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Incidence Of Supine Hypotension Syndrome In Patients Under Going Cesarean Section Under Spinal Anesthesia

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Abstract

Background: Supine Hypotension Syndrome (SHS) is a common maternal complication during cesarean section under spinal anesthesia, resulting from compression of the inferior vena cava by the gravid uterus. This condition reduces venous return, leading to maternal hypotension and potentially adverse maternal and fetal outcomes. Identifying risk factors and implementing preventive measures are essential for improving perioperative care.

Objective: To determine the frequency of Supine Hypotension Syndrome and identify factors associated with its occurrence among women undergoing cesarean section under spinal anesthesia.

Methods: A descriptive cross-sectional study was conducted at Hayatabad Medical Complex, Peshawar, Pakistan, from April to August 2025. A total of 196 pregnant women undergoing elective or emergency cesarean section under spinal anesthesia were enrolled. Maternal demographic and clinical characteristics, including age, gestational age, body mass index (BMI), pre-existing hypertension, and

use of left lateral tilt positioning, were recorded. The occurrence of SHS following spinal anesthesia was assessed, and associated risk factors were analyzed using multivariable logistic regression.
Results: Of the 196 participants, 42 (21.4%) developed SHS. The incidence was significantly higher among women with gestational age ≥36 weeks ($p < 0.01$) and BMI ≥30 kg/m² ($p = 0.03$). Left lateral tilt positioning effectively relieved SHS in 30 (71.4%) affected patients. Multivariable analysis identified obesity (BMI ≥30 kg/m²; OR = 2.3, 95% CI: 1.3–4.2) and gestational age ≥36 weeks (OR = 1.9, 95% CI: 1.1–3.5) as independent predictors of SHS. Overall, 15.3% of patients required vasopressor therapy for hypotension, with a significantly higher frequency among those who did not receive left lateral tilt positioning ($p = 0.02$).
Conclusion: Supine Hypotension Syndrome is a frequent complication during cesarean section under spinal anesthesia. Maternal obesity and advanced gestational age significantly increase the risk of SHS. Routine implementation of left lateral tilt positioning, along with appropriate fluid management and vigilant hemodynamic monitoring, may reduce the incidence and severity of SHS and improve maternal outcomes.

Introduction

Supine Hypotension Syndrome (SHS), also known as aortocaval compression syndrome, is a well-recognized complication during late pregnancy and cesarean section performed under spinal anesthesia. The condition occurs when the enlarged gravid uterus compresses the inferior vena cava and, to a lesser extent, the abdominal aorta while the mother is in the supine position. This compression reduces venous return to the heart, leading to decreased cardiac output and maternal hypotension. The resulting reduction in uteroplacental blood flow may compromise fetal oxygenation and contribute to adverse maternal and neonatal outcomes. Maternal manifestations include dizziness, nausea, vomiting, pallor, diaphoresis, bradycardia, and, in severe cases, loss of consciousness or cardiovascular collapse. Although only a proportion of pregnant women develop symptomatic SHS, aortocaval compression is common during the third trimester and becomes more pronounced as gestational age advances (Humphries et al., 2019; Massoth et al., 2021; Thomopoulos et al., 2024).

Spinal anesthesia is the preferred anesthetic technique for cesarean section because of its rapid onset, excellent sensory blockade, avoidance of airway manipulation, and favorable maternal and neonatal safety profile. Despite these advantages, spinal anesthesia is frequently associated with maternal hypotension due to sympathetic blockade, peripheral vasodilation, and reduced systemic vascular resistance. During pregnancy, these physiological effects are further aggravated by compression of the inferior vena cava by the gravid uterus, increasing the likelihood of SHS and significant hemodynamic instability. Maternal hypotension during cesarean delivery has been associated with nausea, vomiting, reduced uteroplacental perfusion, fetal acidosis, low Apgar scores, and, in severe cases, maternal cardiovascular complications. Therefore, prompt recognition and effective prevention of SHS are essential components of safe obstetric anesthesia (Abraham et al., 2022; Hernandez-Barajas et al., 2025).

Several maternal and obstetric factors have been reported to increase the risk of SHS and spinal anesthesia-induced hypotension. Advanced gestational age, maternal obesity, multiple pregnancy, polyhydramnios, hypertensive disorders of pregnancy, and emergency cesarean delivery may increase the degree of aortocaval compression and reduce maternal cardiovascular compensation. Various preventive and therapeutic strategies have been recommended to minimize the occurrence and severity of SHS, including left lateral uterine displacement, intravenous fluid preloading or co-loading, and the prophylactic or therapeutic administration of vasopressor agents such as phenylephrine. Current international guidelines recommend combining left uterine displacement with appropriate fluid therapy and vasopressor use to maintain maternal

blood pressure near baseline and preserve uteroplacental perfusion (Fan et al., 2021; Kember et al., 2024; Natarajan et al., 2023).

Although numerous studies have investigated maternal hypotension during cesarean section, the reported incidence of SHS varies considerably because of differences in diagnostic criteria, patient characteristics, anesthetic techniques, and preventive protocols. Furthermore, evidence regarding the frequency of SHS and its associated risk factors remains limited in low- and middle-income countries, including Pakistan, where local obstetric practices and patient characteristics may differ from those reported internationally. The lack of locally generated evidence limits the development of context-specific preventive strategies. Therefore, this study aimed to determine the frequency of Supine Hypotension Syndrome and identify the maternal and obstetric factors associated with its occurrence among women undergoing cesarean section under spinal anesthesia at Hayatabad Medical Complex, Peshawar.

METHODOLOGY

Study design

We conducted a cross sectional study

Study setting

The study was conducted at operation room of Hayatabad medical complex Peshawar.

Study duration

The study duration was 4-Months.

Data collection tools

Adopted Questionnaire was used to gather the research data collection.

Sample Technique

The convenience sampling technique was used.

Inclusion Criteria:

Patients walling to participate
Patients receiving spinal anesthesia for cesarean delivery.
Age group 18–40 years.
Singleton pregnancy at term gestation (≥37 weeks).
Hemodynamically stable patients before administration of spinal anesthesia.
Pregnant women undergoing elective or emergency cesarean section.

Exclusion Criteria:

Patients not willingly to participate.
Patients with pregnancy-induced hypertension, preeclampsia, or eclampsia.
Emergency cases with severe fetal distress requiring immediate delivery before assessment.
Patients with known hypersensitivity to local anesthetic drugs used in spinal anesthesia.
Patient presented with a pre-existing disease chronic kidney disease or heart related problem.

Data Analysis

Data were entered and analyzed using SPSS version 26. Quantitative variables (age, gestational age, BMI, baseline BP and heart rate, surgery duration, IV fluids, vasopressor dose, time to hypotension, Apgar scores) will be presented as mean ± SD. Qualitative variables (parity, SHS yes/no, left tilt use, symptoms, vasopressor need, fetal distress, NICU admission) will be presented as frequency and percentage. The frequency of supine hypotension syndrome (SHS) will be calculated with 95% confidence interval. The Chi-square test will compare SHS occurrence between groups (e.g., with/without left tilt). The independent t-test will compare quantitative variables between hypotensive and non-hypotensive patients while the Chi-square test will

compare categorical variables (parity, left tilt use, symptoms). Logistic regression will identify independent risk factors (age, BMI, parity, baseline BP). A p-value ≤ 0.05 is considered significant

Sample Size

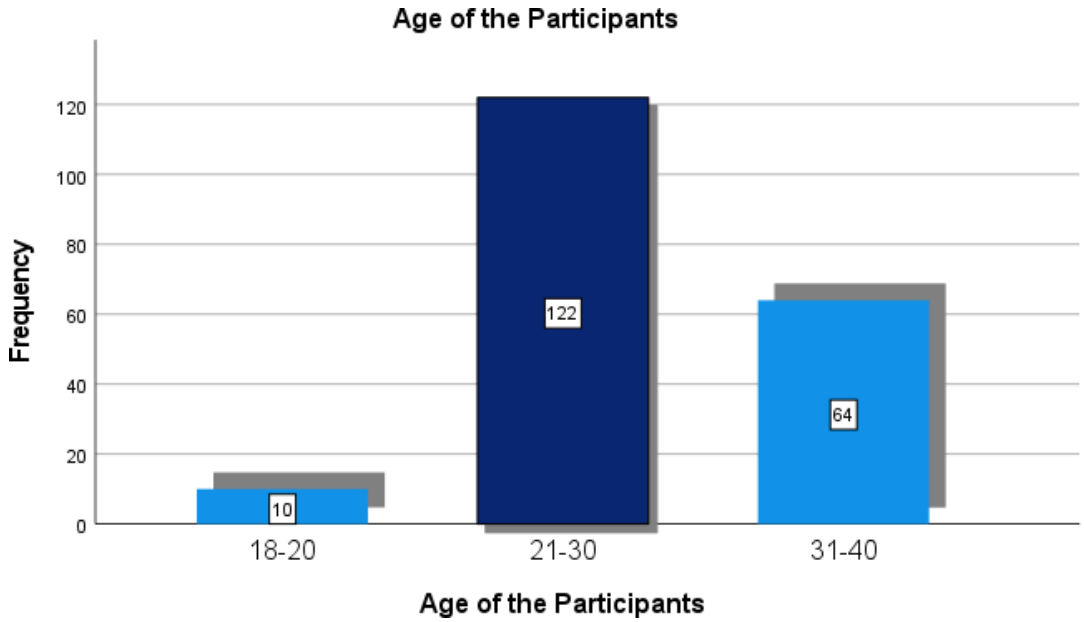
The sample size for this study was calculated by using the WHO Sample Size Calculator on the basis of the expected prevalence of supine hypotension syndrome reported in previous studies. By taking a 95% confidence level, 5% margin of error, and anticipated prevalence from published literature, the calculated sample size was 196 patients. Therefore, a total of 196 patients undergoing cesarean section under spinal anesthesia will be included in the study to determine the frequency of supine hypotension syndrome.

$$n=d2Z2\times P\times(1-P)$$

- **n** = required sample size
- **Z** = Z value at 95% confidence level = **1.96**
- **P** = expected prevalence
- **d** = margin of error

RESULT chapter 4

A total sample size of 196 participants was collected from female patients undergoing cesarean section procedures under spinal anesthesia. The distribution of age showed that the majority (62.2%) were between 21 and 30 years. This was followed by



participants aged 31 to 40 years, comprising 32.7% of the total. A smaller proportion, 5.1%, were between 18 and 20 years. (Figure 4.1)Heart Rate At Different Time Intervals:

The heart rate (HR) of participants was monitored at different time intervals after spinal anesthesia during cesarean sections. At 5 minutes, 21.4% of participants experienced bradycardia (<60 beats/min), 66.8% had a normal heart rate (60–100 beats/min), and 11.7%

. exhibited tachycardia (>100 beats/. By 10 minutes, the proportion of participants with bradycardia decreased significantly to 2.0%, while 93.9% maintained a normal heart rate, and 4.1% had tachycardia. At 15 minutes, bradycardia was further reduced to 1.5%,

with 94.9% of participants showing normal HR and 3.6% exhibiting tachycardia. By 20 minutes, only 0.5% of participants experienced bradycardia, while the majority (95.9%) had a normal HR, and 3.6% continued to show tachycardia. These results indicate a trend toward stabilization of heart rate over time following spinal anesthesia

Table 4.1 Heart Rate at Different Time Intervals

Heart Rate Category	HR at 5 Min	HR at 10 Min	HR at 15 Min	HR at 20 Min
<60 beats/min (Bradycardia)	42 (21.4%)	4 (2.0%)	3 (1.5%)	1 (0.5%)
60–100 beats/min (Normal)	131 (66.8%)	184 (93.9%)	186 (94.9%)	188 (95.9%)
>100 beats/min (Tachycardia)	23 (11.7%)	8 (4.1%)	7 (3.6%)	7 (3.6%)
Total	**196**	**196**	**196**	**196**

Blood Pressure At Different Time Intervals:

The blood pressure (BP) of participants was monitored at different time intervals following spinal anesthesia during cesarean sections. At 5 minutes, 44.4% of participants experienced hypotension (<90/60 mmHg), while 55.1% maintained normal BP (<135/<85 mmHg), and 0.5% had unspecified BP values. By 10 minutes, the incidence of hypotension significantly decreased to 2.6%, with 86.2% of participants having normal BP and 11.2% with unspecified values. At 15 and 20 minutes, the proportion of participants with hypotension remained low at 2.0%, while 96.4% maintained normal BP, and 1.5% had unspecified values. These findings indicate a rapid improvement and stabilization of BP after the initial 5-minute period, with most participants achieving normal BP levels. (Table 4.2)

Table 4.2: Blood Pressure at Different Time Intervals

BP Category	BP at 5 Min	BP at 10 Min	BP at 15 Min	BP at 20 Min
<90/60 mmHg (Hypotension)	87 (44.4%)	5 (2.6%)	4 (2.0%)	4 (2.0%)
<135/<85 mmHg (Normal)	108 (55.1%)	169 (86.2%)	189 (96.4%)	189 (96.4%)
Unspecified	1 (0.5%)	22 (11.2%)	3 (1.5%)	3 (1.5%)
Total	**196**	**196**	**196**	**196**

Mean Arterial Pressure At Different Time Intervals:

The mean arterial pressure (MAP) of participants was monitored at 5-minute intervals following spinal anesthesia during cesarean sections. At 5 minutes, 33.2% of participants had low MAP (<60 mmHg), 65.3% had normal MAP (60–100 mmHg), and 1.5% had high MAP (>100 mmHg). By 10 minutes, the proportion of participants with low MAP decreased to 12.2%, while 85.7% maintained normal MAP, and 2.0% had high MAP. At 15 and 20 minutes, the percentage of participants with low MAP further

reduced to 1.0%, with 96.9% maintaining normal MAP and 2.0% having high MAP at both intervals. These results highlight a trend of stabilization in MAP over time, with most participants achieving normal levels by 15 minutes. (Table 4.3)

Table 4.3: Mean Arterial Pressure (MAP) at Different Time Intervals

MAP Category	MAP at 5 Min	MAP at 10 Min	MAP at 15 Min	MAP at 20 Min
<60 mmHg (Low)	65 (33.2%)	24 (12.2%)	2 (1.0%)	2 (1.0%)
60–100 mmHg (Normal)	128 (65.3%)	168 (85.7%)	190 (96.9%)	190 (96.9%)
>100 mmHg (High)	3 (1.5%)	4 (2.0%)	4 (2.0%)	4 (2.0%)
Total	**196**	**196**	**196**	**196**

DISCUSSION

The present study determined the frequency of Supine Hypotension Syndrome (SHS) among women undergoing cesarean section under spinal anesthesia and identified factors associated with its occurrence. SHS was observed in 21.4% of participants, indicating that it remains a common perioperative complication despite routine anesthetic care. This finding highlights the continued clinical importance of preventing and promptly managing maternal hypotension during cesarean delivery to minimize adverse maternal and fetal outcomes.

The frequency of SHS observed in this study is consistent with previous reports demonstrating considerable variability in the incidence of spinal anesthesia-induced hypotension during cesarean section. Differences in reported frequencies are largely attributable to variations in patient characteristics, diagnostic criteria, anesthetic techniques, and preventive strategies. Horan et al. (2017) reported maternal hypotension in approximately 40% of women undergoing cesarean section under spinal anesthesia, while other studies have documented incidence rates ranging from 20% to 50%. The relatively lower frequency observed in our study may reflect the routine implementation of preventive measures, including left lateral tilt positioning and appropriate perioperative fluid management.

Maternal obesity emerged as an independent predictor of SHS in the present study. Women with a body mass index (BMI) of ≥30 kg/m² were significantly more likely to develop SHS than women with lower BMI. This finding agrees with previous investigations suggesting that increased maternal adiposity enhances compression of the inferior vena cava and abdominal aorta by the gravid uterus, thereby reducing venous return and cardiac output after spinal anesthesia. These physiological changes are further amplified by sympathetic blockade, resulting in more pronounced hypotension.

Advanced gestational age was also significantly associated with SHS. Women with gestational age of 36 weeks or more had a greater likelihood of developing hypotension following spinal anesthesia. As pregnancy advances, progressive enlargement of the uterus increases aortocaval compression when the mother is placed in the supine position, leading to reduced preload and impaired maternal hemodynamics. Similar findings have been reported by Humphries et al. (2019), Yin et al. (2021), and Massoth et al. (2021), who identified late gestation as an important determinant of maternal hypotension during cesarean delivery.

An important finding of the present study was the effectiveness of left lateral tilt positioning. More than two-thirds of women with SHS showed improvement after left lateral tilt, and patients who did not receive this intervention were significantly more likely to require pharmacological treatment for hypotension. These findings support current international recommendations advocating left uterine displacement as a simple, safe, and effective non-pharmacological intervention to reduce aortocaval compression and improve maternal cardiovascular stability. Previous studies by Palanisamy et al. (2015) and Kember et al. (2024) have similarly demonstrated the beneficial effect of left lateral tilt in maintaining venous return and reducing the severity of maternal hypotension.

Although vasopressors such as phenylephrine and ephedrine remain the cornerstone of pharmacological management for spinal anesthesia-induced hypotension, our findings emphasize that non-pharmacological measures should be implemented routinely before hypotension develops. Adequate intravenous fluid administration, careful hemodynamic monitoring, and early recognition of high-risk patients may further reduce the incidence and severity of SHS. Recent evidence suggests that combining left uterine displacement with fluid co-loading and prophylactic vasopressor therapy provides the most effective strategy for maintaining maternal blood pressure and preserving uteroplacental perfusion.

The present study has several strengths, including prospective data collection and evaluation of clinically relevant maternal risk factors in a tertiary care setting. However, several limitations should be acknowledged. The study was conducted at a single center using a cross-sectional design, which may limit the generalizability of the findings. Additionally, neonatal outcomes and long-term maternal follow-up were not evaluated. Future multicenter studies with larger sample sizes are recommended to validate these findings and assess the impact of preventive interventions on both maternal and neonatal outcomes.

Overall, the findings of this study demonstrate that Supine Hypotension Syndrome remains a frequent complication during cesarean section under spinal anesthesia. Maternal obesity and advanced gestational age significantly increase the risk of SHS, while left lateral tilt positioning provides an effective, low-cost intervention for reducing its occurrence and severity. Early identification of high-risk women and adherence to evidence-based preventive strategies may improve maternal hemodynamic stability and optimize obstetric outcomes.

CONCLUSION

Supine Hypotension Syndrome (SHS) remains a frequent complication among women undergoing cesarean section under spinal anesthesia. In the present study, approximately one in five parturients developed SHS, highlighting its continued clinical importance in obstetric anesthesia. Maternal obesity and advanced gestational age were identified as significant risk factors associated with the development of SHS, whereas left lateral tilt positioning proved to be an effective non-pharmacological intervention for reducing the severity of hypotension and the need for pharmacological treatment.

These findings emphasize the importance of early identification of high-risk patients and the routine implementation of evidence-based preventive measures, including left uterine displacement, appropriate intravenous fluid management, and vigilant hemodynamic monitoring throughout the perioperative period. Adoption of these strategies may improve maternal cardiovascular stability, preserve uteroplacental perfusion, and ultimately enhance both maternal and neonatal outcomes.

Although this study provides valuable local evidence regarding the frequency and determinants of SHS in women undergoing cesarean section under spinal anesthesia, it was conducted at a single tertiary care center with a relatively modest sample size. Therefore, the findings should be interpreted within the context of the study population.

Future multicenter studies involving larger and more diverse populations are recommended to validate these findings and improve their general ability. Further research should evaluate additional maternal and obstetric factors, compare different anesthetic techniques and vasopressor protocols, and investigate the effectiveness of combined spinal–epidural anesthesia, low-dose spinal anesthesia, and other preventive strategies in reducing SHS. Longitudinal studies assessing maternal and neonatal outcomes following SHS would also provide valuable evidence to guide clinical practice and optimize obstetric anesthesia care.

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