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FREQUENCY OF HYPOTENSION IN PATIENTS AFTER RECEIVING SPINAL ANAESTHESIA IN LOWER LIMB ORTHOPEDIC SURGERIES

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Abstract

Introduction: Hypotension is one of the most common complications associated with spinal anesthesia. It occurs in approximately 16% to 33% of patients due to sympathetic nerve blockade caused by the administration of local anesthetic drugs. Several factors can affect the severity of hypotension, including age, gender, body mass index (BMI), preloading with intravenous fluids, and the type of surgery. Hypotension can compromise blood supply to vital organs and may become life-threatening if not properly managed.**Methodology:** A quantitative, prospective, cross-sectional study was conducted involving 145 patients who were selected using a convenience non-probability sampling technique. Data were collected and analyzed using SPSS and Microsoft Excel.**Results:** The study showed that 32 out of 145 patients experienced a decrease in blood pressure to below 90 mmHg. Among patients undergoing surgery for femur fractures, 20 (31.8%) out of 63 developed hypotension. Similarly, 10 (21.3%) out of 47 patients with hip fractures and 2 (6.5%) out of 35 patients with proximal tibial fractures developed hypotension. The patients were divided into four age groups. In the 20–30-year age group, 50 patients were included, of whom 12 developed hypotension. In the 30–40-year age group, 24 patients were included, of whom 2 developed hypotension. In the 40–50-year age group, 23 patients were included, of whom 6 developed hypotension. In the 50–60-year age group, 48 patients were included, of whom 12 developed hypotension. Overall, all 145 patients experienced an average 23% decrease in blood pressure from their baseline values approximately 8 minutes after the administration of spinal anesthesia.

Conclusion: The study highlights the frequency of hypotension among patients undergoing different orthopedic surgeries under spinal anesthesia. Hypotension occurred in 31.8% of patients undergoing femur fracture surgery, 21.3% of patients undergoing hip fracture surgery, and 6.5% of patients undergoing proximal tibial fracture surgery. Preloading with intravenous fluids appeared to play an important role in preventing hypotension.

Introduction:

Hypotension is commonly defined as a blood pressure below 90/60 mmHg. It may be asymptomatic; however, a significant reduction in blood pressure can compromise the perfusion and oxygen supply of vital organs. It can result from several factors, including autonomic dysfunction, cardiac abnormalities, fluid depletion, and medication effects. Compensatory mechanisms such as peripheral vasoconstriction and tachycardia normally help maintain adequate tissue perfusion [1]. Orthostatic and neurally mediated hypotension are common clinical forms and may present with dizziness, confusion, weakness, or syncope [2].

Hypotension is one of the most common complications of spinal anesthesia, occurring in approximately 16%–33% of patients. It primarily results from sympathetic blockade produced by local anesthetic agents such as 0.5% bupivacaine. Sympathetic blockade causes vasodilation, decreased systemic vascular resistance, reduced venous return, and a subsequent reduction in cardiac output and blood pressure [3]. The incidence and severity of hypotension may be influenced by factors such as age, gender, body mass index, intravascular volume, fluid administration, level of sympathetic blockade, and type of surgery [4]. Clinically, hypotension may range from mild, with minimal or no symptoms, to severe hypotension associated with inadequate perfusion of vital organs and potentially life-threatening complications [5].

The spinal cord is a major component of the central nervous system and contains ascending and descending pathways responsible for sensory, motor, and autonomic functions [6]. It extends from the medulla oblongata to approximately the level of the first or second lumbar vertebra, where it terminates as the conus medullaris. Below this level, the spinal nerve roots form the cauda equina [7]. Cerebrospinal fluid (CSF) surrounds the brain and spinal cord and provides mechanical protection, metabolic support, and transport of nutrients and waste products. It is mainly produced by the choroid plexuses within the cerebral ventricles [8]. Approximately 150 mL of CSF is present in the adult body and contains water, electrolytes, glucose, proteins, amino acids, vitamins, and other substances [9]. Important electrolytes include sodium, chloride, potassium, calcium, magnesium, and bicarbonate, while glucose and amino acids provide essential nutrients for neural tissues [10]. Spinal anesthesia is a regional anesthesia technique in which a local anesthetic is injected into the subarachnoid space and mixed with CSF to produce temporary sensory, motor, and sympathetic blockade. It is commonly used for procedures involving the lower abdomen, pelvis, perineum, and lower extremities because it provides rapid and reliable anesthesia [11]. Despite its advantages, spinal anesthesia may cause complications including hypotension, headache, nausea, vomiting, urinary retention, and shivering [12].

Proper aseptic technique is essential during spinal anesthesia to minimize the risk of infection. The procedure requires sterile equipment, antiseptic preparation, appropriate patient positioning, and a suitable spinal needle. The patient is commonly positioned in the sitting or lateral position, and the needle is introduced into the lumbar subarachnoid space until CSF is obtained, confirming correct placement before administration of the anesthetic [13,14]. Post-spinal hypotension occurs primarily because of sympathetic blockade, which produces vasodilation, venous pooling, reduced venous return, and decreased cardiac output [15]. Intravenous fluid administration before or during spinal anesthesia can help maintain intravascular

volume and reduce the severity of hypotension. Vasopressors such as phenylephrine, ephedrine, and noradrenaline may also be used when required to maintain adequate blood pressure [16].

Other complications of spinal anesthesia include post-dural puncture headache, which is associated with CSF leakage and may be influenced by needle size, design, and the number of puncture attempts [17]. Nausea and vomiting may reduce patient satisfaction and delay recovery and discharge [18]. Urinary retention may cause discomfort, require catheterization, prolong hospitalization, and increase the risk of urinary tract infection [19]. Shivering is also common during the perioperative period and may result from impaired thermoregulation, exposure to a cold operating environment, or administration of unwarmed intravenous fluids [20]. Its prevention and management may involve patient warming and pharmacological interventions when clinically indicated [21]. Spinal anesthesia is frequently used for lower-limb orthopedic procedures because it provides effective surgical anesthesia and muscle relaxation [22]. However, sympathetic blockade can cause clinically significant reductions in blood pressure, particularly in patients with inadequate intravascular volume or limited cardiovascular reserve. Maintaining adequate blood pressure is therefore essential to preserve tissue perfusion and prevent complications associated with reduced oxygen delivery to vital organs [23].

Therefore, determining the frequency of hypotension and identifying factors associated with post-spinal hypotension among patients undergoing orthopedic surgery are important for improving perioperative management and patient safety. Assessing the occurrence of hypotension in lower-limb orthopedic procedures and evaluating the role of intravenous fluid preloading may help in developing appropriate strategies to reduce the frequency and severity of post-spinal hypotension [24].

MATERIALS AND METHODS

Study Design

A prospective cohort study was conducted to assess the frequency of hypotension among patients undergoing lower-limb orthopedic surgery under spinal anesthesia.

Study Setting

The study was conducted at Mufti Mahmood Memorial Teaching Hospital. Data regarding intraoperative blood pressure were collected from patients undergoing orthopedic procedures in the orthopedic operating theatre.

Study Duration

The study was conducted over a period of six months, from August 2025 to January 2026.

Sampling Technique

A convenience non-probability sampling technique was used for participant selection.

Sample Size

A total of 145 patients were included in the study. The sample size was calculated using the RaoSoft sample size calculator based on a 95% confidence level, 5% margin of error, and a population size of 230.

Inclusion Criteria

Patients were included if they met the following criteria:

- Male and female patients.
- Age between 20 and 60 years.
- Patients undergoing lower-limb orthopedic surgery.
- Patients with or without comorbid conditions.
- Hemoglobin level ≥10 g/dL.
- Patients who were adequately hydrated.

Exclusion Criteria

Patients were excluded if they met any of the following criteria:

- Refusal to participate.
- Spinal deformity.

- Infection at the site of spinal anesthesia injection.
- Known allergy to the anesthetic drug.
- Upper-limb surgery.
- Intervertebral disc deformity.
- Ischemic heart disease.
- Valvular heart disease.

Data Collection Procedure

Permission to conduct the study was obtained from the Research Committee of Apex Institute of Medical Sciences and the administration of Mufti Mahmood Memorial Teaching Hospital. Data were collected from patients undergoing lower-limb orthopedic procedures, including hip, femur, tibia, and fibula fracture surgeries. All procedures were performed under spinal anesthesia by a trained anesthetist with more than 16 years of professional experience.

A standard spinal anesthesia tray containing sterile gloves, sterile drapes, antiseptic solution, 5-mL syringes, a 25-gauge spinal needle, and 0.5% hyperbaric bupivacaine was used. Patient demographic characteristics, comorbidities, premedication, type of surgery, and duration of surgery were recorded using a structured data collection questionnaire.

Intraoperative blood pressure was monitored using an electronic sphygmomanometer. Baseline blood pressure was recorded before administration of spinal anesthesia. The time of spinal anesthetic injection and the onset of hypotension were documented. During surgery, episodes of blood pressure reduction, the lowest recorded systolic and diastolic blood pressure, and the management provided for hypotension were also recorded.

Data Analysis

Data were entered, processed, and analyzed using IBM SPSS Statistics version 27 and Microsoft Excel. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Frequencies, percentages, means, and standard deviations were calculated where appropriate. A paired-samples *t*-test was used to compare baseline and intraoperative blood pressure measurements. Results were presented using tables, bar charts, and pie charts. A *p*-value of <0.05 was considered statistically significant.

Result:

Gender wise Distribution

Gender	Frequency	Percentage
Male	**100**	**69%**
Female	**45**	**31%**

Group Wise Frequency of Gender, Hypotension and Average BMI, Average SBP

Age Group	Total	Males/Females	Avg BMI	Avg SBP (mmHg)	Hypotension
20-30 years	50	40M / 10F	36.01	83.00	12 (24%)
31-40 years	24	19M / 5F	38.58	84.00	2 (8.3%)
41-50 years	23	16M / 7F	38.44	85.00	6 (26.1%)
51-60 years	48	25M / 23F	41.14	87.00	12 (25%)

Represents bar chart presentation of group wise frequency of gender, BMI, frequency of hypotension and average value of systolic BP among males and females of different age groups.

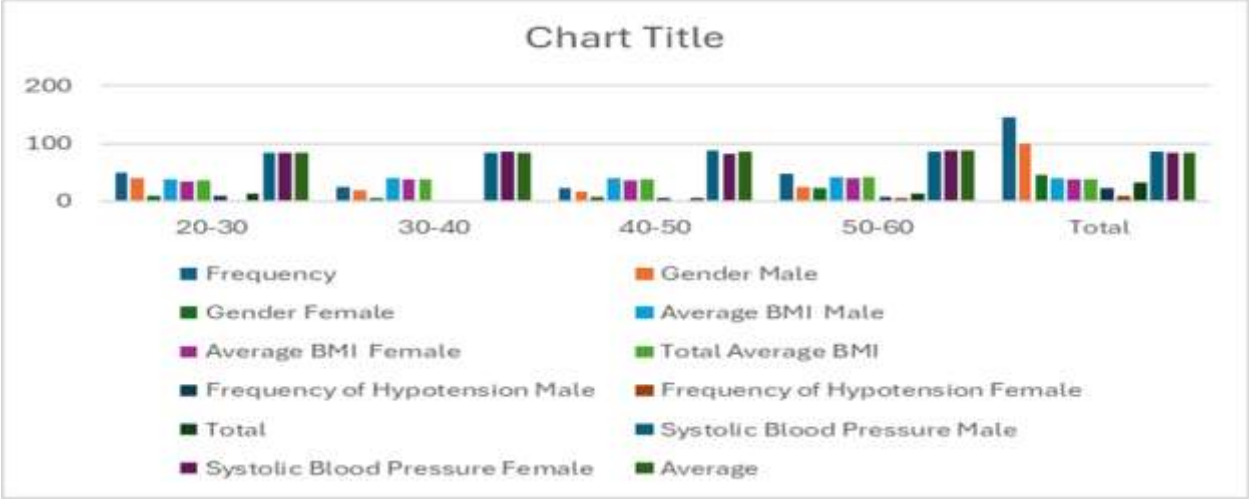

Table: Association Between Gender and Hypotension (SBP < 90 mmHg)

Gender	Hypotension Yes, n (%)	Hypotension No, n (%)	Total, n (%)	χ^2	df	*p*-value
Male	23 (23.0%)	77 (77.0%)	100 (100%)			
Female	9 (20.0%)	36 (80.0%)	45 (100%)			
Total	**32 (22.1%)**	**113 (77.9%)**	**145 (100%)**	**0.035**	**1**	**0.852**

Correlation analysis of BMI, Systolic BP, Diastolic BP, MAP, HR.

Variables	BMI	Systolic BP	Diastolic BP	MAP	Heart Rate
BMI	1	0.001	0.039	0.091	-0.018
Systolic BP	0.001	1	0.417	0.437	0.062
Diastolic BP	0.039	0.417	1	0.445	0.323
MAP	0.091	0.437	0.445	1	-0.211
Heart Rate	-0.018	0.062	0.323	-0.211	1

Represents statistical values of different variables.

Statistics

		BMI	Systolic	Diastolic	HeartRate	TimeofSurgery	PreLoad	Hypotensiononsettime	Hypotensionepisodes	LowestSBP	LowestDBP	IVfluids
N	Valid	145	145	145	145	145	145	145	145	145	145	145
	Missing	0	0	0	0	0	0	0	0	0	0	0
Mean		38.9033	152.59	84.80	84.57	37.48	1337.59	7.77	2.59	117.43	69.94	1722.41
Std. Deviation		5.41784	15.097	6.688	9.803	13.036	235.962	10.385	3.050	23.955	7.881	461.163
Minimum		27.64	121	69	61	24	500	0	0	68	45	500
Maximum		53.12	188	109	113	68	1850	55	11	163	85	2600
Percentiles	25	34.7000	140.00	80.00	78.00	25.00	1200.00	.00	.00	95.00	65.00	1500.00
	50	38.2300	148.00	85.00	85.00	35.00	1300.00	.00	.00	128.00	71.00	1700.00
	75	43.0300	161.50	89.00	91.00	46.50	1500.00	15.00	5.00	135.00	75.00	2000.00

Normality test on age, baseline systolic and diastolic, heart rate, time of surgery, onset time of hypotension, hypotension episodes and lowest systolic blood pressure.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	P-Value
Age	.138	145	<.001	.884	145	<.001
Systolic	.152	145	<.001	.948	145	<.001
Diastolic	.129	145	<.001	.950	145	<.001
Heart Rate	.083	145	<.017	.976	145	<.012
Time of Surgery	.165	145	<.001	.874	145	<.001
Hypotension onset time	.311	145	<.001	.752	145	<.001
Hypotension episodes	.340	145	<.001	.779	145	<.001
Lowest SBP	.182	145	<.001	.923	145	<.001

a. Lilliefors Significance Correction

Discussion:

The present study assessed the frequency of hypotension among 145 patients undergoing lower-limb orthopedic surgeries under spinal anesthesia. The findings showed that 32 (22.1%) patients developed hypotension, defined as a systolic blood pressure below 90 mmHg. All patients experienced a reduction in blood pressure from their baseline values following administration of 0.5% bupivacaine, with an average reduction of approximately 23%. The mean onset time of hypotension was approximately 8 minutes. Hypotension was observed in 20 (31.8%) patients undergoing femur fracture surgery, 10 (21.3%) patients undergoing hip fracture surgery, and 2 (5.7%) patients undergoing proximal tibial surgery. In addition, 5% of patients developed bradycardia, 5% required atropine, and 22.1% required ephedrine for management of hemodynamic instability.

A study conducted by Kumiko Yotsuya et al. in 2024 at the Department of Orthopedic Surgery, Iwata City Hospital, Hamamatsu University School of Medicine, Japan, evaluated factors associated with hypotension following spinal anesthesia. Their review included six studies involving 2,085 screened patients. They reported that spinal anesthesia-induced hypotension could be associated with inadequate fluid administration and extensive sympathetic blockade. They also reported that lower doses of spinal anesthetic were associated with a reduced risk of hypotension (OR = 0.09, 95% CI: 0.04–0.21; p = 0.04) [25]. These findings support the importance of adequate fluid management and appropriate anesthetic dosing in preventing hypotension. In comparison, the present study found that all patients experienced some reduction in blood pressure following spinal anesthesia, while 22.1% developed clinically significant hypotension. The frequency was particularly notable among patients undergoing femur fracture surgery, where 20 of 63 patients (31.8%) developed hypotension.

Yılmaz et al. conducted a study in 2022 at the Department of Anaesthesiology and Reanimation, Kastamonu University, Turkey. Their study included 95 patients, of whom 62 were male and 33 were female, with a mean age of 51 years. They reported that 12 patients (12.6%) developed spinal anesthesia-induced hypotension. Patients who developed hypotension were older, with a mean age of 58 years, compared with 48 years among those without hypotension [27]. In the present study, hypotension was observed across all four age groups. Twelve patients in the 20–30-year group and 12 patients in the 50–60-year group developed hypotension, while 2 and 6 patients developed hypotension in the 30–40-year and 40–50-year groups, respectively. Thus, both the youngest and oldest age groups had the highest number of hypotensive episodes in the present study.

Meseret Hulualem Nega et al. conducted a study in 2022 at the Department of Anesthesia, School of Medicine, College of Medicine and Health Sciences, University of Gondar, Ethiopia. They reported an incidence of post-induction hypotension of 26.95% (95% CI: 22.5–31.7%) and identified age ≥60 years as one of the factors associated with post-induction hypotension [28]. In the present study, 12 of 48 patients (25.0%) in the 50–60-year age group developed hypotension. Although the present study did not include patients older than 60 years, the relatively higher frequency of hypotension in the older age group is consistent with the observation that increasing age may increase susceptibility to perioperative hemodynamic instability.

Amol P. Singam et al. conducted a study in 2021 at the Department of Anaesthesiology, Jawaharlal Nehru Medical College, Maharashtra, India, among 100 ASA class I and II patients undergoing elective lower-limb surgery under spinal anesthesia. Their study reported a significantly lower frequency of hypotension in the group receiving the lower-dose anesthetic regimen, with hypotension occurring in 12% of patients compared with 52% in the comparison group ($p < 0.05$) [29]. In the present study, hypotension occurred in 24.0% of patients in the 20–30-year group, 8.3% in the 30–40-year group, 26.1% in the 40–50-year group, and 25.0% in the 50–60-year group. The difference in hypotension frequency between studies may be related to differences in anesthetic dose, patient characteristics, type of surgery, fluid administration, and criteria used to define hypotension. Sumit Roy Chowdhury et al. conducted a study in 2023 at the Department of Anaesthesiology, Pain Medicine and Critical Care, All India Institute of Medical Sciences, New Delhi, India. Their analysis of 15 observational studies reported a high frequency of post-spinal hypotension, with reported pooled estimates of 84.6% and 58.8%, respectively, depending on the criteria and population analyzed [30]. In contrast, the present study found that 32 (22.1%) of 145 patients developed hypotension. The lower frequency observed in the present study may be related to differences in patient populations, surgical procedures, definitions of hypotension, anesthetic doses, fluid preloading, and perioperative monitoring practices.

Okanlawon et al. conducted research in 2022 at the Department of Anaesthesia, College of Medicine, University of Ibadan/University College Hospital, Ibadan, Nigeria. Their study reported that 55 patients (65.5%) experienced hypotension. The onset of hypotension was significantly associated with age ($p = 0.015$), baseline systolic blood pressure ($p = 0.003$), and baseline diastolic blood pressure ($p = 0.027$) [31]. In the present study, 32 (22.1%) patients developed hypotension. The present findings also demonstrated a reduction in blood pressure following spinal anesthesia, highlighting the importance of baseline hemodynamic status in identifying patients at risk of hypotension. However, differences in the incidence between the two studies may be attributable to differences in study population, anesthetic technique, surgical procedures, fluid management, and definitions of hypotension. Medi Nagapadma et al. conducted a study in 2024 at the Department of Anesthesiology, Government Medical College and Government General Hospital, Nizamabad, Telangana, India. Their study reported that 48% of patients developed hypotension, 18% developed bradycardia, 6% required atropine, and 28% required ephedrine. The greatest reductions in heart rate and systolic blood pressure were 14.1 ± 5.6 beats/min and 26.7 ± 7.9 mmHg, respectively. Hemodynamic parameters gradually returned toward baseline after reaching their lowest values at approximately 10 minutes [34]. In comparison, the present study demonstrated a lower frequency of hypotension (22.1%) and bradycardia (5%). Atropine was required in 5% of patients, while 22.1% required ephedrine. The lowest blood pressure values in the present study were observed approximately 8 minutes after spinal anesthesia, after which the hemodynamic parameters gradually improved.

Overall, the findings of the present study demonstrate that hypotension remains a clinically relevant complication of spinal anesthesia in lower-limb orthopedic surgery.

The frequency of hypotension was highest among patients undergoing femur fracture surgery, followed by hip fracture and proximal tibial surgery. The findings also suggest that blood pressure decreases following spinal anesthesia even when clinically significant hypotension does not develop. Differences between the present study and previously published studies may be explained by variations in patient characteristics, age, type of surgery, anesthetic dose, fluid preloading, criteria for defining hypotension, and perioperative management. Adequate intravenous fluid administration, careful monitoring of blood pressure, and timely use of vasopressors such as ephedrine may therefore be important in reducing the clinical consequences of post-spinal hypotension.

Conclusion

The present study concludes that hypotension is a common hemodynamic change following spinal anesthesia in patients undergoing lower-limb orthopedic surgeries at Mufti Mahmood Memorial Teaching Hospital, Dera Ismail Khan. Although all patients experienced a reduction in blood pressure from their baseline values after administration of spinal anesthesia, clinically significant hypotension (SBP <90 mmHg) occurred in 32 (22.1%) of the 145 patients. The frequency of hypotension was highest among patients undergoing femur fracture surgery, followed by hip fracture and proximal tibial surgery. The findings suggest that adequate intravenous fluid preloading, careful monitoring of blood pressure, and timely management may help reduce the severity and clinical consequences of post-spinal hypotension. Overall, proper perioperative fluid management and close hemodynamic monitoring are important for maintaining cardiovascular stability during lower-limb orthopedic procedures under spinal anesthesia.

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