = 30)	p-value
18–25	11 (36.7%)	10 (33.3%)	
26–30	10 (33.3%)	11 (36.7%)	
31–35	7 (23.3%)	6 (20.0%)	
36–40	2 (6.7%)	3 (10.0%)	
Mean age $\pm$ SD (years)	27.4 ± 4.6	27.9 ± 4.9	0.685
Gender: female, n (%)	30 (100%)	30 (100%)	—

The two groups were similar in weight, height, body mass index, gestational age, previous caesarean delivery, type of surgery and duration of surgery ($p > 0.05$ for all) (Table 2).

Table 2: Baseline obstetric and surgical characteristics of the two groups (n = 60). Data are mean $\pm$ SD or n (%)

Parameter	Group T (n = 30)	Group W (n = 30)	p-value
Weight (kg)	64.8 ± 7.2	65.6 ± 7.8	0.681
Height (cm)	155.4 ± 5.2	154.9 ± 5.6	0.721
Body mass index (kg/m ²)	26.8 ± 2.9	27.3 ± 3.1	0.521
Gestational age (weeks)	38.6 ± 0.9	38.4 ± 1.0	0.419
Previous caesarean delivery, n (%)	11 (36.7%)	12 (40.0%)	0.791
Emergency surgery, n (%)	12 (40.0%)	13 (43.3%)	0.793
Duration of surgery (min)	52.6 ± 8.4	54.1 ± 9.0	0.507

VAS scores at rest were similar on arrival in the recovery room. From 2 to 12 hours, scores at rest were lower in Group T than in Group W. The largest difference was at 6 hours (2.4 ± 0.9 vs 3.8 ± 1.1 ; $p <$

0.001). At 24 hours, the scores did not differ ($p = 0.227$) (Table 3). The trajectory of mean VAS scores at rest is shown in Figure 1.

Table 3: Visual analogue scale (VAS) pain scores at rest over 24 hours (n = 60). VAS 0 = no pain, 10 = worst imaginable pain

Time after surgery	Group T (n = 30)	Group W (n = 30)	p-value
0 hour	0.8 ± 0.6	0.9 ± 0.7	0.555
2 hours	1.4 ± 0.7	2.1 ± 0.9	0.001
4 hours	2.0 ± 0.8	3.1 ± 1.0	<0.001
6 hours	2.4 ± 0.9	3.8 ± 1.1	<0.001
12 hours	2.9 ± 1.0	3.6 ± 1.1	0.013
24 hours	2.6 ± 0.9	2.9 ± 1.0	0.227



Figure 1: Mean visual analogue scale (VAS) pain scores at rest over 24 hours in Group T and Group W.

Table 4: Visual analogue scale (VAS) pain scores on coughing over 24 hours (n = 60). Data are mean $\pm$ SD. Independent samples t-test used

Time after surgery	Group T (n = 30)	Group W (n = 30)	p-value
0 hour	1.4 $\pm$ 0.8	1.6 $\pm$ 0.9	0.367
2 hours	2.3 $\pm$ 0.9	3.2 $\pm$ 1.1	0.001
4 hours	2.9 $\pm$ 1.0	4.3 $\pm$ 1.2	<0.001
6 hours	3.4 $\pm$ 1.1	5.0 $\pm$ 1.3	<0.001
12 hours	3.9 $\pm$ 1.2	4.7 $\pm$ 1.3	0.016
24 hours	3.6 $\pm$ 1.1	4.1 $\pm$ 1.2	0.098

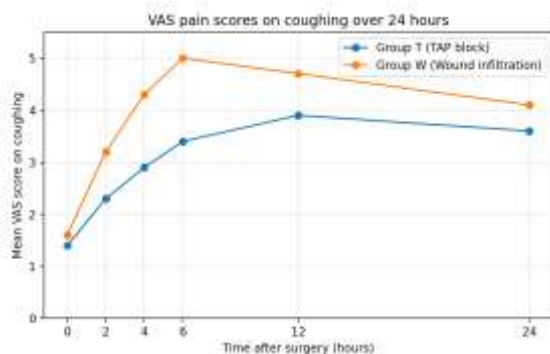


Figure 2: Mean visual analogue scale (VAS) pain scores on coughing over 24 hours in Group T and Group W.

Table 5: Time to first rescue analgesic in the two groups (n = 60). Data are mean $\pm$ SD or n (%). Independent samples t-test used for the mean; chi-square test used for the distribution

Parameter	Group T (n = 30)	Group W (n = 30)	p-value
Time to first rescue analgesic (h)	7.6 $\pm$ 2.1	4.3 $\pm$ 1.5	<0.001
< 4 hours, n (%)	2 (6.7%)	13 (43.3%)	
4–8 hours, n (%)	16 (53.3%)	15 (50.0%)	
> 8 hours, n (%)	12 (40.0%)	2 (6.7%)	
Distribution			<0.001

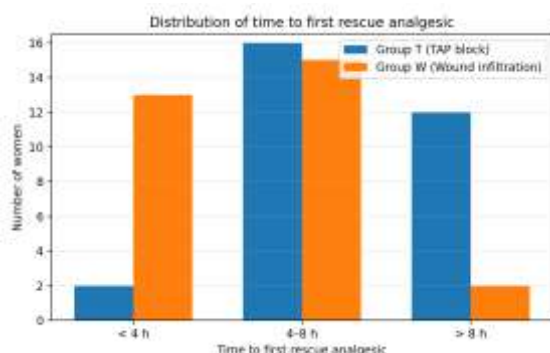


Figure 3: Distribution of time to first rescue analgesic in Group T and Group W.

Pain on coughing followed the same pattern. VAS scores on coughing were lower in Group T at 2, 4, 6 and 12 hours. At 6 hours, the mean score was 3.4 ± 1.1 in Group T and 5.0 ± 1.3 in Group W ($p < 0.001$). There was no difference at 0 and 24 hours (Table 4). The trajectory of mean VAS scores on coughing is shown in Figure 2.

The mean time to first rescue analgesic was 7.6 ± 2.1 hours in Group T and 4.3 ± 1.5 hours in Group W ($p < 0.001$). Thirteen women (43.3%) in Group W needed rescue analgesia within 4 hours, compared with two women (6.7%) in Group T. Twelve women (40.0%) in Group T did not need rescue analgesia for more than 8 hours ($p < 0.001$) (Table 5). The grouped distribution of time to first rescue analgesic is shown in Figure 3.

Group T needed fewer tramadol doses in the first 24 hours than Group W (1.5 ± 0.8 vs 2.5 ± 0.9 ; $p < 0.001$). Total tramadol use was 75.0 ± 41.0 mg in Group T and 126.7 ± 45.0 mg in Group W ($p < 0.001$). Three women in Group T needed no rescue analgesia, while all women in Group W needed at least one dose. [Table 6]

Table 6: Rescue analgesic (intravenous tramadol 50 mg) requirement in the first 24 hours (n = 60)

Parameter	Group T (n = 30)	Group W (n = 30)	p-value
No rescue dose, n (%)	3 (10.0%)	0 (0.0%)	0.237
1 dose, n (%)	12 (40.0%)	4 (13.3%)	
2 doses, n (%)	12 (40.0%)	10 (33.3%)	
3 doses, n (%)	3 (10.0%)	12 (40.0%)	
4 doses, n (%)	0 (0.0%)	4 (13.3%)	
Number of doses in 24 h	1.5 ± 0.8	2.5 ± 0.9	<0.001
Total tramadol in 24 h (mg)	75.0 ± 41.0	126.7 ± 45.0	<0.001

The TAP block took longer to perform than wound infiltration (7.8 ± 1.9 vs 3.4 ± 1.1 minutes; $p < 0.001$). Women in Group T walked earlier after surgery (10.4 ± 2.2 vs 12.6 ± 2.6 hours; $p < 0.001$). Satisfaction was

rated as excellent by 14 women (46.7%) in Group T and 6 women (20.0%) in Group W, but the overall distribution of satisfaction scores did not differ ($p = 0.067$) (Table 7).

Table 7: Procedure time, time to first ambulation and patient satisfaction at 24 hours (n = 60). Data are mean ± SD or n (%)

Parameter	Group T (n = 30)	Group W (n = 30)	p-value
Time to perform technique (min)	7.8 ± 1.9	3.4 ± 1.1	<0.001
Time to first ambulation (h)	10.4 ± 2.2	12.6 ± 2.6	<0.001
Satisfaction: excellent, n (%)	14 (46.7%)	6 (20.0%)	0.067
Satisfaction: good, n (%)	12 (40.0%)	13 (43.3%)	
Satisfaction: fair, n (%)	4 (13.3%)	9 (30.0%)	
Satisfaction: poor, n (%)	0 (0.0%)	2 (6.7%)	

Nausea occurred in 3 women (10.0%) in Group T and 8 women (26.7%) in Group W ($p = 0.181$). Rates of vomiting, sedation and pruritus did not differ

between the groups. No block-site haematoma or sign of local anaesthetic toxicity was seen (Table 8).

Table 8: Adverse effects in the first 24 hours (n = 60). Data are n (%). Fisher's exact test used

Adverse effect	Group T (n = 30)	Group W (n = 30)	p-value
Nausea	3 (10.0%)	8 (26.7%)	0.181
Vomiting	1 (3.3%)	4 (13.3%)	0.353
Sedation (Ramsay ≥ 3)	1 (3.3%)	3 (10.0%)	0.612
Pruritus	0 (0.0%)	1 (3.3%)	1.000
Block-site haematoma	0 (0.0%)	Not applicable	—
Local anaesthetic toxicity	0 (0.0%)	0 (0.0%)	—
Any adverse effect	5 (16.7%)	12 (40.0%)	0.084

DISCUSSION

In this study, bilateral ultrasound-guided TAP block was associated with a longer time to first rescue analgesia than local wound infiltration after caesarean delivery under spinal anaesthesia without intrathecal morphine. The first rescue dose came about three hours later with the block. Women in the TAP group needed less tramadol and had lower pain scores from 2 to 12 hours. By 24 hours, pain scores were similar.

McDonnell et al. first reported the use of the TAP block after caesarean delivery. In their randomised trial, a landmark-based TAP block with ropivacaine reduced pain scores and lowered 48-hour morphine use from 66 mg to 18 mg compared with a placebo block.^[6] Belavy et al. later tested the ultrasound-guided technique used in our study. In women who did not receive long-acting intrathecal opioid, median 24-hour morphine use fell from 31.5 mg to 18.0 mg, and satisfaction with pain relief was higher in the block group.^[7] Our patients also did not receive intrathecal morphine. The lower rescue analgesic use in our TAP group agrees with these two trials.

Two meta-analyses help explain when the TAP block is most useful. Abdallah et al. pooled five trials and

found that the TAP block reduced 24-hour morphine use by 24 mg when spinal morphine was not used. There was no clear benefit when spinal morphine was given.⁸ Mishriky et al. reached a similar conclusion from nine trials. In women who did not receive intrathecal morphine, the TAP block reduced opioid use at 6, 12 and 24 hours and lowered pain scores for up to 12 hours.^[9] This time pattern matches our results. The largest differences in pain scores in our study were at 4 and 6 hours. The gap narrowed at 12 hours and was lost at 24 hours, when a single injection of bupivacaine would be expected to wear off.

Our results are close to those of Sivapurapu et al. They compared TAP block with direct wound infiltration using the same dose of 0.25% bupivacaine in lower abdominal gynaecological surgery. The time to first rescue analgesic was longer, and pain scores and 24-hour morphine use were lower, in the TAP group.^[10] Their patients were not obstetric, but the incision and the nerves involved are the same.

Not all trials agree. Tawfik et al. compared bilateral ultrasound-guided TAP block (40 mL of 0.25% bupivacaine) with wound infiltration (30 mL of 0.25% bupivacaine) in 78 women. They found no difference in 24-hour fentanyl use, time to first opioid

dose, pain scores or satisfaction.^[11] Their patients received regular ketorolac and paracetamol along with patient-controlled fentanyl. This stronger background regimen may have left less room for a difference. Our background regimen was paracetamol alone. Chandon et al. compared TAP block with a 48-hour continuous wound infusion of levobupivacaine and found no difference in pain scores or morphine use.^[12] A continuous infusion is not directly comparable with a single-shot infiltration. That trial was stopped early after a seizure in the TAP group, so the total local anaesthetic dose must stay within safe limits.

Wound infiltration still has a place. Adesope et al. pooled 21 trials. Wound infiltration reduced 24-hour opioid use by about 10 mg morphine equivalents, but it had only a small effect on pain scores.^[13] In our study, the wound infiltration group also had fair pain control, with mean pain at rest at or below 3.8 during the first 24 hours. The main difference was the longer period before the first rescue dose with the TAP block. The TAP block reaches the segmental nerves that supply the whole lower abdominal wall. Wound infiltration acts only on the nerve endings close to the incision. This difference in spread may explain the longer effect of the block.

Our findings should be read in light of the spinal regimen. Kanazi et al. compared intrathecal morphine with ultrasound-guided TAP block. The median time to first analgesic request was 8 hours with intrathecal morphine and 4 hours with the TAP block. Nausea and pruritus were more common with intrathecal morphine.^[14] Costello et al. found that adding a TAP block to a regimen that included intrathecal morphine did not improve pain scores or opioid use.^[15] The evidence for TAP block is strongest when long-acting intrathecal morphine is not used or is contraindicated. This was the setting of our study, and it is common in many hospitals in our region.

Women in the TAP group walked about two hours earlier than those in the wound infiltration group. Lower pain on coughing between 4 and 12 hours may have contributed. We saw no block-related complications or signs of local anaesthetic toxicity. Nausea was less frequent after the block, but the difference was not statistically significant in this sample. The block took about four minutes longer to perform.

This study has limitations. It was a single-centre study with a small sample. The anaesthetist and surgeon could not be blinded to the technique, and there was no sham block. The time to first rescue analgesic was measured from completion of the block or infiltration, although the TAP block was performed after skin closure and wound infiltration before skin closure; the differing reference points may have introduced a small timing bias. VAS scores were compared separately at prespecified time points without a repeated-measures model or adjustment for multiple comparisons, so these secondary pain-score comparisons should be interpreted as exploratory.

The background analgesic regimen included regular paracetamol but not a scheduled non-steroidal anti-inflammatory drug, which may limit generalisability to contemporary multimodal regimens. Larger multicentre trials with standardized timing of outcome measurement, repeated-measures analysis and longer follow-up are needed.

CONCLUSION

In women undergoing caesarean delivery under spinal anaesthesia without intrathecal morphine, ultrasound-guided bilateral TAP block was associated with a longer time to first rescue analgesia than local wound infiltration using the same dose of bupivacaine. It delayed the first rescue analgesic by about three hours, reduced tramadol use in the first 24 hours, and was associated with lower pain scores between 2 and 12 hours in the prespecified time-point analyses. Women walked earlier after the block, and adverse effects were similar. Wound infiltration remains a quick and useful choice where ultrasound or trained staff are not available.

Declarations

Source of funding: None

Conflict of interest: None

Consent: Obtained

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