

Comparison between Hemodynamic Changes and Time to First Postoperative Analgesic Requirement in Patients undergoing Unilateral and Bilateral Spinal Anesthesia for Lower Limb Surgeries

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ABSTRACT

Introduction: Unilateral spinal anesthesia is more favorable than bilateral spinal anesthesia. This study was done to compare hemodynamic changes and time to first postoperative analgesic requirement in patients undergoing unilateral and bilateral spinal anesthesia for lower limb surgeries.

Materials and methods: A prospective, randomized study was done in 60 patients of American Society of Anesthesiologists grade 1 undergoing lower limb surgery. Patients were randomized into two groups. Group A (n=30) received bilateral spinal anesthesia, and group B (n=30) received unilateral spinal anesthesia. Onset, duration, and time to reach maximum height of sensory block; duration of analgesia; and hemodynamic variables were studied in the two groups.

Results: Duration, time to reach maximum height of sensory block, and duration of analgesia were longer in group B. There were less hemodynamic changes in group B.

Conclusion: Unilateral spinal anesthesia offers more favorable hemodynamic and postoperative analgesic outcome when compared with bilateral spinal anesthesia.

Keywords: Levobupivacaine, Postoperative analgesic requirements, Spinal anaesthesia.

How to cite this article: Dongre D, Mahobia M, Narang N. Comparison between Hemodynamic Changes and Time to First Postoperative Analgesic Requirement in Patients undergoing Unilateral and Bilateral Spinal Anesthesia for Lower Limb Surgeries. *J Recent Adv Pain* 2016;2(2):39-43.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Spinal anesthesia is a simple technique that provides a deep and fast surgical block through the injection of small doses of local anesthetic solution in subarachnoid space. It is widely used for providing a fast and effective

sensory and motor blockade. It has been shown to block the stress response to surgery, decrease intraoperative blood loss, lower the incidence of postoperative thromboembolism, and decrease morbidity and mortality in high-risk patients.¹

Bupivacaine, available in both hyperbaric and isobaric formulation, is the most commonly used local anesthetic agent for spinal anesthesia. Migration of local anesthetic in the cerebrospinal fluid (CSF) depends on its specific gravity relative to CSF.²

Spinal anesthesia is accompanied by a decrease in arterial pressure, and bradycardia, due to blockage of pre-ganglionic sympathetic fibers, is common.³ The incidence of hypotension and bradycardia is affected by the extent of subarachnoid blockage, young age, coexisting disorders according to American Society of Anesthesiologists (ASA) classification and β -adrenergic receptor blockers.³ The cardioaccelerator fibers originate from T1–T4 so the level of spinal anesthesia affecting these dermatomes may cause bradycardia.⁴

The cardiac index values are much more stable in unilateral spinal anesthesia when compared with conventional bilateral spinal block, with a smaller reduction in arterial blood pressure and heart rate⁵ and a much lower incidence of clinically relevant hypotension.⁶ It avoids unnecessary paralysis on the nonoperated side, better mobilization during the recovery period, and lower incidence of postoperative urine retention.⁷

Several factors are required for successful unilateral spinal anesthesia, which includes needle shape and bevel direction, site and speed of injection of anesthetic, volume, baricity, and concentration of anesthetic solution.⁸

The purpose of our study is to compare hemodynamic changes, time to first postoperative analgesic requirement, and recovery in patients undergoing unilateral and bilateral spinal anesthesia for lower limb surgery.

MATERIALS AND METHODS

After obtaining approval from the institutional ethics committee and written informed consent, 60 ASA grade I and II adult patients of age group between 20 and 60 years scheduled for lower limb surgery were included

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in this study. Patients with cardiovascular, neurological, respiratory, renal, or endocrine disease; contraindication to spinal anesthesia; and allergy to any of the study drugs were excluded from the study. Visual analogue scale (VAS) 0–10 was explained to the patients.

Patients were randomly divided into two groups; each group included 30 patients. Group A patients received bilateral spinal anesthesia, and group B patients received unilateral spinal anesthesia. In the operation theater, patients were placed on the table in supine position. An intravenous cannula (18G) was inserted. Before starting the procedure, all the monitoring equipments (NIBP cuff, pulse oxymetry probe, electrocardiogram) were attached to the patient, and baseline values of heart rate, blood pressure, peripheral capillary oxygen saturation (SpO₂), and respiratory rate were recorded.

Patients were preloaded with 7 mL/kg intravenous fluid (Ringer's lactate). All patients received spinal block under aseptic conditions. In group A: Patients were placed in lateral position with diseased limb in lower side. Lumber puncture was carried out using 25G Quinke needle in lateral position at L3–L4 intervertebral space and drug injected with the needle bevel turned toward the cephalic direction.⁹ All patients in this group received a total of 2 mL hyperbaric bupivacaine 0.5% over 40 seconds.⁹ All the patients were then placed in supine position immediately after injection. In group B: Patients were placed in lateral position with diseased limb in lower side. Lumber puncture was carried out using 25G Quinke needle in lateral position at L3–L4 intervertebral space and drug injected with the needle bevel turned toward the dependent portion of the spinal canal. All patients in this group received a total of 2 mL hyperbaric bupivacaine 0.5% over 40 seconds. Patients were then kept in lateral position for 15 minutes.

Patients received supplemental oxygen at the rate of 5 L/min through simple face mask after administration of spinal anesthesia. Hemodynamic changes were recorded in preanesthesia state and in anesthetized state in the 1st, 5th, 10th, 15th, 30th, and then every 15th minute till the end of procedure. Clinically relevant hypotension is defined as systolic blood pressure <90 mm Hg or >30% decrease in baseline values. Tachycardia is defined as

heart rate >100/min, and bradycardia is defined as heart rate <60/min.

Following parameters were noted: Onset of sensory block, time to reach maximum height, duration of sensory block, duration of analgesia (the period from spinal injection to the time of administration of first rescue analgesia for pain postoperatively). Pulse rate and blood pressure (systolic and diastolic) were recorded.

The duration of analgesia was recorded as the time from intrathecal injection until the patient's request for additional analgesia in the postoperative period which was assessed by VAS \geq 3. Patients who showed persistent pain (VAS score \geq 7) anytime during the intraoperative period were excluded from the study, and the patient assignment was rerandomized.

RESULTS

There was fall in mean diastolic blood pressure from preoperative value in patients of both groups which was statistically but not clinically significant. Fall in mean diastolic blood pressure was maximum in group A (72.20 ± 3.570 to 57.60 ± 0.453 mm Hg) in comparison with group B (78.40 ± 0.707 to 64.93 ± 0.753 mm Hg) (Table 1 and Graph 1).

There was fall in mean systolic pressure from preoperative value in patients of both groups which was statistically but not clinically significant. Fall in mean systolic blood pressure was maximum in group A (126 ± 3.820 to 107.60 ± 3.360 mm Hg) in comparison with group B (134.60 ± 4.030 to 114.67 ± 4.780 mm Hg) (Table 2 and Graph 2).

There was fall in pulse rate from preoperative value in patients of groups A and B which was statistically but not clinically significant. Fall in mean pulse rate was maximum in group A (91.90 ± 3.400 to 65.57 ± 3.340 minutes) in comparison with group B (87.73 ± 5.000 to 76.00 ± 4.780 minutes) (Table 3 and Graph 3).

The difference in duration of analgesia between group A (128.83 ± 6.9 minutes) and group B (161.33 ± 6.93 minutes) was found to be statistically significant ($p < 0.05$) (Table 4 and Graph 4).

The difference in ages between group A (30.633 ± 9.53 years) and group B (31.76 ± 9.81 years) was found to be statistically not significant ($p > 0.05$). The mean age of both groups was comparable (Table 5).

Table 1: Change in mean diastolic blood pressure (mm Hg)

Groups		Preoperative	1 minute	5 minutes	10 minutes	15 minutes	30 minutes
A	Mean	80.36	72.20	66.33	62.53	59.06	57.60
	\pm SD	5.674	3.570	0.650	0.630	0.447	0.453
B	Mean	80.33	78.40	74.46	68.93	66.93	64.93
	\pm SD	4.876	0.707	0.750	0.741	0.741	0.753
t-value		5.767	6.440	8.170	6.580	9.080	8.430
p-value		0.002	0.001	0.003	0.001	0.002	0.001
Significance		S	S	S	S	S	S

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Table 2: Change in mean systolic blood pressure (mm Hg)

Groups		Preoperative	1 minute	5 minutes	10 minutes	15 minutes	30 minutes
A	Mean	137.16	126.87	119.10	115.10	107.20	107.60
	±SD	3.675	3.820	3.850	3.850	3.890	3.360
B	Mean	136.66	134.60	130.70	124.73	120.67	114.67
	±SD	4.534	4.030	4.110	4.110	4.070	4.780
t-value		6.768	7.617	11.297	9.355	13.070	7.470
p-value		0.002	0.001	0.002	0.001	0.001	0.001
Significance		S	S	S	S	S	S

Table 3: Change in mean pulse rate (minutes)

Groups		Preoperative	1 minute	5 minutes	10 minutes	15 minutes	30 minutes
A	Mean	85.56	91.90	83.53	77.87	76.40	65.57
	±SD	3.76	3.400	8.370	3.390	3.580	3.340
B	Mean	85.73	87.73	85.53	82.23	79.93	76.00
	±SD	4.02	5.000	4.270	4.860	4.680	4.780
t-value		2.676	3.770	-2.015	0.460	0.158	-9.784
p-value		0.001	0.001	0.044	0.001	0.002	0.001
Significance		S	S	S	S	S	S

Table 4: Mean duration of analgesia (minutes)

Groups	Mean	±SD	p-value
A	128.83	6.90	-
B	161.33	6.93	0.001

Table 5: Mean height (cm), weight (kg), age (in years)

Groups		Height (145–165 cm)	Weight (55–75 kg)	Age (20–60 years)
A	Mean	152.9	63.63	30.633
	±SD	3.55	3.81	9.53
B	Mean	152.53	65.53	31.76
	±SD	5.33	2.98	9.81

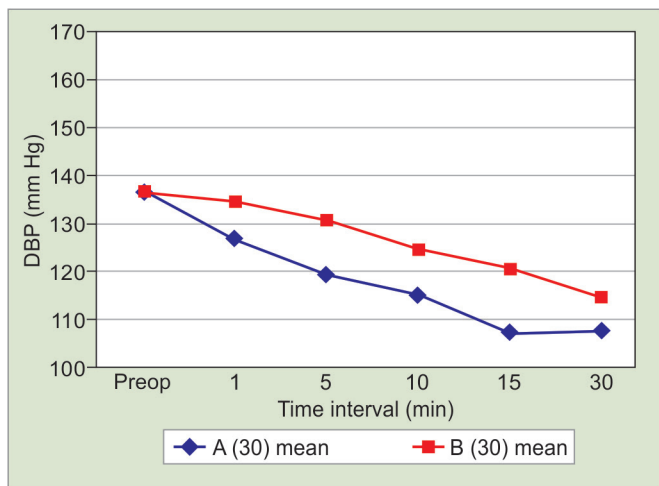
The difference in height between group A (152.9±3.55 cm) and group B (152.53±5.33 cm) was found to be statistically not significant (p>0.05). The mean height of both groups was comparable (Table 5).

The difference in weight between group A (63.63±3.81 kg) and group B (65.53±2.98 kg) was found to be statistically not significant (p>0.05). The mean weight of both groups was comparable (Table 5).

DISCUSSION

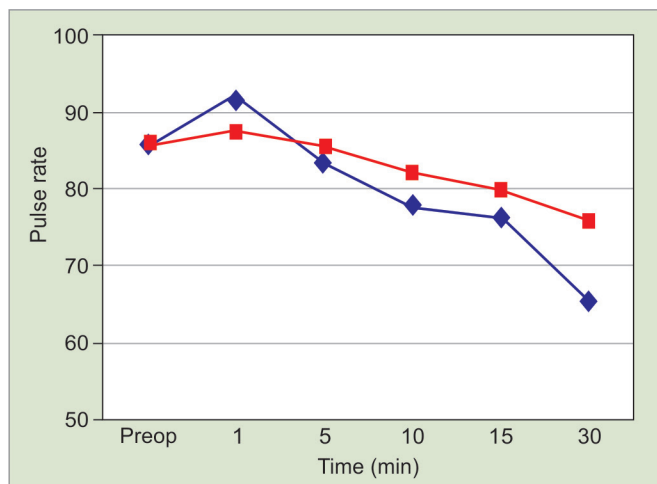
Spinal anesthesia has the advantage of simplicity of technique, rapid onset of action, and reliability in producing uniform sensory and motor blockade. Spinal anesthesia has definitive advantage that profound analgesia can be produced in large parts of body by relatively simple injection of small amount of local anesthetic agent while keeping patient conscious with spontaneous respiration.²

Bupivacaine, available in both hyperbaric and isobaric formulation, is the most commonly used local anesthetic agent for spinal anesthesia.² The incidence of hypotension and bradycardia is affected by the extent of subarachnoid

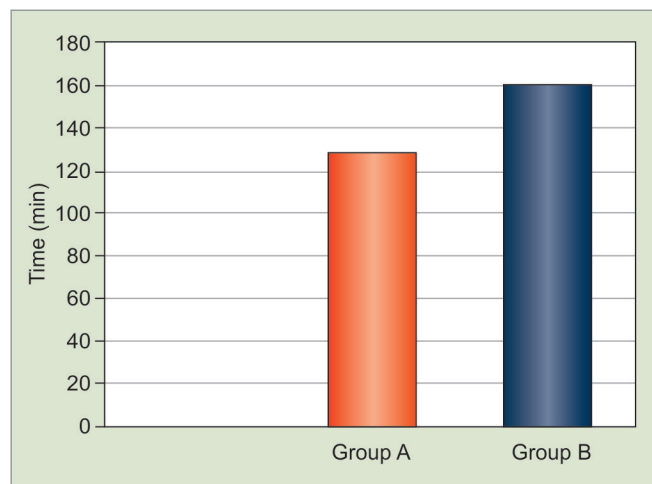


Graph 1: Change in mean diastolic blood pressure

Graph 2: Change in mean systolic blood pressure



Graph 3: Change in mean pulse rate



Graph 4: Duration of Analgesia between the group

blockage, young age, coexisting disorders according to ASA classification and β -adrenergic receptor blockers.³ Ward et al⁴ reported a decrease in mean arterial blood pressure of 21.3% from the baseline following spinal anesthesia.

In our study, both the groups were demographically similar ($p > 0.05$ in all comparisons); it can be presumed that the groups were comparable for the purpose of the study. The main finding of this study was that unilateral spinal anesthesia led to less significant hemodynamic changes and significantly prolonged the duration of sensory blockade without any side-effects. In our study, fall in mean pulse rate, fall in mean systolic blood pressure, and fall in mean diastolic blood pressure were more in patients under bilateral spinal anesthesia in comparison with unilateral spinal anesthesia.

These findings are also in agreement with the studies by Casati et al,¹⁰ Esmaglu et al,¹¹ Akhtar et al,¹² Osinaike et al,¹³ Moosavi Tekye et al,¹⁴ Ijaz et al,¹⁵ Adam et al,¹⁶ and Chohan et al.¹⁷ These authors suggested that unilateral spinal anesthesia is safe, and hemodynamic stability is better than bilateral spinal anesthesia.

Unilateral distribution of spinal anesthesia provided more profound and longer lasting block in the operated limb, less cardiovascular effect, and similar home discharge compared with bilateral spinal anesthesia, with only a slight delay in preparation time.

CONCLUSION

Based on the data from our study, it can be concluded that in patients undergoing lower limb surgeries under unilateral spinal anesthesia, there are:

- Less changes in pulse rate
- Less changes in systolic blood pressure
- Less changes in diastolic blood pressure
- Delay in time to reach maximum sensory block level
- Prolongation of sensory block duration
- Prolongation of duration of analgesia.

So it can be concluded that unilateral spinal anesthesia offers more favorable intraoperative hemodynamic and postoperative analgesic outcome when compared with bilateral spinal anesthesia.

So it is recommended that unilateral spinal anesthesia should be used as the technique of choice in lower limb surgeries.

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