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Bilateral vs. unilateral spinal anesthesia for varicose vein surgery in hypertensive patients

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Abstract

Background and Purpose: *Cardiovascular system may be affected by spinal anaesthesia due to unavoidable sympathetic blockade. One of the most common side effect is hypotension. Hypertensive patients are particularly prone to developing hypotension during spinal anesthesia. The use of unilateral spinal anesthesia may restrict sympathetic block and avoid the undesired cardiovascular effects. The aim of this prospective, randomized study was to compare unilateral with bilateral spinal anesthesia in hypertensive patients undergoing surgery for varicose veins according to hemodynamic change.*

Material and Methods: *Forty ASA II hypertensive patients scheduled for surgical repair of varicose veins were randomly allocated into two groups to receive bilateral (n=20) and unilateral (n=20) spinal anesthesia. Group S patients received bilateral spinal anesthesia with 3 ml isobaric 0.5% levobupivacaine (15 mg) and group US patients received unilateral spinal anesthesia with hyperbaric spinal solution (0.5% levobupivacaine 5 mg plus fentanyl 50 μg and 1 ml of 10% glucose). We measured noninvasive mean arterial blood pressure and heart rate before spinal blockade and then after 5, 15, 30, and 45 minutes. We also recorded the onset of motor and sensory blockade and side-effects.*

Results: *There were no significant differences between two groups with respect to age, gender, weight, height and duration of surgery. In group S, 15 minutes after the initiation of the spinal block a statistically significant drop in the systolic and diastolic blood pressure from the baseline value was observed ($p<0.05$). Comparing systolic and diastolic blood pressure among groups, a statistically significant difference was also found 15 minutes after spinal injections ($p<0.05$). There were no statistically significant differences in heart rate between groups.*

Conclusion: *In hypertensive patients undergoing surgery for varicose veins, unilateral spinal anesthesia is associated with minimal hemodynamic changes. We conclude that unilateral spinal anesthesia is an attractive alternative to bilateral spinal anesthesia in this group of patients.*

INTRODUCTION

The conventional bilateral spinal anesthesia has been a standard technique for surgical repair of varicose veins. The most common side effect of spinal anesthesia is hypotension occurring between 15% to 33%, with a particularly frequent incidence in hypertensive patients, predisposing the individual to myocardial and brain ischaemia *(1, 2)*. Treatment by volume loading or vasoactive drugs may postpone dis-

charge from hospital *(1)*. Although moderate hypertension is not a contraindication to spinal anesthesia, it should be remembered that there is an almost inevitable fall in blood pressure when spinal anesthesia is induced. Hypotension during spinal anesthesia results primarily from blockade of the sympathetic nervous system, which causes decreases in systemic vascular resistance and cardiac output. Different techniques have been used to prevent these hemodynamic disturbances with limited results. An alternative approach suggested by a number of recent authors is the use of unilateral spinal anesthesia. The unilateral spinal anestehesia may have some advantages over bilateral spinal anesthesia including fewer undesired haemodynamic side effects *(3-5)*, a selective block on the operative side, lower incidence of urine retention *(6),* better mobilization as well as good patients satisfaction *(7)*.

Stable arterial blood pressure has been reported during unilateral spinal anesthesia probably due to restricted sympathetic block and efficient homeostatic vascular mechanisms in non blocked areas which compensate for vasodilatation in one leg *(8)*.

The aim of this study was to compare unilateral with bilateral spinal anesthesia in hypertensive patients undergoing surgical repair of varicose veins according to hemodynamic change.

METHODS

After approval by the Hospitals Ethics Committee and written informed patient consent, 40 hypertensive ASA physical status II patients scheduled for surgical repair of varicose veins were enrolled in the study. Patients with any contraindication for spinal anesthesia or allergic to any drug used in study and those who were not willing to undergo spinal anesthesia were excluded. Patients with serious central nervous system disorders (mental disorders), severe cardiopulmonary disease, infection at the injection site, and body mass index > 40 were also excluded.

Patients received no premedication. After arrival in the operating theatre, a crystalloid preload (Ringer's lactate solution, 5 ml/kg) was intravenously infused before performing the block and baseline values of heart rate and noninvasive arterial blood pressure were recorded. Standard monitoring was used throughout the study, including noninvasive arterial blood pressure, heart rate and pulse oximetry. The patients received 6 ml/kg/hr crystalloid infusion during the surgical intervention.

Patients were randomly allocated into two groups of 20 patients. Group S patients received spinal anesthesia with 3 ml isobaric 0.5% levobupivacaine (15 mg) and group US patients received unilateral spinal anesthesia with hyperbaric levobupivacaine mixed with fentanyl 50 μg (total dose 3 ml). Hyperbaric solution was prepared by combining 5 mg of 0.5% isobaric levobupivacaine (= 1ml) with 1 ml of 10% glucose. Unilateral spinal anesthesia was administered in the lateral decubitus position with the limb to be operated in dependent position. Using an aseptic technique, dural punture was performed in the midline at L3-L4 intervertebral space, using a 26-gauge Quincke needle. After free flow of cerebrospinal fluid had been obtained, the anaesthetic solution was slowly injected over 30 seconds and lateral decubitus position was maintained for 20 minutes before patients were turned supine.

Bilateral spinal anesthesia was performed with the patient placed in the sitting position with the same needle inserted at the L3-L4 interspaces. After injection of spinal solution the patients immediately were turned supine, and remained level for the duration of the study period. Sedation was provided to all patients with midazolam 2.5–5 mg intravenously.

Hypotension was defined as a decrease of systolic blood pressure more than 30% of the baseline or less than 90 mmHg. During an episode of hypotension, additional bolus of 2 mg/kg/h crystalloid was given. However, if supplementation of fluids failed to reverse hypotension IV ephedrine 5-10 mg bolus was administrated. A heart rate <50/min was considered a bradycardia and treated with atropine 0.5 mg IV.

The sensory anesthesia level was evaluated by pinprick method with an 18-gauge needle along the anterior median line. The time to onset of analgesia was defined as the time to the onset of sensory block at any segment level. The onset and degree of motor block were evaluated using a modified Bromage scale (0 = no motor block; 1= hip blocked; 2= hip and knee blocked; 3= hip, knee and ankle blocked). Noninvasive blood pressure, heart rate and motor block were recorded throughout the study: baseline – before spinal blockade and then after 5, 15, 30, and 45 minutes. We also recorded the side-effects such as hypotension, bradycardia, urinary retention, nausea, vomiting and headache.

Statistical analysis was performed with Statistica 8 software using Mann-Whitney U, Wilcoxon, and parametric Chi-square tests. Results were expressed as mean ± standard deviation (SD). A value of $p<0.05$ was considered significant.

RESULTS

There were no significant differences between two groups with respect to age, gender, weight, height and duration of surgery (Table 1). In both groups, anesthesia was adequate for the surgical procedure, and none of the studied patients required intraoperative analgesics. No patient in either group required general anesthesia to perform surgery due to inadequate spinal block.

The mean values of arterial blood pressure are shown in Figure 1. At 15 minutes after the initiation of the spinal block a statistically significant drop in the systolic and diastolic blood pressure from the baseline value was observed in patients who received bilateral spinal anesthesia. Comparing systolic and diastolic blood pressure among groups, a statistically significant difference was also found 15 minutes after spinal injections. There were no statistically significant differences in heart rate between groups (Figure 2).

TABLE 1

Demographic dana and clinical variables.

Characteristic	Group S n=20	Group US n=20	*p*
Age (yr)	45.0±9.7	43.0±10.4	0.525
Sex (M/F)	5/15	6/14	0.723
Weight (kg)	69.8±9.3	72.6±10.8	0.263
Height (cm)	167.5±12.0	168.3±11.6	0.708
Duration of surgery (min)	40.0±10.0	45.5±11.6	0.076

Values are mean ±(SD)
There were no statistically significant differences between groups
Group S – bilateral spinal anesthesia; Group US – unilateral spinal anesthesia

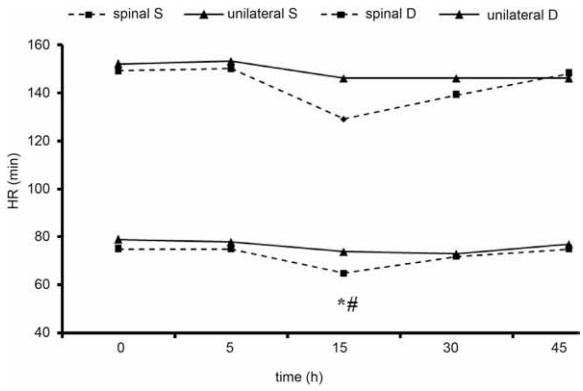

Figure 1. *Changes in systolic and diastolic blood pressure over time. * $p < 0.05$ versus unilateral block; # $p < 0.05$ versus basal value; S – systolic pressure, D – diastolic pressure.*

Seventeen patients in the unilateral group showed pure unilateral spinal block, while in five patients spinal block spread to the nondependent side. No statistically significant difference was seen in the onset time of maximum sensory and motor block (Table 2). Complications and side effects in both groups are shown in Table 3. Four patients in the bilateral, and two patients in unilateral group developed hypotension that required treatment with ephedrine. Bradycardia and urinary retention occurred in two patients in the bilateral group. Five patients in the bilateral group and two in the unilateral group needed treatment for headache. There were no statistically significant differences in the incidence of complications and side effects between study groups.

DISCUSSION

Spinal anesthesia has been considered a standard technique for surgical repair of varicose veins. However, it carries a risk of hemodynamic disturbancies. The most common side-effects of sympathetic denervation are hypotension and bradycardia. In spinal anesthesia both arterial and venous dilation occur, producing hypotension

TABLE 2

Comparison of different groups according to onset time of maximum sensory block and Bromage scale for motor block at different study times.

	Group S n=20	Group US n=20
Onset time of maximum sensory block (min)	5.1±0.8	5.4±0.8
Bromage scale		
Baseline	0.0±0.0	0.0±0.0
5	1.2±0.4	1.1±0.3
15	2.4±0.6	2.5±0.6
30	3.0±0.0	3.0±0.0
45	3.0±0.0	3.0±0.0

Values are mean± (SD)
There were no statistically significant differences between groups
Group S – bilateral spinal anesthesia; Group US – unilateral spinal anesthesia

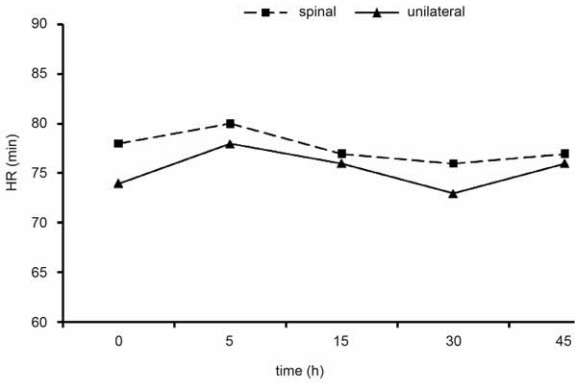

Figure 2. *Changes in heart rate over time. There were no statistically significant differences between groups.*

TABLE 3

Complication and side effects.

	Group S n=20	Group US n=20	*p*
Hypotension	4	2	0.375
Bradycardia	2	0	0.146
Urinary retention	2	0	0.146
Nausea, vomiting	3	1	0.291
Headache	5	2	0.211
Failed anesthesia	0	0	–

Values are number
There were no statistically significant differences between groups
Group S – bilateral spinal anesthesia; Group US – unilateral spinal anesthesia

as a result. Arterial vasodilatation is not maximal after spinal blockade as vascular smooth muscles continue to posses some autonomic tone after sympathetic denervation. Therefore, a mild decrease in total peripheral vascular resistance and mean arterial pressure can be observed if cardiac output is not decreased. In patients with coronary artery disease, systemic vascular resistance can be decreased by up to 33% after spinal anesthesia *(9)*. Based on previous findings, history of hypertension increased the risk for development of hypotension by nearly two fold *(10)*. The difference in the reported cardiovascular changes induced by the administration of regional anesthesia emphasises the unpredictability of the way this population of patients is likely to respond to anesthesia and surgery. There are a number of potential problems associated with the hypertensive patient having spinal anesthesia as they demonstrate perioperative hemodynamic characteristics associated with increased perioperative complications. Untreated patients and those with severe hypertension are at particularly high risk. Hypertensive patients can develop wide swings in blood pressure intraoperatively, which increase the risk of postoperative cardiac and renal complications such as myocardial ischemia, cerebrovascular accidents and acute renal failure. Poorly or untreated hypertension over a period of many years leads to endothelial injury and vascular remodeling that can promote both arteriosclerosis and atherosclerosis. Both are known risk factors for cerebral and renal vascular complications. Structural changes in arteriolar walls play a primary role in hemodynamic response to anesthesia and explain greater changes in systemic vascular resistance and arterial pressure in hypertensive patients than normotensive patients with similar degree of sympathetic blockade *(10)*.

Medial hyperplasia and hypertrophy of the arteries and arterioles increase vasodilatory capacity leading to a loss of central redistribution of the blood volume. In hypertensive patients autoregulation of cerebral blood flow is reset to a higher range than normal, and although it protects the brain against sudden increases in pressure, it makes it more vulnerable to hypotension. Therefore, hypertensive patients will show signs of cerebral ischemia at a higher level of blood pressure than normotensive patients *(11)*.

Since the beginning of 20th century, various techniques of spinal analgesia aimed at restricting the spread of somatic and sympathetic block have been described. The use of localized spinal analgesia was described as early as 1909 by Jonnesco *(12)*. Unilateral spinal anesthesia was first achieved in 1947 and is today a fully recognized, safe and practical method indicated for all procedures involving the lower limb, both orthopedic and vascular, some operations in the perineal area, and some general surgical procedures such as inguinal hernia repair, especially in day case surgery. The hemodynamic stability that the method offers compared to bilateral spinal anesthesia has been emphasized in several studies *(5, 13, 14)*. Casati *et al. (15)* reported a decrease in MAP values when using higher doses of 0.5% bupivacaine in the bilateral spinal anesthetic group, while Kirdemir *et al. (16)*. used the same dose of local anesthetic in both groups and observed no differences in MAP values.

In the present study, we used a much lower dose of local anesthetic in unilateral spinal anesthetic group and observed a statistically significant drop in the systolic and diastolic blood pressure from the baseline value in patients who received bilateral spinal anesthesia 15 minutes after the initiation of the block. So, the study demonstrated that using hyperbaric levobupivacaine in reduced volume for unilateral spinal anesthesia does restrict effectively the extent of the sympathetic block, thus preventing the undesired haemodynamic effects in hypertensive patients. However, using such a small dose of local anesthetic in order to achieve unilateral block presents an undeniable risk of higher failure rate. Kirdemir *et al. (16)* observed successful unilateral block in 24 of 30 patients in their study, while some other authors reported even lower rates of success *(17–19)*. Salvaj *et al. (17)* reported unsuccessful unilateral spinal anesthesia with 12 mg tetracaine due to the higher doses and quick intrathecal injection. In vitro studies using microcatheters have shown that rapid injections tend to cause turbulence, dilution and mixing of the local anesthetic with the CSF, whereas slow injections result in a more gravity-dependent distribution of the local anesthetic whithout turbulence induced mixing effects *(20)*. Holman *et al. (21)* using in vitro spinal canal model, demonstrated that transition from laminar to a turbulent flow occurs at an injection speed of 0.1 ml/sec. In our study seventeen patients in the unilateral group showed pure unilateral spinal block, while in five patients spinal block spread to the nondependent side, but none of the patients presented with a failed sensory block and we were able to include all into the study. The slow administration of local anesthetic over 30 seconds and maintaining the patients in lateral decubitus for 20 minutes before patients were turned supine were probably reasons for the high success rate of unilateral spinal block.

When considering possible complications and side effects we observed certain differences between the two groups, but none of them were statistically significant. Four patients in the bilateral, and two patients in unilateral group developed hypotension that required treatment with ephedrine. Bradycardia and urinary retention occurred in two patients in the bilateral group and did not occur in the unilateral group. Five patients in the bilateral group and two in the unilateral group needed treatment for headache.

In conclusion, we observed that both bilateral and unilateral spinal anesthesia provide adequate intraoperative conditions. However, unilateral sensory block uses small doses of local anesthetic, resulting in greater hemodynamic stability compared to the bilateral spinal block, justifying this method as the superior and promising one in hypertensive patients undergoing peripheral vascular surgery.

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