# COMPARISON BETWEEN INTRATHECAL ISOBARIC LEVOBUPIVACAINE VERSUS HYPERBARIC BUPIVACAINE IN ELDERLY PATIENTS UNDERGOING TROCHANTERIC FRACTURE SURGERY

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**Abstract:**

**Background**: The aim of this randomized blind study was to compare the effects of administering isobaric levobupivacaine (12.5mg) and hyperbaric bupivacaine (12.5mg) with fentanyl (25µg) intrathecally in elderly patients who were undergoing surgery for trochanteric fractures.

**Purpose:** The purpose of this study is to assess the impact of both isobaric levobupivacaine and hyperbaric bupivacaine in spinal anesthesia on hemodynamics, sensory and motor block, postoperative analgesic requirements, and the occurrence of any postoperative complications in elderly patients undergoing trochanteric fracture surgery.

**Methods**: A total of sixty elderly patients, aged 60 years and older, who were scheduled to undergo elective trochanteric fracture surgery under spinal anesthesia, were enrolled in this study. The patients were divided equally into two groups. Prior to the procedure, all patients received intravenous lactated Ringer's solution at a volume preload of 10 ml/kg. The spinal anesthesia procedure was performed with the patient in a sitting position, targeting the L3-4 interspace using a midline approach and a 25-gauge needle. Hemodynamic measurements were taken immediately after the administration of spinal anesthesia, followed by measurements every 10 minutes during the intraoperative period, and then every two hours for up to six hours postoperatively. The onset of sensory and motor block was assessed using the modified Bromage score. Postoperative pain levels were evaluated using the visual analog scale (VAS) score. The time of the first request for analgesia, postoperative complications, and patient and surgeon satisfaction scores were also recorded as part of the study.

**Conclusion**: Based on the primary endpoints evaluated in this study, it can be concluded that the use of isobaric levobupivacaine, which is the pure S (-) enantiomer of racemic bupivacaine, is an equally effective local anesthetic for spinal anesthesia in elderly patients

undergoing trochanteric fracture fixation compared to racemic hyperbaric bupivacaine. Both groups achieved satisfactory sensory and motor blockade intraoperatively. Furthermore, the administration of intrathecal isobaric levobupivacaine in elderly patients undergoing trochanteric fracture surgery demonstrated hemodynamic stability when compared to intrathecal hyperbaric bupivacaine. Additionally, a lower incidence of nausea, vomiting, and itching was observed in both groups.

**Keywords**: Isobaric levobupivacaine, hyperbaric levobupivacaine, spinal anesthesia, elderly patients.

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**Introduction**:

The process of aging is a biological reality that occurs naturally and is largely beyond human control. However, the perception and understanding of old age are also influenced by societal constructs. In developed countries, chronological time, particularly around the age of 60 or 65, which is often associated with retirement, is considered the beginning of old age. In contrast, in many developing countries, chronological time holds less significance in defining old age, and other social constructs and roles assigned to older individuals become more important. Physical decline and the loss of roles can be defining factors in these societies. [(1)]

Hip fractures are common among the elderly population in developed countries, and perioperative morbidity and mortality can be influenced by both the choice of anesthetic agent [(2)] and the surgical procedures employed.

Local anesthetics work by blocking sensory and motor functions through inhibiting the permeability of neuronal cell membranes to sodium. Bupivacaine, with its prolonged duration of action and established clinical use, is particularly noteworthy. It was synthesized in 1957

and introduced to the market in 1965. [3] Bupivacaine can be administered through injection in the vicinity of a nerve or into the epidural space of the spinal canal. In some cases, it is mixed with a small amount of epinephrine to prolong its effect. When administered intrathecally, it typically takes effect within 5 minutes and lasts for 3 to 4 hours. [4, 5]

Levobupivacaine, a relatively new amide local anesthetic, has gained attention in clinical practice due to its lower cardiac and central nervous system toxicity. While its use has been explored in epidural and loco-regional techniques, more information is needed regarding its characteristics in spinal anesthesia. [6] Elderly patients undergoing various surgeries such as transurethral resection of the prostate or bladder tumor, orthopedic trauma or joint replacement, and cataract surgery often have underlying cardiac or pulmonary diseases. [7] Due to its safer pharmacological profile, levobupivacaine is considered a preferable local

anesthetic compared to bupivacaine for subarachnoid block in geriatric patients with coexisting systemic diseases who are undergoing prostatic resections. The addition of fentanyl can further mitigate side effects by reducing the effective dose of levobupivacaine required for adequate analgesia. [8]

**Aim of the study:**

The objective of this research was to compare the effects of intrathecal administration of two different local anesthetics, namely isobaric levobupivacaine and hyperbaric bupivacaine, in the surgical management of trochanteric fractures in elderly patients. Specifically, the study aimed to evaluate the hemodynamic effects in terms of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR). Additionally, the onset and level of sensory and motor block, postoperative analgesic requirements, and any potential adverse effects were assessed.

**Patients and methods:**

A total of sixty elderly patients who were scheduled for elective trochanteric fracture surgery under spinal anesthesia were enrolled in this study. The patients were randomly divided into two groups of equal size (30 patients each) using the closed envelopes technique. One group received spinal anesthesia with 2.5ml (12.5mg) of isobaric levobupivacaine combined with

25µg fentanyl, while the other group received spinal anesthesia with 2.5ml (12.5mg) of 0.5% hyperbaric bupivacaine along with 25µg fentanyl. Standard monitoring equipment, including an electrocardiograph, non-invasive arterial blood pressure monitor, and pulse oximeter, was used to monitor the patients. Additionally, they received intravenous warmed Ringer's solution as a volume preload at a rate of 10 ml/kg. Oxygen supplementation was provided through a face mask. The spinal anesthesia procedure was performed in the sitting position at the L3-4 interspace using a 25-gauge spinal needle under strict aseptic conditions.

**Measurements**:

Measurement of hemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, and oxygen saturation, was conducted prior to spinal anesthesia and then at regular intervals during the intraoperative period. Subsequently, these measurements were taken every two hours for up to six hours in the postoperative phase. To assess pain intensity, a visual analogue scale (VAS) was employed. The VAS scale ranged from 0 to 10, with 0 indicating no pain and 10 representing the most severe pain imaginable. Pain levels were assessed immediately after surgery and subsequently at two-hour intervals during the first eight hours, followed by four-hour intervals for the remainder of the initial 24-hour period[(9)]. The time elapsed until the first request for postoperative analgesia was also recorded. Additionally, any postoperative side effects, such as hypotension, bradycardia, respiratory depression, sedation, itching, nausea, and vomiting, were documented. Patient and surgeon satisfaction scores were assessed using a scale ranging from 1 to 100, where a higher score indicated greater satisfaction[(10)].

**Results:**

Regarding demographic data, there was no significant difference in both groups as regard the patient age (p =0.046) and patients' sex (p=0.793).

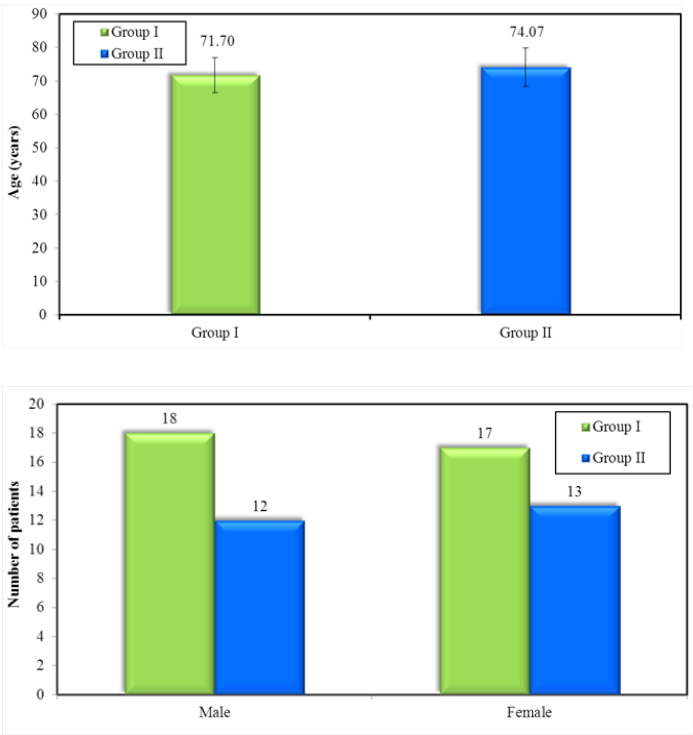


**Figure (1, 2): Comparison between the two studied groups according to demographic data.**

There was no significant difference in both groups as regard the heart rate before the spinal anesthesia "base line" (P value = 0.389), Immediately after spinal(P value = 0.121), intra-operative at 10 min (P value = 0.769), 20 min (P value = 0.628), 30 min (P value = 0.093) ), 40 min (P value = 0.077), 50 min (P value = 0.115) ), 60 min (P value = 0.090), 70 min (P value = 0.316) ), 80 min (P value = 0.375), 90 min (P value = 0.059) and immediate post-operative (P value = 0.084), 2h (P value = 0.497), 4h (P value = 0.055) , 6h (P value = 0.302). There was no significant difference in both groups as regard the mean arterial blood pressure before the spinal anesthesia "base line" (P value = 0.270), Immediate after spinal(P value = 0.176), intra-operative at 10 min (P value = 0.079), 20 min (P value = 0.056), 30 min there was a significant statistical difference between both groups (P value < 0.001), that 4 patients in group I showed decrease in mean arterial blood pressure by more than 20% than the basal level with percentage of 13% of the whole group in comparison with 11 patients in group II with percentage of 36% of the whole group ,40 min (P value = 0.904), 50 min (P value = 0.096), 60 min (P value = 0.130), 70 min (P value = 0.096), 80 min (P value = 0.749), 90 min (P value = 0.756) and immediate post-operative (P value = 0.082), 2h (P value = 0.168), 4h (P value = 0.233) , 6h (P value = 0.435).

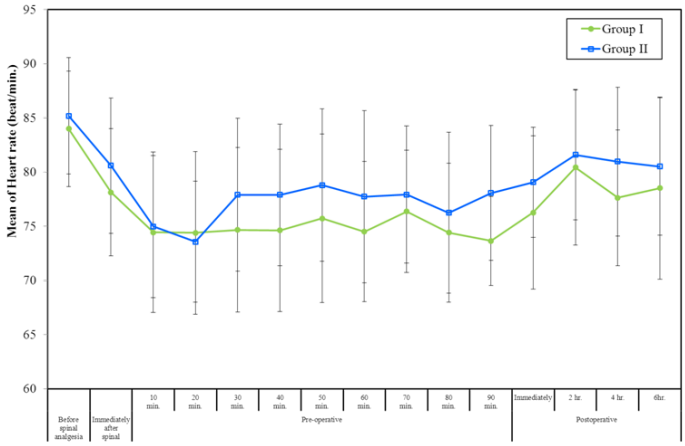


**Figure (3): Comparison between the two studied groups according to heart rate (beats/min).**

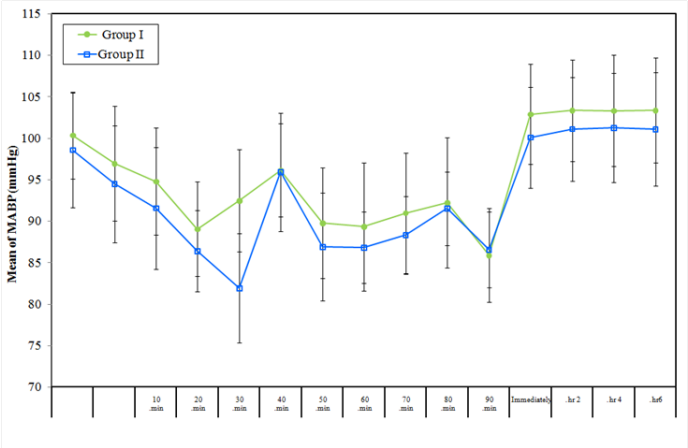


**Figure (4): Comparison between the two studied groups according to MAB (mmHg).**

The readings showed no significant statistical difference between both groups as regard the onset of sensory block (p=0.130), with highest segmental level of anesthesia in Group II (P value = 0.009*).

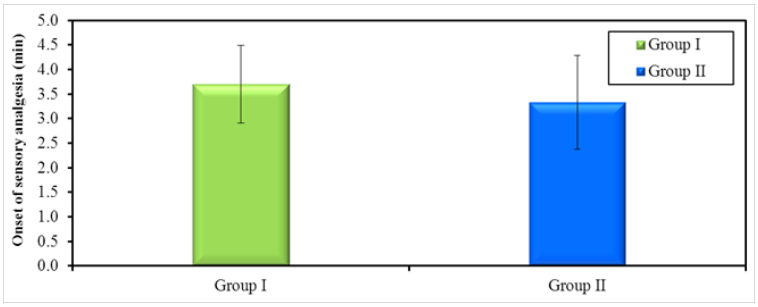


**Figure (5) onset of sensory block.**

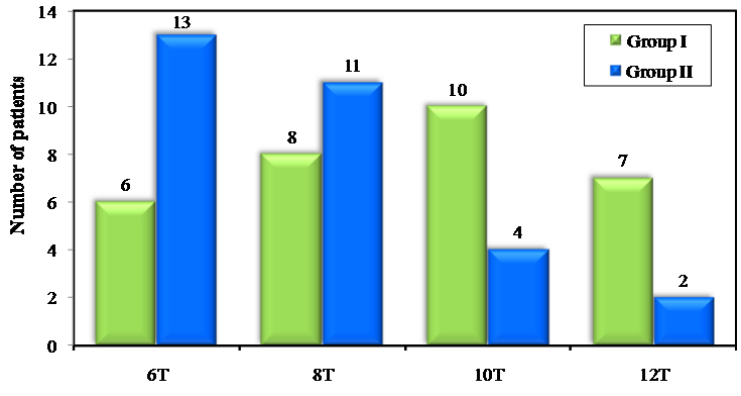


**Figure (6) highest sensory block level.**

The readings showed significant difference as regard motor block using modified Bromage score between both groups immediately after spinal anesthesia with delayed onset of motor block in group I rather than group II (P value <0.001*).

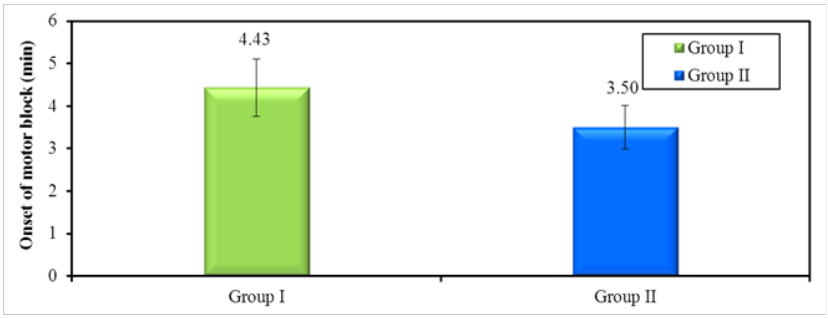


**Figure (7): time onset of motor block.**

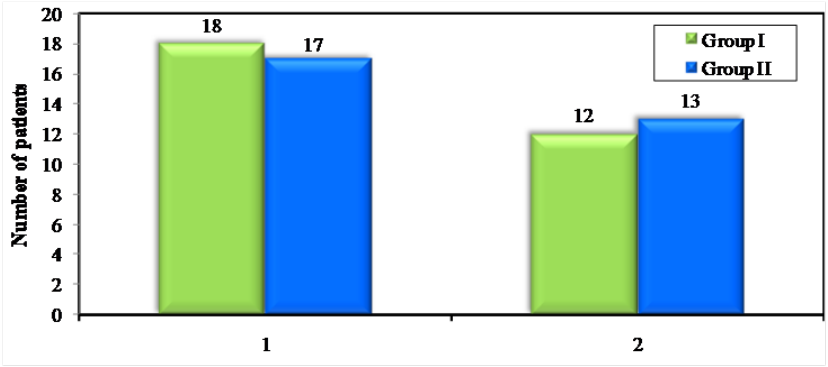


**Figure (8) onsets of motor block as regard MBS.**

As regard the duration of analgesia the readings showed a significant difference between both groups, with earlier request for analgesia in group I (P value <0.001*).Regarding the total analgesic requirements there was a significant difference between both groups (P value =<0.001*) with less total analgesic requirements in group II compared with group I.

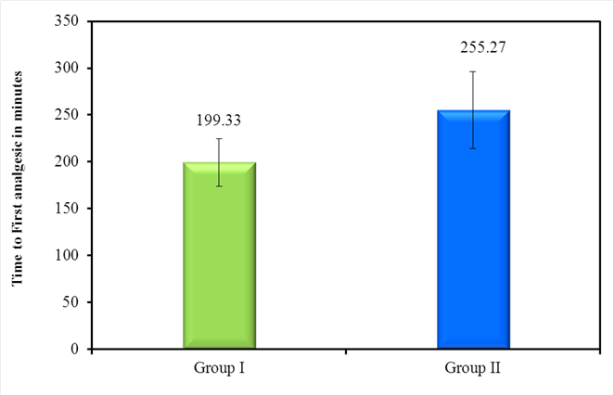


**Figure (9) Comparison between the two studied groups according to time to first analgesic in minutes.**

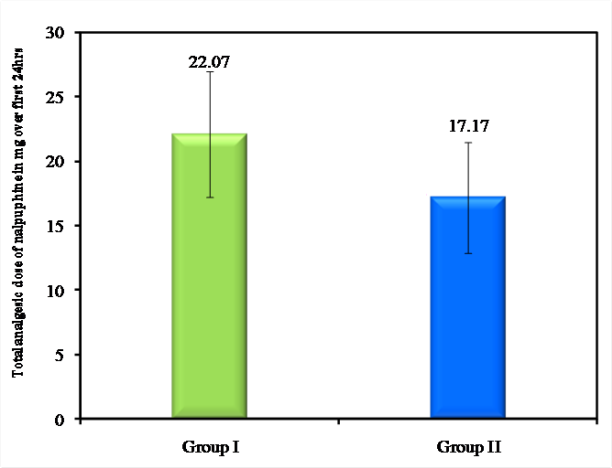


**Figure (10) Comparison between the two studied groups according to the total analgesic dose of nalbuphine in mg within first 24 hrs. postoperatively.**

Regarding the VAS there was no significant difference as regard the pain intensity between both groups from base line immediately postoperative (P value = 0.058), while there was a statistical significant difference between both groups at 2h (P value <0.001*) and 4h (P value <0.001*) and thereafter there was no significant difference between both groups at 6h (P value =0.400) , 8 h (P value = 0.150),12 h (P value = 0.147),16 h (P value = 0.716), 20 h (P value = 0.053),24 h (P value = 0.625).

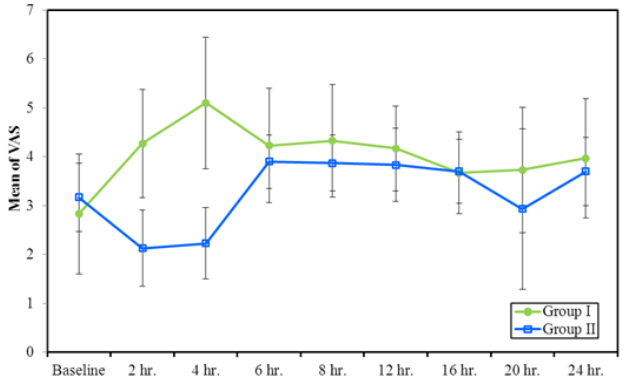


**Figure (11): Comparison between the two studied groups according to VAS.**

Regarding the postoperative side effects, no postoperative side effects were detected as regard hypotension, bradycardia, nausea and vomiting in both groups. Regarding the duration of surgery There was no statistically significant difference between both groups (p=0.622).

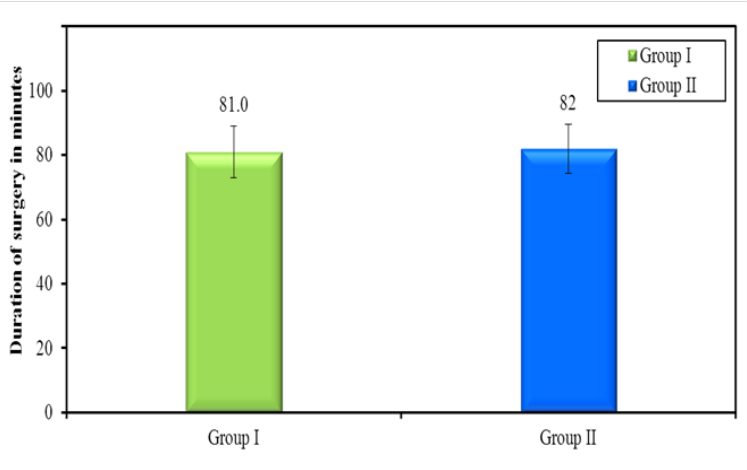


**Figure (12): Comparison between the two studied groups according to duration of surgery.**

Regarding the patient and surgeon satisfaction there was no significant difference as regard satisfaction by patient in both groups (P value = 0.068) and no significant difference between both groups as regard the surgeons' satisfaction (P value = 0.112).

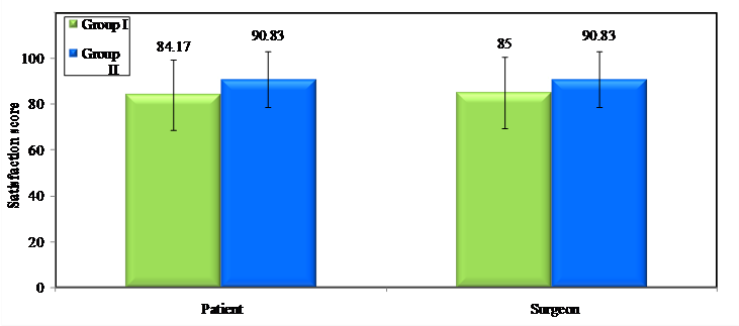


**Figure (13): patient and surgeon satisfaction score.**

**Discussion**:

Spinal anesthesia is considered a safe and effective alternative to general anesthesia, especially for lower extremity surgeries. Utilizing spinal anesthesia without intravenous sedation may help reduce the occurrence of postoperative delirium and cognitive dysfunction in elderly patients [(11)]. With the significant increase in the elderly population, particularly

those aged 65 and older, there has been a corresponding rise in the number of surgical interventions in this age group. It is estimated that more than half of individuals over 65 will require surgery at least once in their remaining lifespan. Regional anesthesia techniques, including peripheral nerve blockade and central neuraxial blockade, are commonly used in elderly patients, offering benefits such as reduced perioperative thromboembolic complications, postoperative analgesia, and early rehabilitation and hospital discharge [12, 13].

Hyperbaric bupivacaine, a commonly used amide local anesthetic in spinal anesthesia, produces somatic and autonomic blockade resulting in a phenomenon of differential blockade. This typically leads to sympathetic blockade at a level two segments higher than sensory blockade, which in turn is two segments higher than motor blockade [14]. Levobupivacaine, the pure S (-) enantiomer of bupivacaine, has emerged as a safer alternative for regional anesthesia compared to its racemic parent. It exhibits lower affinity and depressant effects on vital centers in the heart and central nervous system, along with a superior pharmacokinetic profile, making it an attractive alternative to bupivacaine [15].

In the context of hemodynamics, there were no significant differences in heart rate between the two groups throughout the measurement period. Notably, bradycardia, a potentially serious complication of spinal anesthesia, did not occur in any patient during the surgery, defined as a heart rate below 60 beats/min. Previous studies have also reported no evidence of bradycardia in patients receiving intrathecal bupivacaine alone or in combination with fentanyl [16,17].

Hypotension, a common occurrence during spinal and epidural anesthesia, is a result of sympathetic blockade leading to vasodilation and reduced systemic vascular resistance. Extensive blockade can lead to decreased venous return, a major determinant of hypotension during central neuraxial blockade. Studies have identified high levels of sensory anesthesia and increasing age as risk factors for the development of hypotension. In this study, changes in blood pressure, including systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure, were not significant until 30 minutes after the intrathecal injection. However, thereafter, a significant decrease in these parameters, exceeding 20% of the basal readings, was observed in a higher percentage of patients in the second group compared to the first group. Ephedrine was administered in both groups to treat hypotension, with doses ranging from 2.5 mg to 6 mg. This difference could be partially attributed to the baricity of

the local anesthetic[18]. Hyperbaric bupivacaine, known for its earlier onset of action and greater cephalic distribution, resulted in a more pronounced initial reduction in blood pressure compared to isobaric levobupivacaine [19].

Regarding the onset of sensory and motor block, there was no significant difference in the time of sensory block onset between the two groups. However, the highest level of sensory block achieved was statistically higher in the group receiving bupivacaine compared to the group receiving isobaric levobupivacaine, although this difference was not clinically significant. Similar findings have been reported in other studies investigating the onset of sensory and motor block in different patient populations [20]. Additionally, patients in the bupivacaine group exhibited a slower regression of sensory block, with a longer time until the first analgesic request compared to the levobupivacaine group. This could be attributed to the higher level reached by racemic bupivacaine and the longer regression time in this group [20].

A study conducted by Belgin Akan et al. involving patients undergoing elective transurethral resection of the prostate (TURP) under spinal anesthesia found that the time until the first analgesic request was shorter in the group receiving levobupivacaine alone compared to the other two groups [21]. In the present study, no patients experienced respiratory depression, urinary retention, or post-spinal headache. Most expected complications were assessed in the postoperative period, and no cases of nausea or vomiting were recorded, likely due to the hemodynamic stability achieved in both groups at the end of surgery. Similar findings were reported in a study by P. Gautier et al., where the incidence of hypotension, ephedrine consumption, nausea, and vomiting did not significantly differ between patients receiving different intrathecal solutions [22].

In terms of patient and surgeon satisfaction, there were no significant differences observed between the two groups in the present study.

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