

# The Effect of Different Combination Doses of Intrathecal Hyperbaric Bupivacaine 0.5% and Sufentanil on the Hemodynamic Profile of Geriatric Patients Undergoing Hip Surgery under Spinal Anesthesia

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## Abstract

**Background:** With the increasing number of elderly patients with fragile hemodynamic profiles undergoing lower limb surgery, avoiding hypotension in this population is of great importance. We intended to study the effect of different combination doses of intrathecal hyperbaric bupivacaine 0.5% and sufentanil on the hemodynamic profile of geriatric patients undergoing lower limb surgery.

**Methods:** A total of 60 patients aged over 70, candidates for lower limb surgery under spinal anesthesia were enrolled in this study. The patients were randomly allocated into three groups. Group 1 (G1: 5 mg bupivacaine plus 10 µg sufentanil intrathecally), Group 2 (G2: 10 mg bupivacaine plus 5 µg sufentanil intrathecally), and Group 3 (G3: 15 mg bupivacaine intrathecally). Non-invasive automated blood pressure was checked every 1 minute for the first 5 minutes, and every 5 minutes for 25 minutes and every 15 minutes for 30 minutes during surgery. Heart rate (HR) was recorded at the same intervals. The quality of the blocks was also compared.

**Results:** A total of 60 patients met the inclusion criteria and were enrolled in the study. Five patients had failed spinal anesthesia whom were replaced with new patients. There was no difference between the groups in their baseline characteristics. Mean arterial pressure after 1 minute in Groups 2 and 3 was significantly lower than Group 1 ( $86.0 \pm 9.0$ ,  $87.3 \pm 11.0$ ,  $92.2 \pm 13.0$ ,  $P = 0.001$ ). No statistically significant difference in HR was observed in between the three groups. The degree of motor and sensory block was adequate in all three groups, and no patients required any additional analgesics. 15 (75%) patients in Group 3 received ephedrine in comparison to 11 (55%) patients in Group 2. 3 (15%) patients in group one needed ephedrine.

**Conclusions:** In conclusion, adding sufentanil as an adjuvant and decreasing the dose of intrathecal hyperbaric bupivacaine may help maintain a stable hemodynamic during lower limb surgery in the elderly.

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## Introduction

Regional anesthesia is a popular and commonly used anesthesia technique, especially in lower limb surgeries (1). Fixations of lower limb fractures are the main part of these surgeries. Many patients undergoing lower

limb surgeries are geriatric patients with fragile hemodynamic status (2).

With the increase in the number of aged patients being candidates for lower limb surgeries, spinal anesthesia-related complications such as hypotension have become more noticeable. Although there still is

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not a consensus on whether general anesthesia has a worse outcome compared to regional anesthesia in the elderly, regional anesthesia is being frequently used in elderly patients undergoing surgery (3-5).

The primary aim of this study was to evaluate the effect of three different combination doses of hyperbaric bupivacaine 0.05% and sufentanil, on the changes of mean arterial blood pressure in geriatric patients undergoing spinal anesthesia.

Changes in heart rate (HR) and the quality of block after spinal anesthesia were considered as secondary outcomes.

## Materials and Methods

The Institutional Ethics Committee of Shahid Beheshti University of Medical Sciences approved the study protocol and after a thorough detailed explanation of the nature of the study to the participants an informed written consent was obtained from all the patients.

In this study, a total number of 60 patients compliant with the American Society of Anesthesiologist Physical Status Class II and III aged 70 and older scheduled for elective lower limb orthopedic surgery under spinal anesthesia in supine position, lasting < 3 hours were enrolled. Patients with any contraindications to spinal anesthesia such as infection on the back; addiction to any substance and patients with a history of cardiac, respiratory or psychological disease were not entered in the study. In occasions with failed spinal anesthesia or duration of surgery lasting over 3 hours, new case replacement was done.

On arrival in the operating room, patients in all groups were monitored with an electrocardiogram, noninvasive blood pressure, pulse oximetry, and HR. An 18-gauge cannula was inserted on the dorsum of non-dominant hand and lactated ringer solution 7 ml/kg was administered. Then, with the patient in the lateral decubitus position, using an aseptic technique, a 25-gauge pencil point needle was inserted intrathecally via a midline approach into the L3-4 or L4-5 interspaces.

Based on a computerized randomization list patients were allocated into three groups: Group 1 [G1: Whom received 5 mg (low dose) of intrathecal bupivacaine 0.05% along with 10 µg (high dose) of sufentanil], Group 2 [G2: Whom received 10 mg (medium dose) of intrathecal bupivacaine along with 5 µg (low dose) of sufentanil], and Group 3 [G3: Whom received 15 mg (traditional dose) of intrathecal bupivacaine 0.5%]. All drug solutions were prepared by an anesthetist who was not involved in the study, and all the spinal anesthesia were performed by an expert anesthesiologist who was blinded to group assignment. All the patients received supplemental oxygen (3 L/minutes) through a nasal catheter during and after the procedure in the postanesthesia care unit. To avoid hypothermia, a heat blanket was used.

Non-invasive automated blood pressure was checked every 1 minute for the first 5 minutes, and every 5 minutes for 25 minutes and every 15 minutes for 30 minutes during surgery. HR was recorded at the same intervals.

All the patients were placed in the supine position after drug injection and a T<sub>10</sub> level of anesthesia was achieved by modifying patients' position.

To record the onset time and duration of sensory and motor block, sensory level was assessed using pinprick test every minute for 10 minutes and then every 10 minutes for 120 minutes. The motor blockade was assessed by the Bromage Scale (Grade I: Free movement of the legs and feet, Grade II: Just able to flex knees with free movement of feet, Grade III: Unable to flex knees, but with free movement of feet, Grade VI: Unable to move legs or feet).

If any of the patients complained of pain at any time during the operation, this was considered as a fail spinal anesthesia and general anesthesia was induced immediately.

Hypotension was defined as a decrease in systolic blood pressure to < 90 mm Hg or 25% from baseline, it was treated with bolus doses of intravenous (IV) 10 mg ephedrine and fluids, 50-100 ml IV. Bradycardia (HR < 50/minutes) was treated by 0.5 IV atropine. Nausea, vomiting, and itching were also recorded.

Statistical analysis of the results was performed using SPSS for Windows, release 17.5 (SPSS Inc., Chicago, IL, USA). It was estimated that a sample size of 20 patients in each group would allow detection of a mean difference in blood pressure of 20 mm Hg with a power of 80% at a significant level of 0.05.

Student's t-test was used to analyze the difference in means and chi-squared exact test to analyze the difference in categorical data. A P < 0.050 was considered statistically significant. Analysis of mean arterial pressure measured over time was carried out using repeated measure ANOVA.

## Results

A total of 60 patients met the inclusion criteria and were enrolled in the study. Five patients had failed spinal anesthesia whom were replaced with new patients. 60 patients were enrolled for data analysis. Basic characteristics and baseline HR and mean arterial blood pressure of patients are presented in table 1. There was no difference between the groups in their baseline characteristics. Data on fluid replacement, duration of surgery, duration of block, blood loss, and the incidence of pruritus and post-operative nausea and vomiting (PONV) in between the three groups are presented in table 2.

Changes in mean arterial pressure after spinal anesthesia for 60 minutes are presented in figure 1.

Table 1. Demographic data of patients

Variables	Group 1 (n = 20) [2 cc sufentanil + 1 cc bupivacaine]	Group 2 (n = 20) [1 cc sufentanil + 2 cc bupivacaine]	Group 3 (n = 20) [3 cc bupivacaine]	P-value
Age	80.75 ± 5.66	78.85 ± 8.18	77.40 ± 9.01	0.396
Weight	53.75 ± 8.43	55.05 ± 8.71	57.85 ± 9.34	0.104
Pre-operative Hb (g/dl)	11.1 ± 3.4	11.9 ± 2.7	12.2 ± 1.0	0.341
Ejection fraction	54.50 ± 1.54	54.75 ± 3.02	55.00 ± 3.63	0.960
Pre-operative MAP	96.60 ± 9.89	97.40 ± 14.15	98.95 ± 10.15	0.808
Pre-operative HR	82.50 ± 18.40	82.60 ± 18.30	84.10 ± 11.91	0.943
Sex (%)				
Male	6 (30.0)	5 (25.0)	6 (30.0)	
Female	14 (70.0)	15 (75.0)	14 (70.0)	

Data are presented as mean ± SD. SD: Standard deviation; MAP: Mean arterial pressure; HR: Heart rate; Hb: Hemoglobin

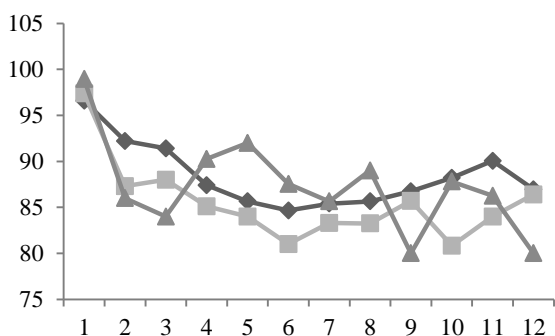


Figure 1. Changes in mean arterial pressure (MAP) after spinal anesthesia-vertical axis = The MAP, horizontal axis = Time after spinal anesthesia (every 1 minute for the first 5 minutes, and every 5 minutes for 25 minutes and every 15 minutes for 30 minutes) in which MAP was measured during surgery. Symbols: Group 1: Square, Group 2: Diamond, Group 3: Triangle

Mean arterial pressure after 1 minute in Groups 2 and 3 was significantly lower than Group 1 ( $86.0 \pm 9.0$ ,  $87.3 \pm 11.0$ ,  $92.2 \pm 13.0$ ,  $P = 0.001$ ). 15 (75%) patients in Group 3 received ephedrine in comparison to 11 (55%) patients in Group 2. 3 (15%) patients in group one needed ephedrine. No statistically significant difference in HR was observed in between the three groups. The degree of motor and sensory block was adequate in all three groups and no patients required

any additional analgesics.

### Discussion

This study showed that increasing the dose of intrathecal sufentanil as an adjuvant, and decreasing the dose of intrathecal hyperbaric bupivacaine 0.5%, could help us maintain a better hemodynamic profile in the geriatric population undergoing lower limb surgery under spinal anesthesia at the expense of shorter duration of the sensory block.

It was shown that a combination of high dose of intrathecal sufentanil (10 µg) added to a low dose of hyperbaric bupivacaine 0.5% (5 mg) (Group 1) resulted in a stable hemodynamic profile during the procedure, but the duration of sensory block was much shorter. A combination of a low dose of sufentanil (5 µg) to a medium dose of bupivacaine (10 mg) (Group 2) resulted in an acceptable hemodynamic profile and sensory block duration. A high dose of intrathecal bupivacaine (Group 3) with no adjuvant resulted in the least favorable hemodynamic profile in the geriatric population, and the highest use of ephedrine for hemodynamic support. The ups and downs observed in hemodynamic profile (Figure 1) of the patients in this group may be partly explained by the need to administer IV ephedrine to help maintain an acceptable blood pressure.

Table 2. Operative data of patients in the three groups

Variables	Group 1 (2 cc sufentanil + 1 cc bupivacaine)	Group 2 (1 cc sufentanil + 2 cc bupivacaine)	Group 3 (3 cc bupivacaine)	P-value
Duration of surgery	113 ± 14	107 ± 16	114 ± 18	0.345
Ephedrine (mg)	3.25 ± 5.68	13.75 ± 18.56	20.50 ± 23.06*	0.002
Duration of surgery	113 ± 14	107 ± 16	114 ± 18	0.345
Blood loss	154 ± 49	140 ± 47	159 ± 58	0.437
Duration of block	160.3 ± 14	174 ± 23	193 ± 17*	0.001
Fluids (ml)	2555.00 ± 426	2285.00 ± 438	2400.00 ± 416	0.282
PONV (%)				
0	12 (60.0)	16 (80.0)	16 (80.0)	
1	8 (40.0)	4 (20.0)	4 (20.0)	
Pruritus (%)				
0	10 (50.0)	12 (60.0)	20 (100)	
1	10 (50.0)	8 (40.0)	0 (0.0)	0.001

PONV: Post-operative nausea and vomiting

With the general population aging and the increase in the number of older patients undergoing different kinds of surgeries, anesthesiologists are confronting new challenges in the management of the geriatric population: hemodynamic stability being on top of the list.

Previously different solutions have been proposed and studied in the geriatric population to decrease the changes confronted in the hemodynamic of elderly patients with conflicting results. It has been shown that a reduced dose of hyperbaric bupivacaine (7.5 mg) in combination with sufentanil (5 µg) provides reliable spinal anesthesia for the repair of hip fracture in aged patients with few events of hypotension and little need for vasopressor support of blood pressure (6). A “mini dose” of 4 mg bupivacaine in combination with 20 µg of fentanyl has also been studied and proven to help maintain a good hemodynamic profile in the aged population (7). Even a reduction of 40% in the dose of local anesthetic has been proposed to prevent the exaggerated hemodynamic response (8).

IV drugs, such as lidocaine, have also been proposed to render the changes induced by bupivacaine QT after spinal anesthesia in elderly patients, boding out the fragility of elderly patients (9). Prophylactic phenylephrine infusion has also been shown to use full and delays the time to onset of hypotension and decreases the number of hypotensive episodes per patient (10). What should be noted is that in the current study a high dose of sufentanil (10 µg) was administered intrathecally in the elderly which has not been previously studied thoroughly. Although we do know that such doses of intrathecal opioids may cause respiratory depression (11,12), we did not encounter any in the studied populations.

Incidence of pruritus and PONV was much higher in patients receiving high doses of intrathecal sufentanil which was congruent with previous studies.

The quality of blocks was adequate for the surgeries in this study but it should be noted that decreasing the dose of local intrathecal anesthetics decreases the length of sensory and motor block and if a long surgery is anticipated; it is not a good choice to decrease the dose of local anesthetic and add opioids. The same issue accounts for post-operative pain which is less controlled when high doses of opioids are combined with low doses of local anesthetics.

We face a variety of limitations during this study. Apart from the small number of participants in each group, unfortunately, we could not measure the baricity of the solution which we injected which is important in determining the height of the block.

As conclusion, adding sufentanil as an adjuvant and decreasing the dose of intrathecal hyperbaric bupivacaine may help maintain a stable hemodynamic during lower limb surgery in the elderly.

## Conflict of Interests

Authors have no conflict of interests.

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