COMPARISON BETWEEN UNILATERAL SPINAL ANESTHESIA AND CONVENTIONAL SPINAL ANESTHESIA IN ORTHOPEDIC LOWER LIMB OPERATION FOR HEMODYNAMIC STABILITY

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ABSTRACT

Background

A restricted sympathetic block when performing spinal anesthesia may lead to lower hemodynamic changes.

Objectives

The aim of this study is to make a comparison between unilateral spinal anesthesia with conventional spinal block in orthopedic lower limb operation regarding hemodynamic stability and vasopressors use.

Materials and Methods

Hyperbaric bupivacaine 0.5% and 27G Quincke spinal needle were used for 42 ASA I and II patients, they were divided randomly into two groups; Unilateral block was performed with patients in sitting position, spinal needle were inserted, needle's bevel faced to target side 1.5-2 ml of hyperbaric bupivacaine injected within 2 minutes, patient positioned at lateral position with target side downwards for 15 minutes then turned to supine position. Conventional spinal block performed with patients in sitting position, 2-2.5 ml of bupivacaine was injected, and then the patient shifted to supine position.

Results

Systolic and diastolic blood pressure readings at 5, 10, and 15 minutes after induction was significantly higher in unilateral group with more vasopressor use in bilateral group (p value = 0.02). No statistically significant deference regarding pulse rate and arterial oxygen saturation

Conclusion

Unilateral spinal anesthesia using slow, low flow and low volume method in lower limb orthopedic procedures is associated with better hemodynamic stability in comparison to conventional spinal block.

Keywords: *Unilateral spinal, Bupivacaine, Lower limb, Hemodynamics.*

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INTRODUCTION

Patients who undergo orthopedic lower limb surgical operation are different in their age, sex and type of operation performed. Regional anesthesia, especially spinal anesthesia is beneficial for these groups of patients. Bilateral or unilateral spinal anesthesia requires different doses and volumes of bupivacaine [1].

Since spinal analgesia was first described in 1909, various spinal analgesia techniques, including unilateral spinal anesthesia, have been described [2].

The type of anesthesia technique used depends on various factors, such as the anesthesiologist's and patient's preferences, in addition to the patient's age, type of surgery, underlying diseases, intraoperative body position, duration of the surgery, and pain-management methods [3, 4].

Regional anesthesia (spinal and epidural) is often preferred for surgeries involving the lower abdomen or extremities to induce required sensory levels while exerting minimum effects on the sympathetic nervous system [5, 6]. Unilateral spinal anesthesia is used for many surgical operations performed on lower limb. Limiting the spread of the spinal block offers many clinical advantages, including greatly reducing the hemodynamic impact of spinal anesthesia [7].

There are many benefits to this technique apart from fewer hemodynamic changes, less urinary retention, more satisfied patient, better motility during recovery and restriction of the nerve block to the relevant limb. Some factors are required for successful unilateral spinal anesthesia, including the type of needle and its bevel direction, speed of injection, volume, baricity, and concentration of local anesthesia as well as the position of the patient on operation.

In addition, unilateral spinal anesthesia can be useful in elderly patients who have low cardiac output and a risk of early postoperative embolisation [8].

Contraindications to spinal and epidural anesthesia include patient refusal, sepsis, infection at the site, elevated intracranial pressure, allergies to local anesthetics, and inability to maintain the required body position [9].

Hypotension (and possibly decreased cerebral blood flow) may be responsible for nausea and vomiting observed with subarachnoid anesthesia (SAB). Patients should receive a bolus of crystalloid or colloid (250 to 1000 ml) before SAB. Volume loading should also be used cautiously in patients with limited cardiac reserve. In these patients, as the block recedes, vascular tone increases, raising the central blood volume, which may precipitate heart failure. Performing unilateral block may decrease the hypotension associated with subarachnoid block [10].

Sympathetic outflow from the spinal cord occurs from T1 to L2, while parasympathetic outflow is cranio-sacral. Sympathetic cardio-accelerator fibers from T1 to T4 increase the heart rate. Blockade of these fibers from a high spinal anesthetic can cause bradycardia and decreased cardiac output. Hypotension results from decreased systemic vascular resistance through dilation of arteries and venous capacitance vessels [11]

MATERIALS AND METHOD

After the study protocol had been approved by research and ethical committee of Kurdistan board for medical specialties, Informed consent were taken from the 42 ASA physical status I and II patients with age ranging from 18 to 65 years were scheduled for elective lower limb operation requiring spinal anesthesia from June 2018 to June 2019 which were operated in Sulaimani Teaching Hospital and Shar Hospital were enrolled in the study.

Exclusion criteria: Patients with contraindications to spinal anesthesia, peripheral neuropathy, and patients on medications that affect hemodynamic measures were excluded.

Patients were divided randomly into two equal groups; group A with unilateral block and group B for conventional spinal anesthesia. After insertion of IV line all patients were given a preload of 10 ml/kg Ringer's lactate solution over 15 to 20 minutes.

In group A, patients in sitting position, L3-L4 interspace located, 27G Quincke spinal needle were intrathecally inserted, CSF visualized and needle's bevel faced to target side 1.5-2 ml of 0.5 % hyperbaric bupivacaine injected within 2 minute, patient positioned at lateral position for 15 minutes with target side downwards then turned to supine position.

For group B, patients in sitting position , at L3-L4 interspace 2-2.5 ml of 0.5% bupivacaine was injected using same needle size as group A, then patient shifted to supine position. Hypotension is defined as decrease in systolic arterial blood pressure by 30% or more when compared with baseline values, initially treated with 0.9% NaCl then 5 mg ephedrine.

Duration of fasting (NPO) and sedation regimen was same in both groups , Patients of both groups were sedated with 3 mg midazolam after induction of anesthesia and the readings of systolic, diastolic blood pressure (SBP, DBP), pulse rate (PR) and oxygen saturation (SPO2) were recorded 5 , 10 and 15 minutes afterwards. Patients were monitored with ECG, non-invasive blood pressure and pulse oximetry.

Assessment of sensory block was done by cold applying method on operated limb side and motor block of target limb was evaluated using a Modified Bromage scale before readiness for operation.

Bromage 0: Free movement of limb at hip, knee and ankle joint. Bromage 1: Free movement of limb at knee and ankle joint. Bromage 2: Free movement limb at ankle joint. Bromage 3: No movement of limb at hip, knee and ankle joint.

Data analyzed with Statistical Package for the Social Science (SPSS) version 20 program. In this randomized clinical trial data were collected prospectively and we used chi squared test in inferential statistics for ordinal and categorical data to know the correlation between them and students T test for the numerical data. We will also correlate frequencies, means and standard deviations to measure the dispersion of the data. P-value of <0.05 considered statistically significant.

RESULTS

Total of 42 patients were divided in to two groups of 21 patients each, with no failed block. There were no significant differences between both groups in regard of ASA, gender and age (p value of > 0.05) (Table 1).

In comparing SBP, DBP between two groups in three deferent times (5, 10 ,15) minutes after induction ,there were significantly higher blood pressure readings in group A with significantly less need for ephedrine use in compared to group B (Table 2) (figure 1).

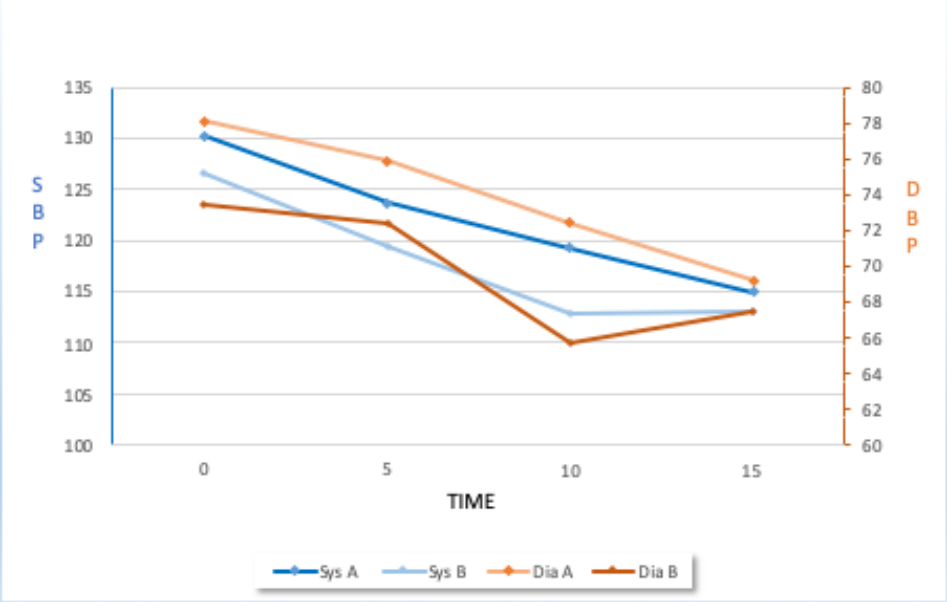
Regarding pulse rate and oxygen saturation there were no significant differences between study groups in different times (5, 10, 15) minutes after induction of anesthesia (Table 3).

Table 1. Demonstrating demographic data and baseline parameters.

VARIABLES	UNILATERAL	BILATERAL	P VALUE
ASA I/II	13/8	15/6	0.52
GENDER M/F	12/9	9/12	0.36
AGE (MEAN) + SD	41.3±12.1	40.1±14.7	0.77
SBP **DBP** **PR**	130.33±12 78.1±8.7 80.5±9.8	126.7±15.7 73.5±9.9 89.1±16.2	0.1 0.7 0.1

Table 2. Differences in blood pressure and ephedrine use in both groups.

Parameters mmHg	Group A (Unilateral) (Mean? SD) N=21	Group B (Bilateral) (Mean? SD) N=21	Significance (P value= 0.05)
SBP (5 min)	123.76?11	119.33?21	0.037
DBP (5 min)	75.9±8	72.4±13	0.023
SBP (10 min)	119.33±8	112.8±17	0.027
DBP (10 min)	72.42±6.9	65.71±13	0.007
SBP (15 min)	114.9±8.4	113±19	0.011
DBP (15 min)	69.28±8.2	67.42±13	0.017
Ephedrine use	2 times	8 times	0.02



Figuer 1. Shows SBP and DBP in different times after induction.

Table 3. Difference in PR and SPO2 of both groups.

Variables	Group A (Unilateral) (Mean ± SD) N=21	Group B (Bilateral) (Mean ± SD) N=21	Significance (P value 0.05)
PR (5 min)	79.90±10	94.8±17	0.295
PR (10 min)	79.33±9	90.85±14	0.872
PR (15 min)	77.47±9	87.95±15	0.270
SPO2 (5min)	98.38±1	97.28±2	0.12
SPO2 (10 min)	98.0±1	96.9±1	0.27
SPO2 (15 min)	97.5±1	97.7±1	0.92

DISCUSSION

Position of patient during and immediately after spinal block influences the intrathecal distribution of the drug. Unilateral block is achievable with anesthetic drugs which are hypobaric or hyperbaric in comparison to cerebrospinal fluid. The distance between left and right nerve roots in the lumbar and thoracic regions is about 10–15 cm, which makes it possible to achieve unilateral spinal anesthesia [12].

Any clinically relevant hypotension (decrease in systolic arterial blood pressure by 30% or more when compared with baseline values) was initially treated with intravenous infusion of 0.9% NaCl solution and then 5 mg ephedrine. Incidence of hypotension requiring treatment with ephedrine in our study was 8 times in group B (bilateral) and 2 times in group A (unilateral), (P value of 0.02).

In this study we used hyperbaric bupivacaine, because hyperbaric bupivacaine is more effective in achieving unilateral spinal block than plain bupivacaine [13]. For hyperbaric spinal anesthesia, the injection flow is an important factor in achieving unilateral sympathetic block. A slow injection proves useful to restrict spinal anesthesia to the side of surgery [14].

The anesthetic drug may migrate even when the patient is placed in the lateral position for 30–60 min.

Conversely, if a low dose (5-8 mg) of anesthetic solution is used, putting the patient in the lateral position for 10–15 min may prevent migration of the anesthetic drug [15].

The onset of sensory block using hyperbaric bupivacaine is within two minutes while complete motor block needs 5 to 6 minutes [16]. We assessed sensory block at level of T10. However, there are no clear recommendations about the assessment of the sensory block [17].

The literature contains many reports on the effect of injection speed of drug in unilateral block. Several studies utilizing different local anesthetic volumes and injection speeds, show that low-volume is more important than low-flow injection [18, 19]. In our study we considered both low volume (1.5-2 ml) and low flow injection (1 ml/min) to achieve desired side restricted block.

Casati and Fanelli used of 8 mg of 0.5% hyperbaric bupivacaine slowly injected through a directional needle provided a spinal block relatively restricted to the operative side with minimal effects on cardiovascular homeostasis [20] there are other studies consistent with this observation that recommend 7.5 mg of bupivacaine 0.5% as enough for adequate unilateral block [21].

Chohan and Afshan administered unilateral spinal anesthesia with hyperbaric bupivacaine 0.5% (1.1 to 1.8 ml) to patients with ASA III and IV undergoing lower limb surgical operation and found no significant hemodynamic change [22].

In our study, unilateral spinal block was associated with intraoperative hemodynamic stability which is the results of other researches [1, 23, 24].

There was no incidence of bradycardia (which is defined as pulse rate less than 50 bpm), no significant deference in pulse rate or oxygen saturation between groups in our study. None significant deference in heart rate between groups in our study is comparable with results of other studies, [25] while in other studies there was significant deference regarding decrease in heart rate which was more noticed in bilateral block group [20].

Frequency of vasopressor use to treat hypotension that is matching the above definition, was significantly lesser in unilateral block group (P value = 0.02), and the results were similar to other studies [26, 27].

When partial sympathetic blockade is performed a reflex increase in sympathetic activity occurs in sympathetically intact areas [28]. For that unilateral distribution of intrathecal anesthetic is superior to bilateral block in surgical procedures involving one leg because the hemodynamic effects of conventional spinal anesthesia are reduced, that's what supported by many literatures and the result of our study was in the same line [19, 29, 30, 31, 32].

In conclusion, performing unilateral spinal block in lower limb orthopedic surgical procedures, is associated with more hemodynamic stability than bilateral spinal block, for this, we recommend that slow, low dose and low flow injection technique unilateral block is a good choice for patients with limited cardiovascular reserve.

Conflict of interest: None

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