

Postoperative Analgesia with Ropivacaine-Fentanyl versus Ropivacaine-Morphine after Spinal Anesthesia in Patients Undergoing Cesarean Section

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Abstract

Objective: To compare postoperative analgesia after spinal anesthesia with ropivacaine + fentanyl versus ropivacaine + morphine. **Methods:** A prospective, randomized, observational study was conducted with a total of 64 patients undergoing emergency cesarean section. Patients were divided into two groups: group F (isobaric ropivacaine + fentanyl) and group M (isobaric ropivacaine + morphine). Clinical, demographic, and hemodynamic data were collected. Pain intensity using the Number Rating Scale (NRS) was assessed both at rest and during movement for up to 24 hours postoperatively. Adverse effects were also recorded. **Results:** The fall in blood pressure after anesthesia induction was greater in group F. Intraoperative pain was more frequent in group M ($p = 0.015$), with a mean onset time of 37.69 ± 4.42 minutes. The frequency of pruritus was significantly higher in group F; (37.50%) compared to group M (3.13%). During the first 4, 8, and 12 hours postoperatively, pain intensity both at rest and with movement was lower in group M. **Conclusion:** The combination of intrathecal ropivacaine and morphine demonstrated better hemodynamic stability and postoperative analgesia, with fewer adverse effects, making it an effective and safe option for spinal anesthesia in cesarean section.

Keywords

Spinal Anesthesia, Cesarean Section, Postoperative Analgesia, Acute Pain, Ropivacaine

1. Introduction

Postoperative pain in patients who underwent cesarean section is an important and constant concern for women [1], inadequate or delayed analgesia is associated with maternal dissatisfaction [2]. Postoperative pain is an independent risk factor for the development of chronic pain and postpartum depression [3]-[5]. Controlling pain is essential for breastfeeding, maternal-neonatal bonding and optimal functional recovery [6] [7]. In addition to pain, hypotension is the most common side effect of spinal anesthesia, occurring immediately after intrathecal injection. This condition can cause nausea, vomiting, and dizziness in the mother and reduce blood flow to the placenta, which can lead to fetal acidosis and lower Apgar scores [8]. The incidence of spinal anesthesia-induced hypotension varies from 7.4% to 74.1% due to its different definitions [9]. A significant drop in blood pressure during a cesarean section can put both mother and fetus at risk.

A local anesthetic and opioids are frequently used for spinal anesthesia. In this study, we used ropivacaine because it has a shorter duration of motor block, considered helpful for maternal recovery [10] [11] and allows earlier mobilization [12]. Ropivacaine is a long-acting amide local anesthetic, a pure S-enantiomer, with a high pKa and relatively low lipid solubility. Local anesthetics act by reversibly blocking excitation and conduction of neuronal communications. Its main mechanism of action is interference with sodium entry, which prevents depolarization of the nerve cell membrane and subsequently hinders the progression of the action potential [13]. Ropivacaine in its isobaric form is not affected by the patient's position during and after intrathecal administration [12] [14].

Fentanyl (10 - 25 µg) and morphine (100 - 200 µg) are two opioids commonly used for obstetric pain relief, each with distinct advantages regarding the onset and duration of their effects. Intrathecal fentanyl used as an adjuvant improves the quality of spinal anesthesia by acting quickly and reducing the time to establish the block [15]. The onset of effects of morphine is slower, as it is more hydrophilic, but lasts a longer period, producing excellent analgesia after surgery [16]. However, there is still no agreement on the best choice of opioid and dosage.

The objectives of the study were to evaluate hemodynamic parameters, the frequency of side effects such as nausea, vomiting, pruritus, and postoperative pain after spinal anesthesia with isobaric ropivacaine + morphine 100 µg or fentanyl 25 µg in patients undergoing cesarean section.

2. Materials and Methods

The study was conducted at the Regional Hospital of High Specialty for Women, Villahermosa, Tabasco, Mexico. This was an observational, descriptive, prospective, randomized study. Sixty-four patients were included for cesarean delivery under spinal anesthesia.

The inclusion criteria were ASA I-II patients; ages 18 - 40 years; indication for cesarean section with a pregnancy equal to or greater than 37 weeks; and a live, single fetus.

The exclusion criteria were patients with allergy to any of the drugs administered, diagnosis of preeclampsia, previous administration of opioids, history of chronic pain or regular use of analgesics and history of drug addiction.

The criteria for elimination from the study were patients lost to follow-up after cesarean section, surgical reintervention in the next 72 hours after cesarean section, and patient refusal to participate.

Followed the institution's confidentiality protocols, obtained informed consent from patients, and approved the procedures by the institutional Ethics Committee.

The treatment assignments were made according to the order of patient arrival, with no influence from the researchers on selecting the administered drug. Although this assignment was not performed using software or random numbers, it is considered a directed random allocation, which reduced the likelihood of bias from the research team. After the procedure, the anesthesiologist was excluded from the study, and the outcome assessor continued the investigation of the clinical parameters. Both the assessor and the participants were unaware of the group assignments, ensuring the blinding of the results.

All patients received spinal anesthesia. The patients were placed in the left lateral decubitus position, spinal puncture was performed in the L2-L3 intervertebral space with a 17G Tuohy spinal needle (Becton Dickinson) using the loss of resistance method and a long 27 G Whitacre spinal needle (Becton Dickinson). Spinal block was performed with 9 mg of isobaric ropivacaine (7.5 mg/ml) and 25 µg of fentanyl (Group F) and 9 mg of isobaric ropivacaine (7.5 mg/ml) and 100 µg of morphine (Group M). Surgery was started when sensory blockade reached the level of T4-T6. During the first 20 minutes, blood pressure records were taken and the administration of ephedrine in 5 mg IV boluses to maintain blood pressure was at the discretion of the anesthesiologist. All medications administered during surgery were recorded. Epidural analgesic rescue was given to patients who presented intraoperative pain with 2% lidocaine or 2% lidocaine with epinephrine.

The intensity of pain was evaluated with the numerical scale (NRS) both at rest and in movement, before entering surgery (0) and 2 h, 4 h, 8 h, 12 h, and 24 h postoperatively. The postoperative analgesic regimen consisted of 30 mg of ketorolac every 8 h; side effects of anesthesia such as nausea, vomiting, dizziness, and itching were recorded.

Statistical Analysis

The continuous variables are expressed as mean \pm standard deviation. Discontinuous variables are expressed as percentages. Normality was analyzed using the Shapiro-Wilk test. For two comparisons, each value was compared with Student's *t* test for independent samples or Mann-Whitney test if data are not normal. The count data were analyzed using the Chi-square test or Fisher's exact test. Statistical analysis was performed with GraphPad Prism® version 9.03, (GraphPad Software, Inc., La Jolla, CA) and a *p* value < 0.05 was considered statistically significant.

3. Results

Sixty-four patients eligible for emergency cesarean section under spinal anesthesia were studied, divided into two groups. Data on clinical and demographic characteristics are shown in **Table 1**. No significant differences were observed between the groups ($P > 0.05$), indicating that these variables had no influence on the results. Similarly, the duration of surgery ($P = 0.4040$) and duration of anesthesia ($P = 0.2366$) were not found to be significantly different.

Table 1. Clinical and demographic characteristics.

	Grupo F	Grupo M	p
Gestational age (weeks)	37.45 ± 0.56	37.41 ± 0.47	0.9628
Age (years)	23.88 ± 0.92	25.25 ± 1.13	0.3496
Weight (kg)	74.05 ± 2.65	74.63 ± 2.32	0.8716
Height	1.55 ± 0.01	1.54 ± 0.01	0.8803
Pregnancies	2.22 ± 0.23	1.94 ± 0.14	0.3050
Vaginal births	0.34 ± 0.16	0.31 ± 0.13	0.8799
Cesarean sections	1.72 ± 0.16	1.56 ± 0.11	0.4298
Abortions	0.16 ± 0.07	0.06 ± 0.04	0.2362
Duration of surgery (minutes)	51.81 ± 2.85	63.28 ± 3.44	0.4040
Duration de anesthesia	65.03 ± 3.15	75.22 ± 3.52	0.2366

Data are expressed as mean ± standard error. P value was calculated using Student's t-test and normality test using Shapiro-Wilk. A p-value < 0.05 was considered significant.

Table 2. Hemodynamic data and intraoperative pain.

	Grupo F	Grupo M	p
Ephedrine rescue	7 (21.88)	8 (25)	>0.9999
Intravenous crystalloid fluids	1246.88 ± 49.39	1512.12 ± 88.23	0.0116*
Bleeding quantification	409.38 ± 30.07	524.24 ± 79.75	0.1852
Intraoperative pain	4 (12.50)	17 (53.13)	0.0011*
Pain onset time (min)	13.50 ± 2.10	37.69 ± 4.42	0.0158*

Data are expressed as mean ± standard error and number (%). P value was calculated with Fisher's exact test and Student's t-test. A p-value < 0.05 was considered significant.

Table 3. Postoperative adverse events.

Side effects	Grupo F	Grupo M	P
Pruritus	12 (37.50)	1 (3.12)	0.0012**
Nausea	2 (6.25)	7 (21.87)	0.1477
Vomiting	0	4 (12.5)	0.1132

The data are presented as the number (%) of patients. Statistical significance between groups was calculated using the chi-square or Fisher's exact test.

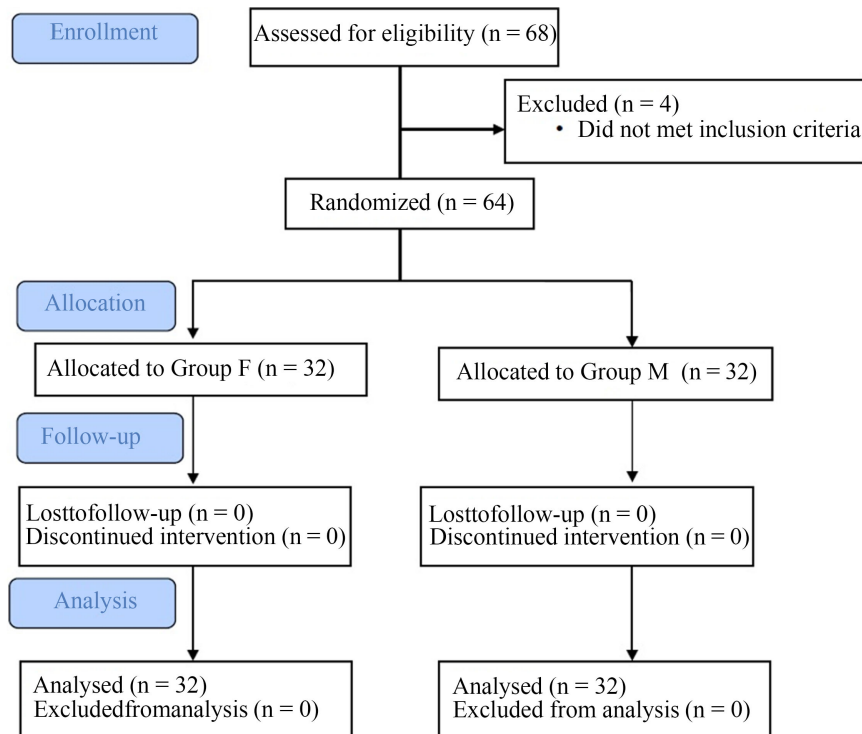


Figure 1. Flow diagram of study participants.

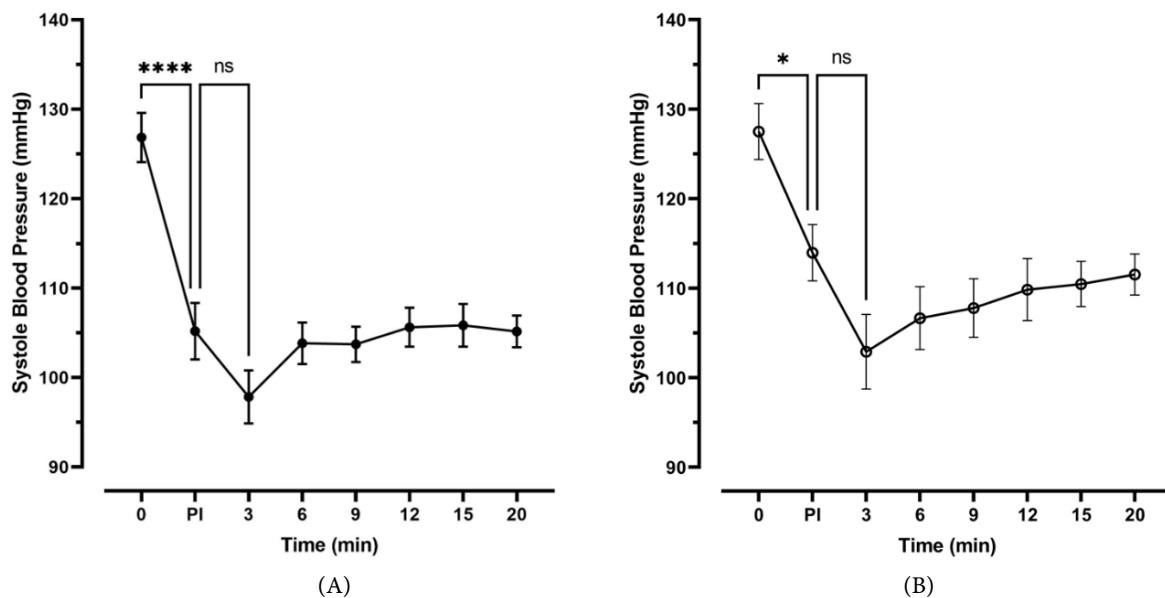


Figure 2. Time course of systolic blood pressure. (A) F group $p = <0.0001$; (B) M group $p = 0.0419$. Before anesthetic block (0) Post anesthetic induction (PI). Data are expressed as mean \pm standard error.

The decrease in blood pressure after anesthesia induction (IP) was greater in group F compared with group M, **Figure 1** and **Figure 2**. At subsequent time points, no statistical difference was observed ($P > 0.05$). **Table 2** shows other hemodynamic variables to consider; the administration of ephedrine during surgery was similar in both groups, with no statistical difference. However, a greater amount

of intravenous fluids was used in group M during surgery ($P = 0.0116$). Intraoperative pain was greater in group M, with an approximate time of onset of 37.69 ± 4.42 minutes $p = 0.0158$, **Table 3**. Adverse events associated with anesthesia were recorded; nausea, vomiting and pruritus. Where the frequency of pruritus was higher in group F; 37.50% vs 3.13% of group M, being statistically significant ($P = 0.0012$). Dizziness, sedation, or respiratory depression were not reported in either group.

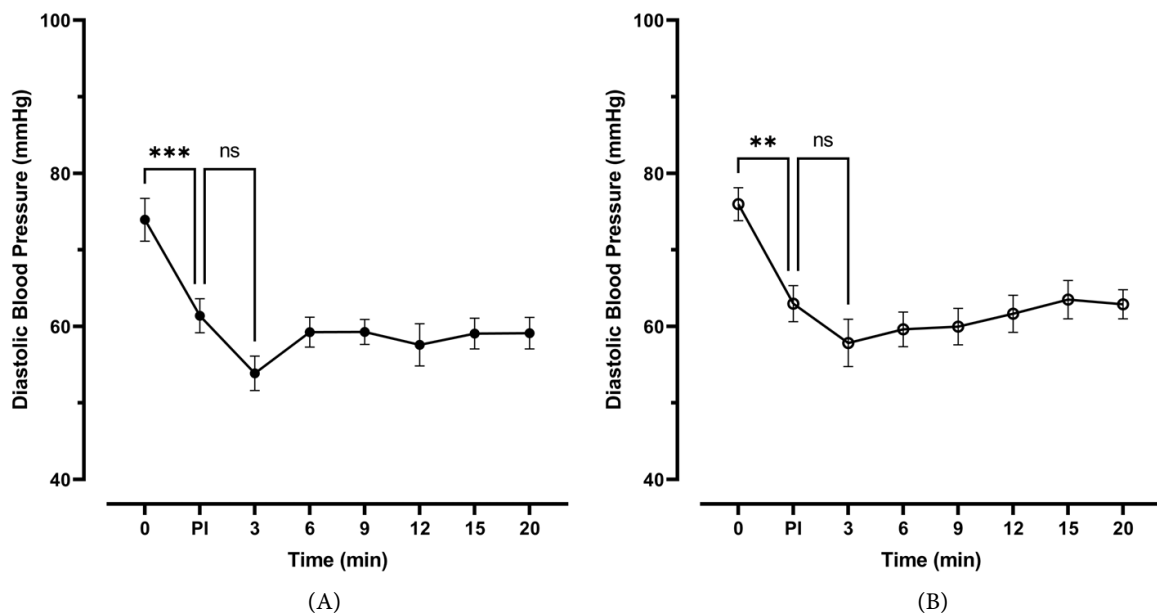


Figure 3. Time course of diastolic blood pressure. (A) F group $p = <0.0007$; (B) M group $p = 0.0012$. Before anesthetic block (0) Post anesthetic induction (PI). Data are expressed as mean \pm standard error.

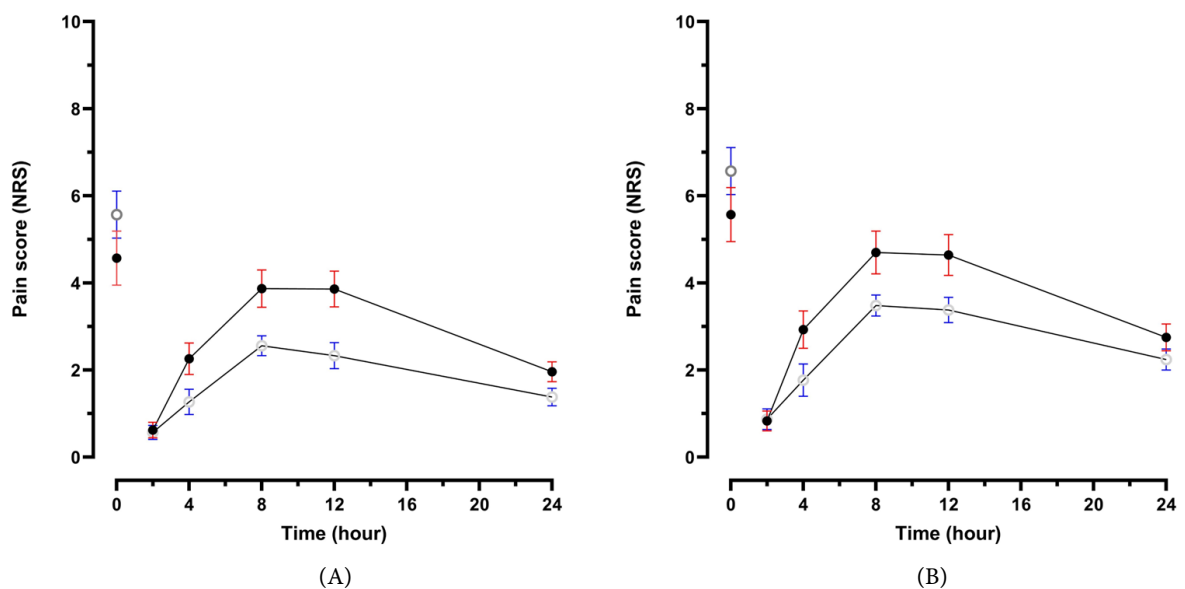


Figure 4. Time course of pain intensity. Pain intensity is indicated by a numerical rating scale (NRS), where zero is no pain and 10 is the worst pain imaginable. Data are expressed as mean \pm standard error. Group F is in red, and Group M is in blue. (A) pain at rest; (B) pain on movement.

Postoperative pain was measured at rest and during movement before entering surgery (0) and at the end of the cesarean section at 2, 4, 8, 12, and 24 hours. Pain was classified as no pain (NRS = 0), mild (NRS = 1 - 3), moderate (NRS = 4 - 6), and severe (NRS = 7 - 10). Before entering surgery, the pain reported was of moderate-severe intensity due to the labor that the patients were in. At 2 hours postoperatively, both groups continued to have the effects of anesthesia and did not experience pain. A significant difference was found between both groups during the following 4 h, 8 h and 12 h postoperatively, group M had less pain both at rest and during movement, **Figure 3**. From the time courses of pain, the area under the curve (AUC) was calculated as an interpretation of the pain intensity during the evaluation period (0 - 24 h) **Figure 4**. Group M showed better pain management over 24 hours, both at rest and during movement. Area under the curve of pain scores (NRS) is shown in **Figure 5**.

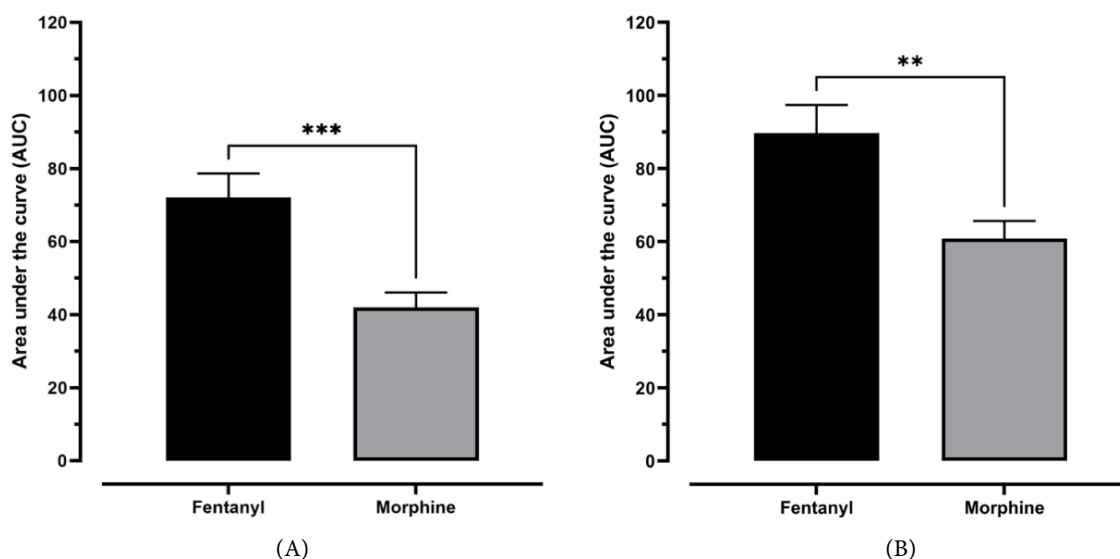


Figure 5. Area under the curve of pain scores (NRS). Data are expressed as mean \pm standard error. (A) Pain at rest; (B) Pain on movement.

4. Discussion

Our approach to the prevention and management of hypotension included the administration of Hartmann's solution, reduction of aortocaval compression of the pregnant uterus, intrathecal administration of lower doses of local anesthetic combined with an opioid analgesic, and the use of a vasopressor if necessary. In our study, the incidence of hypotension was 18.75%. The drop in blood pressure following intrathecal injection was greater in group F; however, no statistically significant difference was observed during the subsequent 20 minutes. It has been reported that administering a lower dose of hyperbaric bupivacaine (7 mg) provides an equally rapid and effective onset of anesthesia for cesarean section, while also reducing the incidence of hypotension compared to 8 and 9 mg doses [17]. In another study, the administration of low-dose ropivacaine showed significantly

greater anesthetic efficacy, improved hemodynamic stability, and higher anesthetic safety compared to low-dose bupivacaine [18]. A low spinal dose provides a similarly rapid and effective onset of anesthesia for cesarean section, while reducing the incidence of hypotension. However, due to its shorter duration, it is recommended to leave a functional epidural catheter in place for reinforcement when needed.

Previous evidence indicates that postoperative nausea and vomiting were triggered by hypotension [8] [19] [20], and may be exacerbated by uterine manipulation and peritoneal closure [21]. However, nausea and vomiting during cesarean section may have multiple etiologies, including hypotension, vagal hyperactivity, visceral pain, opioid administration, uterotonic agents, and movement [21]. It has been reported that approximately 40% of patients may experience nausea and between 15% and 25% may experience vomiting following the administration of spinal opioids. In our study, no statistically significant difference was found regarding nausea and vomiting; our patients showed a lower incidence, likely due to blood pressure control and the routine administration of single doses of metoclopramide and dexamethasone during the surgical procedure.

In our study, the incidence of pruritus was higher in group F, occurring in approximately 37.5% of cases. This is attributed to fentanyl's high lipophilicity, which allows it to rapidly diffuse through the spinal cord, enhancing central activity. In contrast, morphine, being more hydrophilic, diffuses more slowly and tends to cause delayed-onset pruritus.

Intraoperative pain occurred in 32.81% of cases, more frequently in group M, with an approximate onset time of 37.69 ± 4.42 minutes. Other studies have reported an incidence of intraoperative pain ranging from 18% to 29% following the intrathecal administration of morphine at doses of 0.1 to 0.2 mg [22] [23]. Some authors report that intrathecal morphine reduces intraoperative pain [24] [25], while others have observed that it has a slower onset of action [26]. Fournier noted that the onset of morphine's action occurs between 30 and 60 minutes after spinal administration [27]. This slow onset has raised concerns about its intraoperative effectiveness during cesarean section, where pain is visceral and mainly caused by peritoneal traction. However, intrathecal morphine is effective for postoperative analgesia after cesarean delivery, and its use is recommended by clinical practice guidelines due to its low cost, superior analgesic quality, and prolonged effects [28].

In our study, all patients experienced pain following cesarean delivery. It has been reported that 89% of women who underwent cesarean section reported pain at the surgical site during their hospital stay [29]. Cesarean delivery is associated with higher pain scores [30]; however, the pain reported in group M at 4, 8, and 12 hours postoperatively was of lower intensity. When calculating the area under the curve (AUC), group M (ropivacaine + morphine) showed lower overall pain levels. This finding is consistent with studies reporting that the use of intrathecal morphine prolongs the duration of postoperative analgesia [31] [32]. On the other

hand, the quality of postoperative analgesia with fentanyl, when used alone, was found to be inferior to that of morphine [24]. The combination of opioids offered no advantage for postoperative analgesia and increased the incidence of opioid-related side effects [16] [24] [33]. Higher doses of fentanyl (40 - 60 µg) have been reported to provide clinically significant postoperative analgesia with relatively few adverse effects [34]. However, direct comparisons between single doses of morphine and fentanyl in postoperative pain management may be challenging due to differences in their pharmacokinetic profiles.

5. Limitations

This study has several limitations that should be considered when interpreting the results. First, the sample size was small, which may limit the generalizability of the findings. Additionally, the study was conducted at a single center, so the results may not be representative of other populations or clinical settings. The design was not fully randomized, as group allocation was based on the order of patient arrival. Treatment assignment was not performed using computerized randomization; however, investigators did not participate in selecting the treatment for each patient. This allowed for a non-directed distribution, although the possibility of bias due to uncontrolled factors cannot be completely excluded. Furthermore, pain assessment was based on a subjective scale, which is susceptible to individual variability.

6. Conclusion

Spinal anesthesia with ropivacaine (9 mg) plus morphine (100 µg) resulted in better hemodynamic stability during cesarean delivery, fewer adverse events, and lower pain intensity during the first 24 hours postoperatively.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Declaration on the use of artificial intelligence: The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

References

- [1] Uribe-Leitz, T., Barrero-Castillero, A., Cervantes-Trejo, A., Santos, J.M., de la Rosa-Rabago, A., Lipsitz, S.R., *et al.* (2019) Trends of Caesarean Delivery from 2008 to 2017, Mexico. *Bulletin of the World Health Organization*, **97**, 502-512. <https://doi.org/10.2471/blt.18.224303>
- [2] Shamah Levy, T., Rivera-Dommarco, J. and Bertozzi, S. (2020) Encuesta Nacional de Salud y Nutrición 2018-19: Análisis de sus principales resultados. *Salud Pública de México*, **62**, 614-617. <https://doi.org/10.21149/12280>
- [3] Guendelman, S., Gemmill, A., Thornton, D., Walker, D., Harvey, M., Walsh, J., *et al.* (2017) Prevalence, Disparities, and Determinants of Primary Cesarean Births among First-Time Mothers in Mexico. *Health Affairs*, **36**, 714-722. <https://doi.org/10.1377/hlthaff.2016.1084>
- [4] Carvalho, B., Cohen, S.E., Lipman, S.S., Fuller, A., Mathusamy, A.D. and Macario, A.

- (2005) Patient Preferences for Anesthesia Outcomes Associated with Cesarean Delivery. *Anesthesia & Analgesia*, **101**, 1182-1187. <https://doi.org/10.1213/01.ane.0000167774.36833.99>
- [5] Yurashevich, M., Carvalho, B., Butwick, A.J., Ando, K. and Flood, P.D. (2019) Determinants of Women's Dissatisfaction with Anaesthesia Care in Labour and Delivery. *Anaesthesia*, **74**, 1112-1120. <https://doi.org/10.1111/anae.14756>
- [6] Weibel, S., Neubert, K., Jelting, Y., Meissner, W., Wöckel, A., Roewer, N., *et al.* (2016) Incidence and Severity of Chronic Pain after Caesarean Section. *European Journal of Anaesthesiology*, **33**, 853-865. <https://doi.org/10.1097/eja.0000000000000535>
- [7] Landau, R., Bollag, L. and Ortner, C. (2013) Chronic Pain after Childbirth. *International Journal of Obstetric Anesthesia*, **22**, 133-145. <https://doi.org/10.1016/j.ijoa.2013.01.008>
- [8] Eisenach, J.C., Pan, P.H., Smiley, R., Lavand'homme, P., Landau, R. and Houle, T.T. (2008) Severity of Acute Pain after Childbirth, but Not Type of Delivery, Predicts Persistent Pain and Postpartum Depression. *Pain*, **140**, 87-94. <https://doi.org/10.1016/j.pain.2008.07.011>
- [9] Sultan, P. and Carvalho, B. (2020) Postpartum Recovery: What Does It Take to Get Back to a Baseline? *Current Opinion in Obstetrics & Gynecology*, **33**, 86-93. <https://doi.org/10.1097/gco.0000000000000684>
- [10] Buhagiar, L., Cassar, O., Brincat, M., Buttigieg, G., Inglott, A., Adami, M., *et al.* (2011) Predictors of Post-Caesarean Section Pain and Analgesic Consumption. *Journal of Anaesthesiology Clinical Pharmacology*, **27**, 185-191. <https://doi.org/10.4103/0970-9185.81822>
- [11] Lane, S., Evans, P., Arfeen, Z. and Misra, U. (2005) A Comparison of Intrathecal Fentanyl and Diamorphine as Adjuncts in Spinal Anaesthesia for Caesarean Section. *Anaesthesia*, **60**, 453-457. <https://doi.org/10.1111/j.1365-2044.2005.04175.x>
- [12] Karaman, S., Gunusen, I., Uyar, M., Biricik, E. and First, V. (2011) The Effects of Morphine and Fentanyl Alone or in Combination Added to Intrathecal Bupivacaine in Spinal Anesthesia for Cesarean Section. *AGRI*, **23**, 57-63.
- [13] Olapour, A., Akhondzadeh, R., Rashidi, M., Gousheh, M. and Homayoon, R. (2020) Comparing the Effect of Bupivacaine and Ropivacaine in Cesarean Delivery with Spinal Anesthesia. *Anesthesiology and Pain Medicine*, **10**, e94155. <https://doi.org/10.5812/aapm.94155>
- [14] Kang, T., Tao, J., Wang, X., Liu, Y. and Jin, D. (2024) Epidural Ropivacaine versus Bupivacaine for Cesarean Sections: A System Review and Meta-Analysis. *The Journal of Maternal-Fetal & Neonatal Medicine*, **37**, Article ID: 2313356. <https://doi.org/10.1080/14767058.2024.2313356>
- [15] Chung, C., Choi, S., Yeo, K., Park, H., Lee, S. and Chin, Y. (2001) Hyperbaric Spinal Ropivacaine for Cesarean Delivery: A Comparison to Hyperbaric Bupivacaine. *Anesthesia & Analgesia*, **93**, 157-161. <https://doi.org/10.1097/00000539-200107000-00031>
- [16] Danelli, G., Fanelli, G., Berti, M., Cornini, A., Lacava, L., Nuzzi, M., *et al.* (2004) Spinal Ropivacaine or Bupivacaine for Cesarean Delivery. *Regional Anesthesia and Pain Medicine*, **29**, 221-226. <https://doi.org/10.1097/00115550-200405000-00007>
- [17] Patil, P., Dhulkhed, P.V. and Dhulkhed, V.K. (2023) Isobaric Forms of Ropivacaine vs. Bupivacaine in Lower Abdominal Surgeries. *Medical Gas Research*, **13**, 123-127. <https://doi.org/10.4103/2045-9912.359678>
- [18] Cheng, Q., Zhang, W., Lu, Y., Chen, J. and Tian, H. (2019) Ropivacaine Vs. Levobu-

- pivacaine: Analgesic Effect of Combined Spinal-epidural Anesthesia during Child-birth and Effects on Neonatal Apgar Scores, as Well as Maternal Vital Signs. *Experimental and Therapeutic Medicine*, **18**, 2307-2313. <https://doi.org/10.3892/etm.2019.7776>
- [19] Riley, E.T., Cohen, S.E., Rubenstein, A.J. and Flanagan, B. (1995) Prevention of Hypotension after Spinal Anesthesia for Cesarean Section. *Anesthesia & Analgesia*, **81**, 838-842. <https://doi.org/10.1097/00000539-199510000-00031>
- [20] Ebrie, A.M., Woldeyohanis, M., Abafita, B.J., Ali, S.A., Zemedkun, A., Yimer, Y., *et al.* (2022) Hemodynamic and Analgesic Effect of Intrathecal Fentanyl with Bupivacaine in Patients Undergoing Elective Cesarean Section; a Prospective Cohort Study. *PLOS ONE*, **17**, e0268318. <https://doi.org/10.1371/journal.pone.0268318>
- [21] Braga, A.A., Frias, J.A.F., Braga, F.S., Potério, G.B., Hirata, E.S. and Torres, N.A. (2012) Spinal Anesthesia for Cesarean Section. Use of Hyperbaric Bupivacaine (10mg) Combined with Different Adjuvants. *Brazilian Journal of Anesthesiology*, **62**, 775-787. [https://doi.org/10.1016/s0034-7094\(12\)70178-2](https://doi.org/10.1016/s0034-7094(12)70178-2)
- [22] Carvalho, B., Drover, D.R., Ginosar, Y., Cohen, S.E. and Riley, E.T. (2012) Intrathecal Fentanyl Added to Bupivacaine and Morphine for Cesarean Delivery May Induce a Subtle Acute Opioid Tolerance. *International Journal of Obstetric Anesthesia*, **21**, 29-34. <https://doi.org/10.1016/j.ijoa.2011.09.002>
- [23] Sibilla, C., Albertazz, P., Zatelli, R. and Martinello, R. (1997) Perioperative Analgesia for Caesarean Section: Comparison of Intrathecal Morphine and Fentanyl Alone or in Combination. *International Journal of Obstetric Anesthesia*, **6**, 43-48. [https://doi.org/10.1016/s0959-289x\(97\)80051-9](https://doi.org/10.1016/s0959-289x(97)80051-9)
- [24] Dahl, J.B., Jeppesen, I.S., Jørgensen, H., Wetterslev, J. and Møiniche, S. (1999) Intraoperative and Postoperative Analgesic Efficacy and Adverse Effects of Intrathecal Opioids in Patients Undergoing Cesarean Section with Spinal Anesthesia. *Anesthesiology*, **91**, 1919. <https://doi.org/10.1097/00000542-199912000-00045>
- [25] Culebras, X., Gaggero, G., Zatloukal, J., Kern, C. and Marti, R. (2000) Advantages of Intrathecal Nalbuphine, Compared with Intrathecal Morphine, after Cesarean Delivery: An Evaluation of Postoperative Analgesia and Adverse Effects. *Anesthesia & Analgesia*, **91**, 601-605. <https://doi.org/10.1213/00000539-200009000-00019>
- [26] Fournier, R., Van Gessel, E., Macksay, M. and Gamulin, Z. (2000) Onset and Offset of Intrathecal Morphine versus Nalbuphine for Postoperative Pain Relief after Total Hip Replacement. *Acta Anaesthesiologica Scandinavica*, **44**, 940-945. <https://doi.org/10.1034/j.1399-6576.2000.440808.x>
- [27] (2016) Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology*, **124**, 270-300.
- [28] Pöpping, D.M., Elia, N., Marret, E., Wenk, M. and Tramèr, M.R. (2012) Opioids Added to Local Anesthetics for Single-Shot Intrathecal Anesthesia in Patients Undergoing Minor Surgery: A Meta-Analysis of Randomized Trials. *Pain*, **153**, 784-793. <https://doi.org/10.1016/j.pain.2011.11.028>
- [29] Weigl, W., Bierylo, A., Krzemien-Wiczynska, S. and Mayzner-Zawadzka, E. (2009) Comparative Study of Postoperative Analgesia after Intrathecal Administration of Bupivacaine with Fentanyl or Morphine for Elective Caesarean Section. *Anestezjologia Intensywna Terapia*, **41**, 28-32.
- [30] Thornton, P., Hanumanthaiah, D., O'Leary, R.A. and Iohom, G. (2015) Effects of Fentanyl Added to a Mixture of Intrathecal Bupivacaine and Morphine for Spinal Anaes-

- thetia in Elective Caesarean Section. *Romanian Journal of Anaesthesia and Intensive Care*, **22**, 97-102.
- [31] Milner, A.R., Bogod, D.G. and Harwood, R.J. (1996) Intrathecal Administration of Morphine for Elective Caesarean Section. *Anaesthesia*, **51**, 871-873. <https://doi.org/10.1111/j.1365-2044.1996.tb12622.x>
- [32] Mallick-Searle, T. and Fillman, M. (2017) The Pathophysiology, Incidence, Impact, and Treatment of Opioid-induced Nausea and Vomiting. *Journal of the American Association of Nurse Practitioners*, **29**, 704-710. <https://doi.org/10.1002/2327-6924.12532>
- [33] Seki, H., Shiga, T., Mihara, T., Hoshijima, H., Hosokawa, Y., Hyuga, S., *et al.* (2021) Effects of Intrathecal Opioids on Cesarean Section: A Systematic Review and Bayesian Network Meta-Analysis of Randomized Controlled Trials. *Journal of Anesthesia*, **35**, 911-927. <https://doi.org/10.1007/s00540-021-02980-2>
- [34] Mehta, M.V., Chudasama, P.A. and Baria, T. (2022) To Compare the Effectiveness of Granisetron versus Ondansetron to Control Nausea and Vomiting during Lower Segment Cesarean Section under Subarachnoid Block. *Anesthesia Essays & Researches*, **16**, 378-380. https://doi.org/10.4103/aer.aer_86_22