

ORIGINAL ARTICLE

Perioperative pain and inflammation after TAP block and wound infiltration

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Abstract. *Background and aim:* Effective pain management after cesarean section is essential for promoting a smooth recovery. This study compares the efficacy of the transversus abdominis plane (TAP) block with local anesthetic infiltration as multimodal analgesia techniques in reducing pain intensity, time until first opioid requirement, and neutrophil-to-lymphocyte ratio (NLR) in post-cesarean patients under spinal anesthesia. *Methods:* This single-blind randomized clinical trial included 46 patients undergoing elective cesarean sections under spinal anesthesia. Patients were randomly assigned to receive either a TAP block or local anesthetic infiltration. Pain intensity, time until first opioid requirement, and NLR values were measured at various intervals post-surgery. *Results:* There were no significant differences in pain scores during movement between the two groups. However, the TAP block group showed significantly lower pain scores at rest 24 hours post-surgery, indicating a longer-lasting analgesic effect. The NLR values were significantly higher in the local anesthetic infiltration group at 24 hours. No postoperative opioid rescue was required in either group. *Conclusions:* Both TAP block and local anesthetic infiltration effectively manage post-cesarean pain. However, the TAP block may offer a more prolonged analgesic effect. Additionally, NLR may serve as a valuable predictor for postoperative pain. Further research is warranted to investigate the potential of NLR as a biomarker for postoperative pain management. (www.actabiomedica.it)

Key words: cesarean section, local anesthetic infiltration, pain management, TAP block, neutrophil-to-lymphocyte ratio

Introduction

Postoperative pain following Caesarean section represented a prevalent concern that significantly impacted women's recovery. This surgical procedure often resulted in moderate to severe pain lasting up to 48 hours (1), with incidence rates of post-Caesarean pain reported between 1% and 23% within one year (2). A critical issue was the association of postoperative pain with chronic pain syndromes, which rose from 3% in 1997 to 29.3% in 2004 (3,4). Effective pain

management after Caesarean delivery presented substantial challenges, as it had to account for daily activities, quality of life, physiological changes, and the potential for drug transmission through breast milk (2,5). The Procedure Specific Postoperative Pain Management (PROSPECT) study group established evidence-based guidelines in 2014, which continued to evolve based on clinical relevance and effectiveness (6). These guidelines recommended the use of oral or intravenous paracetamol alongside NSAIDs, with opioids reserved for rescue (6). While NSAIDs and acetaminophen

were generally well tolerated, they had limitations in managing postoperative pain, particularly after major abdominal surgeries. Opioids could provide comprehensive analgesia but were associated with adverse effects such as nausea and respiratory depression (7). Intraoperative options included intrathecal morphine or, if not available, transversus abdominis plane (TAP) blocks and local wound infiltration (6). Studies indicated that TAP blocks and local anesthetic infiltration could effectively reduce pain, extend the duration of analgesia, and decrease opioid consumption within 24 hours postoperatively when employed as part of a multimodal analgesia regimen (8,9). A study demonstrated that TAP blocks could lower pain intensity for up to 24 hours, showcasing their feasibility and safety in remote hospitals (10). Another study supported the use of TAP blocks as a safe and economical option for post-Caesarean pain management, promoting early mobilization and enhancing mother-infant bonding (11). Local anesthetic infiltration had long been utilized for postoperative analgesia. Studies showed that ropivacaine infiltration after Caesarean section effectively provided analgesia and reduced the need for systemic analgesics (12). Additionally, local infiltration during spinal anesthesia was associated with decreased opioid requirements (13). The neutrophil-to-lymphocyte ratio (NLR) emerged as a recognized marker of sub-clinical inflammation, reflecting the balance between innate (neutrophils) and adaptive (lymphocytes) immune responses (14). NLR had been employed in various clinical investigations to assess inflammation and predict disease prognosis and outcomes. Its predictive role in conditions such as coronary artery disease and cancer suggested it could also serve as a useful tool for evaluating postoperative pain related to inflammatory pathways resulting from surgical trauma (15). Higher NLR scores indicated more severe inflammation, with studies demonstrating that lower NLR values correlated with better prognoses (16). Recent literature emphasized the importance of community-based data and identifying thresholds for utilizing NLR in prognostic applications (17). This study aimed to compare the effectiveness of TAP block with local anesthetic infiltration combined with intraoperative paracetamol as a multimodal analgesia approach on pain intensity, time to first opioid rescue, and NLR scores in patients undergoing spinal anesthesia for Caesarean section.

Patients and Methods

This study was a single-blind randomized clinical trial (RCT) conducted at Wahidin Sudirohusodo General Hospital and its Educational Network Hospital from August to September 2023. The participants included patients scheduled for elective Caesarean section surgery with spinal anesthesia. A simple random sampling technique was used. Inclusion criteria comprised patients aged 18–40 years with ASA physical status of 2, body mass index (BMI) of 18.50–29.99 kg/m², who consented to participate, and were undergoing transverse incision Caesarean section. Exclusion criteria included patient refusal, comorbidities, contraindications to TAP block or local anesthetic infiltration, drug allergies, and midline incision procedures. Drop-out criteria included clinical deterioration, severe allergic reactions, surgery duration exceeding 2 hours, or conversion to general anesthesia. This study has been performed in accordance with the Declaration of Helsinki and has been approved by Ethics Commission for Biomedical Research, Faculty of Medicine, Hasanuddin University (protocol number 810/UN4.5.4.5.31/PP36/2023) for the duration of the study. Participants who met inclusion criteria received a verbal explanation and signed a consent form. Participants were randomized into two groups: Treatment Group 1 received the TAP block, while Treatment Group 2 received local anesthetic infiltration. All patients underwent standard preparations, including 1 g paracetamol intravenously 30 minutes prior as preventive analgesia. Regional anesthesia was performed using 12.5 mg of 0.5% hyperbaric bupivacaine at the L3–L4 interspace with a 25 G spinal needle targeting the level of thoracal 6 block. Supplemental oxygen was provided at a flow rate of 3 liters per minute via nasal cannula. In Treatment Group 1, TAP block was performed intraoperatively using ultrasonography to identify the Transverse Abdominis Plane and injecting 0.25% isobaric bupivacaine (50 mg in 20 ml) bilaterally. In Treatment Group 2, local anesthetic infiltration was administered using 25 mg of bupivacaine 0.25% in the intraperitoneal, musculofascial, and subdermal areas. Postoperative pain management was given using paracetamol 500 mg orally every 6 hours. Pain intensity was measured using the Numeric Rating Scale (NRS), which ranges from 0 to 10, where 0 means no

pain and 10 indicates the worst possible pain. Based on the NRS, pain was classified into mild (NRS 1 to 3), moderate (NRS 4 to 6), and severe (NRS 7 to 10) pain (18). NRS measurements were taken at rest and during movement at 2-, 4-, 6-, 8-, 12-, and 24-hours post-treatment. Rescue analgesia was provided if the NRS exceeded 4, using intravenous fentanyl (0.5 - 1 mcg/kg), and the timing of the first rescue was recorded. Peripheral blood sampling of 3 mL was performed to measure NLR values before subarachnoid block and at 12- and 24-hours post-treatment. A normal range of NLR is between 1-2, the values higher than 3.0 and below 0.7 in adults are pathological (19). Data were processed using SPSS 25.0 for Windows, presented as narratives, tables, or graphs showing means, standard deviations, frequencies, and percentages. Categorical data were reported as frequencies (n) and percentages. Numerical data were presented as mean $\pm$ standard deviation (mean $\pm$ SD). The Kolmogorov-Smirnov test assessed data normality; unpaired t-tests or Mann-Whitney U tests were used for comparisons as appropriate. Paired T-Tests or Wilcoxon Z-Tests evaluated within-group changes, while chi-square or Fisher exact tests analyzed categorical data. Significance was set at $p \leq 0.05$.

Results

Sample characteristics

Table 1 presents the sample characteristics, indicating that the mean age of patients in Group 1 was 30.3 years (SD = 7.13), while in Group 2, it was 29.30 years (SD = 5.08). The mean BMI for Group 1 was 26.55 (SD = 5.40) compared to 28.68 (SD = 4.26) in Group 2. There were no significant differences in

age, weight, height, or BMI between the two groups ($p > 0.05$).

Pain intensity

The resting Numeric Rating Scale (NRS) values for Group 1 and Group 2 at the 2nd, 4th, 6th, 8th, and 12th hours showed no significant differences ($p > 0.05$) (Table 2). However, at the 24th hour, a significant difference was observed ($p < 0.05$). Similarly, for moving NRS, no significant differences were noted between the two groups at all time points ($p > 0.05$) (Table 3).

Comparison of time to first rescue opioid

No postoperative opioid rescue was required in either group.

Comparison of NLR levels

Table 4 and 5 showed that there was a significant difference in NLR values between Group 1 and Group 2 at the 24th hour post-surgery ($p < 0.05$). In Group 1, significant differences were observed between pre-surgery and 12 hours post-surgery, 12 hours and 24 hours post-surgery, and pre-surgery and 24 hours post-surgery ($p < 0.05$). Likewise, in Group 2, significant differences were noted ($p < 0.05$).

Discussion

Sample characteristics

There was no significant differences in age, weight, height, and BMI between the two groups, confirming the homogeneity of the sample characteristics.

Table 1. Sample characteristics

Characteristics	Group 1	Group 2	P-value
	Mean $\pm$ SD	Mean $\pm$ SD	
Age (year)	30.30 $\pm$ 7.13	29.30 $\pm$ 5.08	0.100
Body weight (kg)	63.50 $\pm$ 15.54	65.45 $\pm$ 12.67	0.107
Height (cm)	154.50 $\pm$ 0.06	156.01 $\pm$ 0.005	0.288
BMI (kg/m ²)	26.55 $\pm$ 5.40	26.86 $\pm$ 4.86	0.516

Data were presented as mean $\pm$ SD. Data were analyzed by unpaired t test. *Abbreviations:* ns: no significant difference. BMI: body mass index.

Table 2. Comparison of resting Numeric Rating Scale (NRS) of both groups.

	Treatment		P-value
	Group 1 (n=23)	Group 2 (n=23)	
2 nd hour	2 (2-3)	2 (2-3)	0.48
4 th hour	2 (2-4)	2 (2-4)	0.23
6 th hour	2 (2-4)	2 (2-4)	0.932
8 th hour	2 (2-4)	2 (2-4)	0.072
12 th hour	2 (2-4)	2 (2-4)	0.007*
24 th hour	2 (2-4)	2 (2-4)	0.001*

Data were presented as median (min-max). Data were analyzed by Mann-Whitney test. *: Significant, $p < 0.05$.

Table 3. Comparison of moving Numeric Rating Scale (NRS) of both groups.

Measurement Time	Treatment		P-value
	Group 1 (n=23)	Group 2 (n=23)	
2 nd hour	2 (2-3)	2 (2-3)	0.48
4 th hour	2 (2-4)	2 (2-4)	0.953
6 th hour	2 (2-4)	2 (2-4)	0.682
8 th hour	2 (2-4)	3 (2-4)	0.202
12 th hour	2 (2-4)	2 (2-4)	0.886
24 th hour	2 (2-4)	3 (2-4)	0.203

Data were presented as median (min-max). Data were analyzed by Mann-Whitney test. *: Significant, $p < 0.05$.

Comparison of moving NRS

This study found no significant difference in pain levels during movement between the two groups. Both analgesic strategies effectively controlled pain, maintaining mean NRS below 2 in the first 24 hours post-surgery. These findings aligned with previous studies in other surgical contexts, such as laparoscopic cholecystectomy, where similar pain control was observed. A randomized controlled trial by Ana et al. reported no differences in morphine consumption and VAS scores between ultrasound-guided TAP block and continuous wound infiltration (20). Similar results were noted by Fanny et al., Ganta et al., Michael et al., and Tawfik et al., where

no significant differences were found in postoperative analgesia or patient satisfaction (21-24). Meta-analysis by Gaetano et al. confirmed comparable efficacy, safety, and tolerability between TAP block and local infiltration in postoperative analgesia (25). Choosing an ideal pain management strategy should consider safety, efficacy, ease of administration, and cost. Local anesthetic infiltration may be more advantageous due to its simplicity, reduced time consumption, and low complication rates. Conversely, TAP block requires more resources and expertise, suggesting that wound infiltration with local anesthetic remains a viable option for regional analgesia post-Caesarean section.

Comparison of resting NRS

The study revealed no significant difference in resting pain levels at 2, 4, 6, 8, and 12 hours. However, a significant difference was observed at 24 hours, with TAP block demonstrating a longer analgesic effect. This was consistent with findings from Das et al. and Aydogmus et al., who noted significant differences in NRS scores at 12 and 24 hours (26, 27). The TAP block may provide effective analgesia post-Caesarean section, as it allows the local anesthetic to block sensory nerve pathways effectively, prolonging analgesia (28). In addition, movement can also help prevent adhesions within the surgical wound, thus speeding up recovery (29).

Comparison of NLR

There were no significant differences in NLR between groups at pre-surgery and 12 hours post-surgery. However, a significant difference was noted at 24 hours, with local anesthetic infiltration exhibiting higher values, which clinically correlated with the findings on pain intensity described above. Previous studies suggest that preoperative NLR may predict postoperative analgesic demand and pain levels (29). Canbolat et al. demonstrated an association between NLR and pain in patients undergoing orthognathic surgery (30). Moreover, Oner et al. indicated that preoperative NLR is a strong predictor of high acute pain levels after surgical procedures (31).

Table 4. Difference in NLR values between the groups.

Measurement Time	Group	NLR value	P-value
		Mean $\pm$ SD	
Preoperative (no intervention)	Group 1	3.36 $\pm$ 0.82	2.44
	Group 2	3.51 $\pm$ 0.62	
12 hours post-treatment	Group 1	9.38 $\pm$ 2.79	0.07
	Group 2	8.43 $\pm$ 3.49	
24 hours post-treatment	Group 1	4.86 $\pm$ 1.30	0.01*
	Group 2	5.88 $\pm$ 1.60	

Data were presented as mean $\pm$ SD. Data were analyzed by T-test.

*: Significant, $p < 0.05$. NLR: neutrophil-lymphocyte ratio.

Table 5. Comparison of NLR values between two measurement times in both groups.

Group	Measurement Time	NLR value	P-value
		Mean $\pm$ SD	
Group 1	Preoperative	3.33 $\pm$ 0.81	<0.001*
	12 hours post-treatment	9.65 $\pm$ 2.87	
	12 hours post-treatment	9.65 $\pm$ 2.87	<0.001*
	24 hours post-treatment	4.86 $\pm$ 1.27	
	Preoperative	3.33 $\pm$ 0.81	<0.001*
	24 hours post-treatment	4.86 $\pm$ 1.27	
Group 2	Preoperative	3.57 $\pm$ 16.11	<0.001*
	12 hours post-treatment	8.57 $\pm$ 17.32	
	12 hours post-treatment	8.57 $\pm$ 17.32	<0.001*
	24 hours post-treatment	5.92 $\pm$ 21.80	
	Preoperative	3.55 $\pm$ 16.11	<0.001*
	24 hours post-treatment	5.92 $\pm$ 21.8	

Data were presented as Mean $\pm$ SD. Data were analyzed by T-test.

*: Significant, $p < 0.05$. NLR: neutrophil-lymphocyte ratio.

Research limitations

This study had several limitations, including a small sample size, which may have influenced the

statistical significance. Additionally, NLR measurements were limited to three time points, potentially restricting the assessment of changes. The short sample collection period may also affect predictive accuracy.

In conclusion, this study demonstrated that both TAP block and local anesthetic infiltration provided effective analgesia for patients undergoing cesarean sections, with no significant differences in pain levels during movement. Notably, a significant difference in resting pain levels was observed at 24 hours postoperatively, indicating a longer analgesic effect for the TAP block. Additionally, both groups did not require postoperative rescue opioids, suggesting adequate pain control. The NLR levels correlated with pain intensity, supporting its potential as a predictive marker for acute pain. Future research should involve larger sample sizes and diverse patient characteristics, explore multimodal analgesia strategies, and investigate additional biomarkers to further validate and enhance postoperative pain management techniques.

Ethic Approval: Ethics Commission for Biomedical Research on Humans, Faculty of Medicine, Hasanuddin University, with protocol number 810/UN4.5.4.5.31/PP36/2023 (2023).

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