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ORIGINAL ARTICLE

Comparison between Local Infiltration Combination of 1% 200 mg Lidocaine and 10 mg Dexametason with 0.75% 150 mg Ropivacaine on Degree of Pain in Post-Caesarian Operative Wounds

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Abstract

Background: Postoperative pain after cesarean section can delay mobilization and prolong hospitalization. Local anesthetic infiltration, such as lidocaine, reduces pain intensity and facilitates recovery. Adding dexamethasone may prolong analgesic effects, whereas ropivacaine provides longer-lasting pain relief but is less available and more expensive. This study aimed to compare the effectiveness of lidocaine-dexamethasone versus ropivacaine for post-cesarean wound pain.

Methods: A randomized double-blind controlled trial was conducted on 38 patients undergoing cesarean section at H. Adam Malik General Hospital Medan and affiliated hospitals. Patients received local wound infiltration with either 1% lidocaine 200 mg combined with 10 mg dexamethasone or 0.75% ropivacaine 150 mg. Postoperative pain was assessed using the Numeric Rating Scale (NRS) at rest and during passive movement at 2, 6, 12, and 24 hours.

Results: The ropivacaine group had significantly lower NRS scores at 2, 6, and 12 hours postoperatively, both at rest and with movement ($p<0.05$). At 24 hours, the difference between groups was not statistically significant ($p>0.05$).

Discussion: Local infiltration with 0.75% ropivacaine provided superior analgesia during the first 12 hours compared to lidocaine with dexamethasone, likely due to its longer duration of action. While lidocaine-dexamethasone is more accessible and cost-effective, ropivacaine offers better early postoperative pain control.

Conclusion: Ropivacaine infiltration significantly reduces pain intensity within the first 12 hours after cesarean section compared to lidocaine combined with dexamethasone, although both methods are comparable at 24 hours.

Keywords: Caesarean section; dexamethasone; local infiltration; lidocaine; ropivacaine

Introduction

Cesarean section has a good prognosis in terms of maternal and fetal safety. Approximately 15–20% of births worldwide are performed via cesarean section, and this proportion is even higher in developing countries, at around 70%. Postoperative pain after cesarean section remains a significant clinical concern, as inadequate pain control may delay mobilization, prolong hospital stay, and negatively affect maternal recovery. Ineffective management of postoperative pain can lead to poor postoperative outcomes

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such as tachycardia, hypertension, myocardial ischemia, decreased alveolar ventilation, and poor wound healing.[1]

Recently, preventive analgesia has been introduced, and it can reduce postoperative pain with multimodal analgesia. The benefits are numerous, such as relieving pain after cesarean section, faster mobilization, less opioid use, and shorter hospital stays. Local infiltration analgesia (LIA) or local analgesic infiltration improves the quality of postoperative analgesia and demonstrates opioid-saving effects. The advantages of LIA are safety, simplicity, and improved postoperative analgesia, especially during mobilization.[2–4]

Ropivacaine is an aminoamide local anesthetic with vasoconstrictive properties and an improved safety profile.[5] Ropivacaine is believed to produce a long-lasting local anesthetic block that is effective in treating postoperative pain. A previous study reported the use of ropivacaine for local infiltration in patients after cesarean section. The results showed that the use of 0.5% ropivacaine was effective in providing analgesic effects for up to 12 hours and reducing systemic analgesic consumption.1 However, its higher cost and limited availability in some healthcare settings, particularly in peripheral and resource-limited hospitals, restrict its routine use. In contrast, lidocaine is more readily available and cost-effective but has a shorter duration of action when used alone.

A comparison between lidocaine and ropivacaine has been previously studied in vaginal deliveries. Perineal infiltration of lidocaine versus ropivacaine during deliveries with epidural analgesia showed that ropivacaine provided significantly superior analgesia up to 6 hours postpartum.[6] Previous studies have shown that the analgesic effect of ropivacaine lasts longer than that of lidocaine.[7]

The addition of dexamethasone as an adjuvant to local anesthetics has been reported to prolong analgesic duration through mechanisms such as local vasoconstriction and modulation of nociceptive C-fiber activity. Several studies have shown that dexamethasone combined with lidocaine provides superior postoperative analgesia compared with lidocaine alone.8 Nevertheless, direct comparisons between lidocaine–dexamethasone and ropivacaine for post-cesarean wound infiltration remain limited. To date, evidence directly evaluating whether the lidocaine–dexamethasone combination can provide analgesic efficacy comparable to ropivacaine is scarce, particularly in the context of post-cesarean section pain.

Therefore, this study aimed to compare postoperative pain intensity following local wound infiltration with lidocaine combined with dexamethasone versus ropivacaine in patients undergoing cesarean section. This study hypothesized that ropivacaine would provide superior analgesia during the early postoperative period; however, the lidocaine–dexamethasone combination may still offer clinically meaningful pain control as a more accessible alternative in settings with limited resources.

Subject and Methods

This randomized, double-blind, controlled clinical trial was conducted at Haji Adam Malik General Hospital, Medan, and affiliated network hospitals between July 1 and September 30, 2023. The study protocol was approved by the Health Research Ethics Committee of the University of North Sumatra, and written informed consent was obtained from all participants before enrollment.

Participants were enrolled using consecutive sampling until the target sample size was reached. Eligible participants were pregnant patients undergoing cesarean section under spinal anesthesia with a Pfannenstiel incision, aged 18–45 years, and classified as ASA physical status I–II. Exclusion criteria were refusal to participate, allergy to study drugs, use of analgesics before surgery, and pre-existing chronic pain with NRS 6–8.

The minimum sample size is calculated using the following formula:

$$n_1 = n_2 = \left[2\left(\frac{[z_\alpha + z_\beta]s}{x_1 - x_2}\right)^2\right]$$

The minimum sample size per group was calculated using a two-independent-means formula, with α = 0.05 (one-tailed; Zα = 1.96) and β = 0.10 (power = 90%; Zβ = 1.28). The pooled standard deviation was set at S = 4, and the minimum clinically meaningful difference between group means at the selected time point was set at Δ (x_1–x_2) = 4.2, based on prior published evidence. This yielded n=18.97 per group, rounded up to 19 participants per group (total n=38).

Randomization was performed using a computer-generated random sequence with a 1:1 allocation ratio. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes (SNOSE) prepared by an independent staff member not involved in recruitment, drug preparation, or outcome assessment. Study solutions were prepared in identical syringes labeled only with the participant code. Patients, surgeons, ward staff, and outcome assessors were blinded to group assignment; data analysis was performed after group codes were locked and concealed from the analyst.

All participants received spinal anesthesia at L3–L4 using 12.5 mg hyperbaric bupivacaine 0.5% and 25 mcg fentanyl, with sensory block adjusted to T4–T5. All patients received ondansetron 8 mg IV as premedication. Cesarean section was performed using a Pfannenstiel incision.

Local infiltration was administered after skin closure along the Pfannenstiel incision line. Group A (lidocaine–dexamethasone): Participants received lidocaine 1% (total dose 200 mg) plus dexamethasone 10 mg diluted with 0.9% NaCl to a final volume of 20 mL, evenly infiltrated along the incision. Lidocaine 1% (10 mg/mL) at a total dose of 200 mg corresponds to 20 mL of a 1% solution; if a 2% lidocaine stock (20 mg/mL) were used, it would be diluted to 1% in the 20 mL syringe.

Group B (ropivacaine): Participants received ropivacaine 0.75% at a total dose of 150 mg, in a final volume of 20 mL, evenly infiltrated along the incision. Ropivacaine wound infiltration has been reported as effective for post-cesarean pain control in prior studies. All patients received multimodal analgesia with ketorolac 30 mg every 8 hours postoperatively.

Postoperative pain intensity was assessed using the Numeric Rating Scale (NRS; 0 = no pain, 10 = worst imaginable pain) at rest and during passive movement at 2, 6, 12, and 24 hours after surgery. Passive movement assessment consisted of standardized knee flexion and passive hip movement performed by trained staff. Rescue analgesia was planned for NRS ≥5 at 24 hours using paracetamol 1 g/24 hours and fentanyl 1 mcg/kg as opioid rescue.

Secondary outcomes included duration of analgesia and early mobilization parameters (time to awakening, sitting up, mobilizing in bed, and urinary catheter removal within 24 hours).

Data were analyzed using SPSS. Normality was assessed using the Shapiro–Wilk test. For between-group comparisons of NRS at each time point, an independent t-test was planned for normally distributed data; otherwise, the Mann–Whitney test was used. Repeated within-group comparisons across time points were analyzed using the Friedman test when data were non-normally distributed. A two-sided p-value<0.05 was considered statistically significant, and effect estimates should be reported with 95% confidence intervals where applicable.

Results

Baseline demographic and clinical characteristics of the study participants are presented in Table 1. A total of 38 patients were included, with 19 patients in the ropivacaine group and 19 in the lidocaine plus dexamethasone group. The mean age of participants was 28.89±4.47 years, with similar age distributions between the ropivacaine and lidocaine plus dexamethasone. groups

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(28.63±3.92 vs 29.16±5.06 years).

The mean systolic blood pressure (BP) was 126 mmHg, while the mean diastolic blood pressure was 69 mmHg. The mean pulse rate of the subjects in this study was 78.26 beats per minute, while the mean respiratory rate was 19.47 breaths per minute. The average weight of the subjects in this study was 58.26 kg, while the average height was 168.26 cm. Based on the body mass index, all subjects had a normal BMI in both the ropivacaine and lidocaine+dexamethasone groups. Based on the JNC 8 classification of hypertension, most patients had prehypertension, namely 35 people (91.2%). There were 2 patients (5.3%) who had grade 1 hypertension, while only 1 person (2.6%) had normal blood pressure.

Preliminary statistical analyses were conducted to assess the comparability of baseline characteristics between the two groups. The Shapiro–Wilk test confirmed that the demographic data were normally distributed. Baseline variables, including age, blood pressure, pulse rate, respiratory rate, body weight, and height, were compared between the ropivacaine and lidocaine plus dexamethasone groups using an independent t-test. No statistically significant differences were observed for any baseline parameter (all $p>0.05$), indicating that the two groups were homogeneous prior to intervention.

Postoperative pain intensity at rest and during passive movement between the two intervention groups is presented in Table 2. At rest, the ropivacaine group demonstrated significantly lower Numeric Rating Scale (NRS) scores compared with the lidocaine plus dexamethasone group at 2, 6, and 12 hourspostoperatively ($p=0.018$, 0.039, and 0.023, respectively). At 24 hours, no statistically significant difference in resting NRS scores was observed between groups ($p=0.784$). Similarly, during passive movement, NRS scores were significantly lower in the ropivacaine group at 2, 6, and 12 hours after surgery ($p=0.001$,0.001, and 0.018, respectively), whereas no significant difference was observed at 24 hours ($p=0.409$). This study compared Numeric Rating Scale (NRS) scores at rest in the 1% lidocaine 200 mL + dexamethasone group with those in the 0.75% ropivacaine 150 mL group on day 2 at 6, 12, and 24 hours after administration of the anesthetic. The Shapiro–Wilk normality test showed that the NRS data were not normally distributed, so the Mann–Whitney test was used. Table 2 shows a significant difference ($p<0.05$) in resting NRS scores between the control and intervention groups at 2, 6, and 12 hours after anesthesia administration, but no significant difference at 24 hours. In general, the mean NRS scores in the ropivacaine group

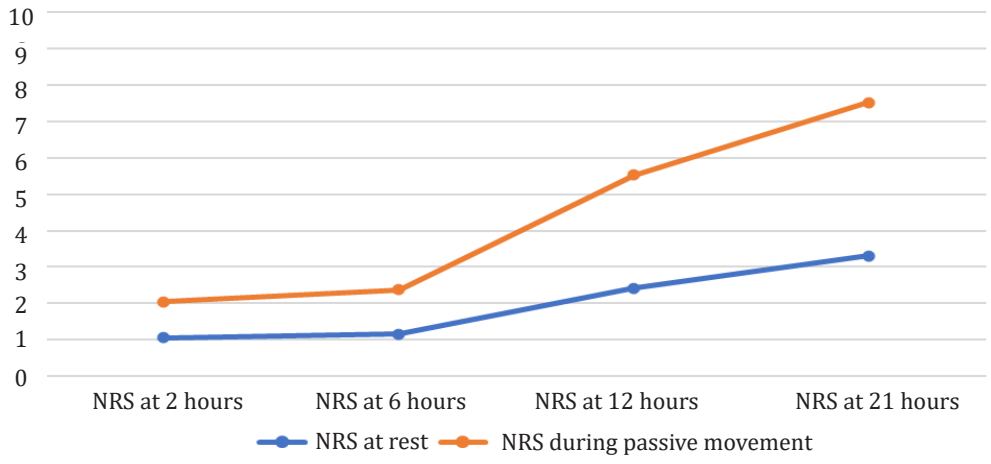

Figure 1 Ropivacaine Group During Rest and Passive Movement at Hours 2, 6, 12, and 24

Table 1 Demographic Characteristics in the Study

Characteristics	Ropivacaine 0,75% 150 mL (n=19) (Mean±SD)	Lidocaine 1% 200 mL + Dexamethasone (n=19) (Mean±SD)	Total Population (n=38) (Mean±SD)
Age	28,63±3,92	29,16±5,06	28,89±4,47
Systolic blood pressure	124,89±5,92	127,11±6,94	126±6,46
Diastolic blood pressure	70,11±5,92	67,89±6,94	69±6,46
Pulse rate	78,26±3,91	78,26±4,89	78,26±4,37
Respiratory rate	21,05±3,15	19,47±3,13	20,26±3,20
Weight	58,26±3,91	58,26±4,89	58,26±4,37
Height	168,26±3,91	168,26±4,89	168,26±4,37

were lower at 2 hours, 6 hours, 12 hours, and 24 hours after anesthesia compared to the lidocaine + dexamethasone group.

An analysis was also conducted to compare NRS levels in patients performing passive movements in the 1% lidocaine 200 mL + dexamethasone group with the 0.75% ropivacaine 150 mL group at 2, 6, 12, and 24 hours after anesthesia administration. The Shapiro-Wilk normality test indicated that the data were not normally distributed, so the Mann-Whitney test was used. Referring to Table 2 shows a significant difference ($p<0.05$) in NRS values when patients performed passive movements between the lidocaine + dexamethasone group and the ropivacaine group, at 2, 6, and 12 hours after anesthesia administration. At 24 hours, the p-value was>0.05, indicating that the difference in mean NRS scores during passive movement between the groups was not statistically significant. In general, the mean NRS scores in the ropivacaine group were lower at 2, 6, 12, and 24 hours after anesthesia compared to the lidocaine + dexamethasone group.

In this study, analysis was also performed at 2, 6, 12, and 24 hours in the group given lidocaine + dexamethasone in the resting position and passive hip movement. The Shapiro-Wilk normality test indicated that the data were not normally distributed, so a statistical test was performed using the

Table 2 Comparison of Mean NRS at Rest and During Passive Movement in the Lidocaine + Dexamethasone Group with the Ropivacaine Group

Numeric Rating Scale (NRS) Score	Ropivacaine 0,75% 150 mL (Mean±SD)	Lidocaine 1% 200 mL + Dexamethasone (Mean±SD)	*p-value
At rest			
NRS at 2 hours	1,05±0,23	1,37±0,50	0,018
NRS at 6 hours	1,16±0,37	1,47±0,51	0,039
NRS at 12 hours	2,42±0,77	3,0±0,75	0,023
NRS at 24 hours	3,31±0,67	3,37±0,68	0,784
During passive movement			
NRS at 2 hours	1,00±0,33	2,26±0,45	0,001
NRS at 6 hours	1,21±0,53	2,16±0,37	0,001
NRS at 12 hours	3,10±0,87	3,89±0,73	0,018
NRS at 24 hours	4,21±0,63	4,37±0,68	0,409

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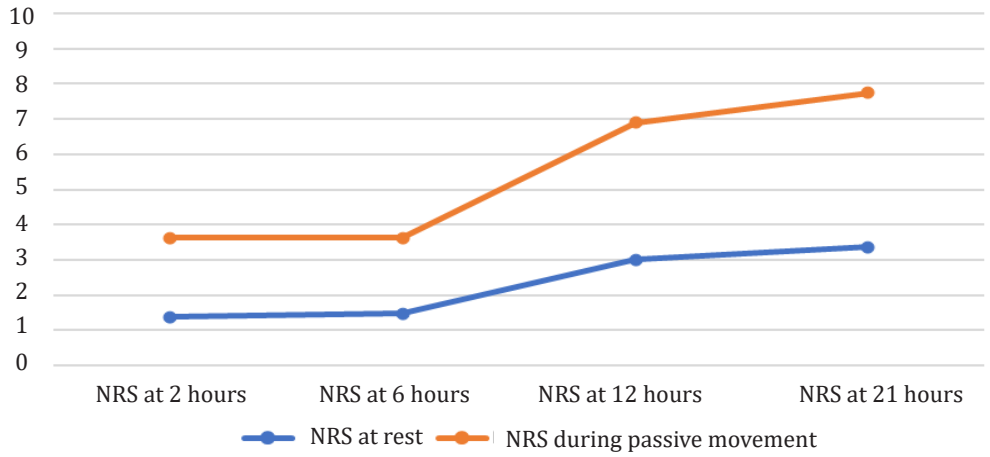

Figure 2 Lidocaine + Dexamethasone Group at Rest and Passive Movement at 2, 6, 12, and 24 Hours

Friedman test for repeated measures within a single group.

The analysis showed a significant difference ($p<0.05$) in NRS values at rest and during passive hip movement in the lidocaine + dexamethasone group at 2, 6, 12, and 24 hours after cesarean section. In Figure 1, the NRS values in the resting position and passive hip movement increased as the hours after cesarean section increased.

Similar results were observed in the group given ropivacaine. The normality test showed that the data were not normally distributed, so the Friedman test was also used to analyze changes in NRS over time in this group. The analysis showed significant differences ($p<0.05$) in NRS values at rest and during passive hip movement at 2, 6, 12, and 24 hours after cesarean section in the ropivacaine group. In Figure 2, NRS values at rest increased over time after cesarean section.

Table 2 shows the results of a significant comparison of the mean NRS at rest and during passive movement in both lidocaine + dexamethasone groups with the ropivacaine group at 2, 6, and 12 hours, but not at 24 hours. Theoretically, the concentration of ropivacaine in plasma depends on the dose and method of administration, as well as hemodynamic conditions, which cause the anesthetic effect of ropivacaine to last up to 12 hours after administration by subcutaneous infiltration.

Another study found that ropivacaine is superior to lidocaine in terms of effectiveness in nerve block and duration of postoperative analgesia. In a study, the duration of nerve block in the lidocaine group lasted approximately.1.5 to 2 hours, while in the ropivacaine group, it lasted 5 to 6 hours, so ropivacaine produced longer sympathetic nerve inhibition and reduced sympathetic nerve stimulation for a more extended period of time.[9] This study also found that the treatment efficiency of the ropivacaine group was significantly higher than that of the lidocaine group.

The longer duration of anesthesia with ropivacaine is related to its high affinity for nerve membranes and its high solubility in fat. Lidocaine causes local vasodilation and has low lipid solubility compared to ropivacaine, resulting in a shorter duration.[9] Ropivacaine was superior to lidocaine in this study. Theoretically, ropivacaine provides prolonged analgesic effects. The second explanation is that ropivacaine helps block pain stimuli and thus it better controls secondary hyperalgesia.[10]

Although several studies have shown the analgesic effects of dexamethasone during intraoperative and postoperative administration, the mechanism by which dexamethasone prolongs the analgesic effect is still not fully understood. Several theoretical

mechanisms have been proposed in the literature, namely through systemic local vasoconstriction and local C-fiber blockade.[10]

Discussion

In this study, it can be assumed that dexamethasone exerts its effects through local vasoconstriction and C-fiber blockade. The vasoconstrictive effect of local application occurs through a non-genomic pathway. Dexamethasone causes vasoconstriction in topical application through a non-genomic pathway. This pathway does not require de novo protein synthesis and works by modulating the level of activation and response of target cells, such as monocytes, T cells, and platelets. Dexamethasone also causes peripheral vasoconstriction, further increasing the local drug concentration.

Other mechanisms suggested in the literature include blockade of transmission in C–fiber nociceptors but not in A–fibers and B–fibers, or changes in potassium channels in peripheral nerves. Interestingly, when dexamethasone is used alone in regional blocks, no blockade effect is produced. Therefore, dexamethasone may exert this effect by altering the function of potassium channels in excitable cell membranes, and its impact may be reversible when administered with other analgesics.[10]

This study also analyzed the numerical rating scale (NRS) in the group given 1% lidocaine 200ml plus dexamethasone, which had a significant p-value for both the NRS at rest and passive hip movement at 2, 6, and 12 hours, but not at 24 hours. This also indicates that the doses of lidocaine and dexamethasone in this study still provide an anesthetic effect. This also shows that the doses of lidocaine and dexamethasone in this study still provided anesthetic effects during the first 12 hours. The addition of dexamethasone to lidocaine was also found in the study by Gao, Ren, and Cui. The analysis showed that the incidence of acute, subacute, and chronic back pain was lower in the dexamethasone group than in the lidocaine-alone group (p value<0.05 in all categories of events). VAS scores on the first and second days and in the first and second months were found to be lower in the dexamethasone + lidocaine group compared to lidocaine alone (p=0.0028; p<0.001), respectively.[8]

Previous studies have reported that the analgesic effect of lidocaine administered via subcutaneous infiltration does not exceed 2 hours, while the effect of ropivacaine lasts up to 12 hours.9 The vasoconstrictor relationship between epinephrineandlidocaine can prolong the duration of anesthetic effectiveness.

The increased infiltration pain associated with epinephrine can be compensated for, for example, with a lower lidocaine concentration or alkalinization techniques, such as the addition of bicarbonate, without compromising the anesthetic effect. Lidocaine at concentrations lower than 2% also showed no difference in anesthetic effect in the first 30 minutes, confirming the influence of the anesthetic technique used. Lower concentrations of lidocaine, in combination with epinephrine, may improve the safety of anesthesia, especially when larger volumes of anesthetic are required.[11]

Thesafetyofdexamethasoneincombination with ropivacaine remains controversial. In isolated nerve cells (dorsal root ganglia), ropivacaine-induced neurotoxicity increased with high doses of dexamethasone (depending on time and concentration).13 The mechanism is an increase in intracellular calcium flow (inducing cell apoptosis) and activation of apoptosis-inducing factors and caspases.[3]

This study shows that the NRS values in the group administered 150 mL of 0.75% ropivacaine had significant p-values for both NRS at rest and during passive hip movement at 2, 6, and 12 hours, but not at 24 hours after anesthesia administration.

This indicates that the ropivacaine dose used in this study still provides anesthetic effects during the first 12 hours. The analgesic effect of ropivacaine can be felt for up to 12 hours.[9] The concentration of ropivacaine in plasma depends on the dose and method of administration, as well as hemodynamic and

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circulatory conditions and vascularization at the site of drug administration.12 Therefore, it can be concluded that the NRS values at rest and during passive movement in the group administered ropivacaine were not significant at 24 hours. This may be because, theoretically, the plasma concentration of ropivacaine depends on the dose and route of administration, as well as hemodynamic conditions, which limit the anesthetic effect to up to 12 hours after administration. The drug is administered via subcutaneous infiltration.

In a similar study, local infiltration anesthesia with ropivacaine for post-cesarean section pain control significantly reduced pain scores at 4, 6, and 12 hours ($p<0.001$).[1] This study is the first to compare thecombination of ropivacaine and lidocaine + Dexamethasone in reducing pain in postoperative cesarean section wounds. The study design was a randomized, double-masked, controlled clinical trial with appropriate randomization and blinding. This study includes a relatively comprehensive analysis of pain scores. There are several limitations to this study. No analysis of surgical duration was performed for each subject. All subjects underwent different durations of surgery, so it is possible that the administration of spinal anesthesia could still affect the degree of pain felt by patients during shorter durations of surgery.

Conclusion

Local infiltration of 0.75% ropivacaine 150 mg significantly reduced pain perception in post-cesarean section patients compared to a combination of 1% lidocaine 200 mg + dexamethasone 10 mg at 2, 6, and 12 hours post-surgery. However, at 24 hours, the difference in pain levels between the two groups was not statistically significant, indicating that the analgesic effect of ropivacaine persists for up to 12 hours after infiltration.

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