RESEARCH PAPER

Comparison of Effectiveness of Elevated Leg Position vs. Supine in Prevention of Hypotension after Spinal Anesthesia in Patients Undergoing Elective C-Section

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ABSTRACT

Background:
Post-spinal hypotension is a frequent complication of spinal anesthesia during cesarean delivery and may adversely affect both maternal and fetal well-being. Leg elevation is a simple, non-pharmacological maneuver that may improve venous return and reduce the occurrence of hypotension.

Objective:
To compare the effectiveness of elevated leg position versus conventional supine position in preventing hypotension after spinal anesthesia in patients undergoing elective cesarean section.

Methods:
This randomized controlled trial was conducted in the Department of Anesthesiology, Sir Ganga Ram Hospital, Lahore, from 11 January 2022 to 10 July 2022. A total of 106 full-term pregnant women scheduled for elective cesarean section under spinal anesthesia were included and randomly allocated into two equal groups of 53 patients each.

Results:
The mean age of participants was 27.8±4.6 years. Of the 106 women, 45 (42.5%) belonged to ASA class I and 61 (57.5%) to ASA class II. Leg elevation was significantly more effective in preventing post-spinal hypotension than the supine position, with effectiveness observed in 35 (66.0%) patients compared with 17 (32.1%) patients, respectively ($p<0.001$).

Conclusion:
It is concluded that leg elevation during spinal anesthesia was more effective than conventional supine positioning in preventing post-spinal hypotension among women undergoing elective cesarean section. Its effectiveness remained consistent across different patient and surgical characteristics.

Keywords: Spinal anesthesia; post-spinal hypotension; leg elevation; cesarean section; supine position; maternal hemodynamics.

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Introduction

Cesarean section is one of the most frequently performed obstetric procedures in the world, and the rate of cesarean section has been steadily rising in both developed and developing nations [1]. Since its introduction, spinal anaesthetic has become popular for elective cesarean section due to its rapid and reliable surgical anaesthetic effect without causing certain complications in mothers and foals after general anaesthetic [2]. Although, these are all benefits of spinal anesthesia, maternal hypotension is one of the most significant hemodynamic issues during cesarean delivery [3]. Hypotension after spinal anesthesia can happen in about 60-70% of parturients and lead to nausea, vomiting, dizziness, loss of consciousness, aspiration, and extreme hypotension, which can result in cardiovascular collapse [4]. A decrease in uteroplacental perfusion can also lead to fetal hypoxia and result in neonatal acidosis and impaired fetal outcomes [5]. In the case of spinal anesthesia, the main action of the anesthetic is on the sympathetic nerves, leading to peripheral vasodilatation, decreasing systemic vascular resistance, venous pooling, and the decrease in venous return to the heart [6]. The hemodynamic changes are especially significant during late pregnancy as the enlarged uterus can compress the inferior vena cava when lying on its back, which decreases the preload and cardiac output even more [7]. A number of preventive measures have been explored, such as intravenous fluid therapy, vasopressor use, uterine displacement, compression devices, and positional therapy [8].

In general, leg elevation is a simple non-pharmacological movement which can help stabilize the maternal hemodynamics by moving blood from the lower part of the body to the central circulation. The condition of pregnancy is associated with significant cardiovascular adaptations, such as the gradual rise in cardiac output, which can be up to 30-50% greater than pre-pregnancy levels [9]. This, coupled with the increase in stroke volume, accounts for large part of this increase in cardiac output [10] and maternal body position has a significant effect on venous return and cardiovascular performance [11]. Supine position in late pregnancy may cause a decrease in cardiac output of about 10-30% compared to lateral position due to aortocaval compression [12]. Posture and venous return is therefore important for changes relating to neuraxial anesthesia [13]. Elevation of the legs can improve preload, stroke volume and cardiac output, without the mother or fetus being exposed to more drugs [14]. In the past the incidence of post spinal hypotension was reported to be reduced in leg elevation position versus the conventional supine position, but the evidence was limited and inconsistent [15]. The thesis itself was one of the biggest drivers to study this low cost and widely applicable intervention was that there was no evidence published locally.

Objective

To compare the effectiveness of elevated leg position versus conventional supine position in preventing hypotension after spinal anesthesia in patients undergoing elective cesarean section.

Methodology

This randomized controlled trial was conducted in the Department of Anesthesiology, Sir Ganga Ram Hospital, Lahore, from 11 January 2022 to 10 July 2022. A total of 106 full-term pregnant women scheduled for elective cesarean section under spinal anesthesia were included and randomly allocated into two equal groups of 53 patients each. The calculated sample size was based on 80% study power, 5% level of significance, and expected effectiveness rates of 65.3% with leg elevation and 41.3% with the supine position. Patients were selected through non-probability consecutive sampling. Women aged 18–40 years with singleton uncomplicated pregnancies at >37 weeks of gestation and ASA physical status I or II were included. Patients with baseline systolic blood pressure <100 mmHg, antepartum hemorrhage, failed or total spinal block requiring general anesthesia,

severe cardiac disease, hypertensive disorders of pregnancy, BMI ≥30 kg/m², height <155 cm, preterm gestation, or multiple pregnancy were excluded.

Data Collection

After ethical approval and written informed consent, patients were randomized by lottery method to the leg-elevation group or conventional supine group. Baseline blood pressure and heart rate were recorded, and all patients received intravenous Ringer's lactate 10 mL/kg as coload during spinal anesthesia. Spinal anesthesia was administered at the L3–L4 interspace, after which patients were positioned supine with approximately 15° left lateral tilt. In the intervention group, the legs were elevated to approximately 40°, while the control group remained in the conventional supine position. Blood pressure was recorded every 5 minutes for 30 minutes. Effectiveness was defined as the absence of post-spinal hypotension, with hypotension identified by a fall in systolic blood pressure of more than 20% from baseline. The thesis confirms that written informed consent was obtained and that hypotension was assessed during the first 30 minutes after spinal anesthesia.

Statistical Analysis

Data were analyzed using SPSS version 23.0. Numerical variables including age, height, weight, and duration of surgery were expressed as mean±standard deviation, while ASA physical status and post-spinal hypotension were presented as frequencies and percentages. The chi-square test was used to compare effectiveness between the two groups. Data were stratified according to age, height, weight, ASA status, and duration of surgery, followed by post-stratification chi-square analysis. A p-value ≤0.05 was considered statistically significant.

Results

The 106 participants had a mean age of 27.8±4.6 years, with 43 (40.6%) aged 18–27 years and 63 (59.4%) aged 28–35 years. Overall, 45 (42.5%) were ASA class I and 61 (57.5%) were ASA class II. Mean height was 164.8±5.7 cm, mean weight was 69.7±5.0 kg, and mean duration of surgery was 49.5±10.2 minutes. Most procedures, 69 (65.1%), lasted ≤50 minutes.

Table 1. Demographic and clinical characteristics of participants (n=106)

Characteristic	n (%) / Mean±SD
Age (years)	27.8±4.6
18–27 years	43 (40.6%)
28–35 years	63 (59.4%)
ASA Class I	45 (42.5%)
ASA Class II	61 (57.5%)
Height (cm)	164.8±5.7
Height <165 cm	57 (53.8%)
Height ≥165 cm	49 (46.2%)
Weight (kg)	69.7±5.0
Weight <70 kg	53 (50.0%)
Weight ≥70 kg	53 (50.0%)
Duration of surgery (minutes)	49.5±10.2
Duration ≤50 minutes	69 (65.1%)
Duration >50 minutes	37 (34.9%)

Baseline characteristics were comparable between the two groups. Mean age was 27.9±4.6 years in the leg-elevation group and 27.7±4.7 years in the supine group (p=0.835). Mean height was 164.9±5.5 versus 164.7±5.9 cm (p=0.865), mean weight was 69.8±4.7 versus 69.6±5.3 kg (p=0.847), and mean surgical duration was 49.4±9.5 versus 49.6±10.9 minutes (p=0.917). ASA status and all subgroup distributions were also similar, with no statistically significant differences.

Table 2. Comparison of baseline characteristics between study groups

Characteristic	Leg Elevation (n=53)	Supine (n=53)	p-value
Age (years)	27.9±4.6	27.7±4.7	0.835
Age 18–27 years	21 (39.6%)	22 (41.5%)	0.843
Age 28–35 years	32 (60.4%)	31 (58.5%)	
ASA Class I	22 (41.5%)	23 (43.4%)	0.844
ASA Class II	31 (58.5%)	30 (56.6%)	
Height (cm)	164.9±5.5	164.7±5.9	0.865
Height <165 cm	28 (52.8%)	29 (54.7%)	0.846
Height ≥165 cm	25 (47.2%)	24 (45.3%)	
Weight (kg)	69.8±4.7	69.6±5.3	0.847
Weight <70 kg	26 (49.1%)	27 (50.9%)	0.846
Weight ≥70 kg	27 (50.9%)	26 (49.1%)	

Duration of surgery (minutes)	49.4±9.5	49.6±10.9	0.917
Duration ≤50 minutes	35 (66.0%)	34 (64.2%)	0.839
Duration >50 minutes	18 (34.0%)	19 (35.8%)	

Leg elevation was significantly more effective in preventing post-spinal hypotension. Effectiveness was achieved in 35 (66.0%) patients in the leg-elevation group compared with 17 (32.1%) in the supine group, while lack of effectiveness occurred in 18 (34.0%) and 36 (67.9%) patients, respectively. This difference was statistically significant (p<0.001).

Table 3. Comparison of effectiveness in preventing post-spinal hypotension

Effectiveness	Leg Elevation (n=53)	Supine (n=53)	p-value
Effective	35 (66.0%)	17 (32.1%)	<0.001
Not effective	18 (34.0%)	36 (67.9%)	
Total	53 (100.0%)	53 (100.0%)	

The benefit of leg elevation remained consistent across all analyzed subgroups. Effectiveness was significantly higher with leg elevation among women aged 18–27 years (66.7% vs. 31.8%; p=0.022) and 28–35 years (65.6% vs. 32.3%; p=0.008), as well as among ASA I (68.2% vs. 34.8%; p=0.025) and ASA II patients (64.5% vs. 30.0%; p=0.007). Similar significant advantages were observed across height, weight, and duration-of-surgery categories, with all p-values <0.05.

Table 4. Effectiveness of leg elevation versus supine positioning across patient subgroups

Subgroup	Leg Elevation	Supine	p-value
Age 18–27 years	14/21 (66.7%)	7/22 (31.8%)	0.022
Age 28–35 years	21/32 (65.6%)	10/31 (32.3%)	0.008
ASA Class I	15/22 (68.2%)	8/23 (34.8%)	0.025
ASA Class II	20/31 (64.5%)	9/30 (30.0%)	0.007
Height <165 cm	18/28 (64.3%)	9/29 (31.0%)	0.012
Height ≥165 cm	17/25 (68.0%)	8/24 (33.3%)	0.015
Weight <70 kg	17/26 (65.4%)	9/27 (33.3%)	0.020
Weight ≥70 kg	18/27 (66.7%)	8/26 (30.8%)	0.009
Surgery ≤50 minutes	23/35 (65.7%)	11/34 (32.4%)	0.006
Surgery >50 minutes	12/18 (66.7%)	6/19 (31.6%)	0.033

Discussion

In the present study, the authors showed that the supine position was not as effective as leg elevation in preventing hypotension after spinal anesthesia for elective cesarean section. Effectiveness was seen in 35 (66.0%) women who were in the leg-elevation group, and in 17 (32.1%) women who were in the supine group (P<0.001), with a clinically significant decrease in post-spinal hypotension in the leg-elevation group. Both groups were matched with respect to age, height, weight, ASA class and length of surgery, indicating the difference seen was largely due to the position intervention alone [16]. The results agree with earlier studies that included 150 women who were undergoing cesarean section under spinal anesthesia, and found that leg elevation prevented hypotension in 65.3% of these as opposed to 41.3% in the supine position (p=0.005) [17]. A previous study measuring effectiveness on 52 full term pregnant women found the figures were 66.7% for the leg-elevation group and 37.5% for the control group (p=0.043) [18]. The size of benefit that was observed in the present study is well supported by these results. Previous studies have also been conducted with 60 women and leg elevation was shown to prevent post-spinal hypotension in 90.0% of patients versus 33.4% who had the conventional supine positioning (p<0.001) [19]. The direction of effect was the same as that seen in the present study, with the magnitude of benefit being larger than that seen in the present study; this lends support to the hemodynamic benefit of raising the lower limbs during spinal anesthesia.

These results were also observed in more recent previous studies in which 140 pregnant women were used, the effectiveness was 58.6% for leg elevation group, and 22.9% for control group (p<0.001) [20]. These results are similar in each population studied, indicating that leg elevation could offer a consistent, protective effect against hypotenstion associated with spinal anesthesia during cesarean delivery. This effect

of leg elevation is beneficial and can be understood based on the pathophysiology of spinal anesthesia induced hypotension. Sympathetic blockade causes peripheral vasodilation and venous pooling, which causes decreased venous return and cardiac output. Raised legs help to move pooled blood from the lower body back toward the centre of the circulatory system which increases preload, increases stroke volume and improves cardiovascular stability. In this regard, this simple mechanical method could be used along with other preventative measures without exposing the patient to pharmacologic treatment [21]. Importantly, there was a consistent benefit in leg elevation with all subgroups studied. The effectiveness did not differ with age, ASA class, height, weight or duration of surgery (all p-values for the subgroups were < 0.05). This homogeneity indicates that the intervention was not only not restricted to a specific group of patients but that it might also be applicable to a wide variety of otherwise normal women who give birth by cesarean section. No comparison was made with other validated preventive strategies like crystalloid coloading and phenylephrine infusion. This is a partial evaluation of the efficacy of leg elevation in a larger multimodal approach to preventing post-spinal hypotension.

Conclusion

It is concluded that leg elevation during spinal anesthesia was more effective than the conventional supine position in preventing post-spinal hypotension in women undergoing elective cesarean section. Its beneficial effect remained consistent across age, height, weight, ASA status, and duration of surgery, supporting its use as a simple non-pharmacological preventive measure.

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