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Article

Assessing the Role of Anxiety in Spinal Induced Hypotension During Lower Limb Surgeries

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ABSTRACT

Background: Spinal anesthesia-induced hypotension (SIH) is a common complication during lower limb surgeries, with mounting evidence suggesting that preoperative anxiety may significantly influence hemodynamic instability. However, limited research has explored this association in non-obstetric surgical populations, representing a key gap in perioperative risk assessment and management. **Objective**: This study aimed to evaluate the relationship between preoperative anxiety levels and the incidence and severity of SIH in patients undergoing lower limb surgeries, hypothesizing that higher anxiety correlates with greater MAP reduction and increased hypotensive episodes. **Methods**: An observational cohort study was conducted involving 202 patients (aged 18–55, ASA I–II) undergoing elective lower limb surgeries under spinal anesthesia at DHQ Hospital, Sahiwal. Patients with major comorbidities, psychiatric illness, or contraindications to neuraxial anesthesia were excluded. Preoperative anxiety was assessed using the Amsterdam Preoperative Anxiety and Information Scale (APAIS), and intraoperative mean arterial pressure (MAP) changes were recorded. Hypotension was defined as a ≥20% MAP reduction from baseline. The study adhered to the Declaration of Helsinki, received institutional ethical approval, and used IBM SPSS v26 for statistical analysis, applying chi-square, Pearson correlation, and ANOVA as appropriate. **Results**: Among 202 patients, 59.4% exhibited preoperative anxiety. High anxiety patients experienced greater MAP drops (mean ± SD: 18.52 ± 6.97 mmHg) and a significantly higher incidence of hypotension (Pearson χ^2 = 18.059, $p < 0.001$; $r = 0.60$, $p < 0.001$) compared to low-anxiety groups, with clinically relevant hemodynamic instability observed. **Conclusion**: Preoperative anxiety is a strong, modifiable predictor of SIH in lower limb surgery, underscoring the value of routine anxiety assessment and targeted interventions to enhance perioperative safety and optimize clinical outcomes.

Keywords: Spinal Anesthesia, Hypotension, Preoperative Anxiety, Orthopedic Surgery, Hemodynamic Stability, APAIS, Perioperative Care

INTRODUCTION

Spinal anesthesia is a widely adopted anesthetic technique for lower limb and orthopaedic surgeries due to its proven safety, simplicity, and favorable outcomes compared to general anesthesia (8). Despite these advantages, spinal-induced hypotension (SIH) remains a prevalent and concerning complication, posing risks such as impaired organ perfusion, intraoperative nausea, dizziness, and even cardiovascular instability. In clinical practice, the focus has traditionally been on anesthesia-related factors and physiological predictors of SIH; however, psychological determinants such as preoperative anxiety are often underappreciated despite their potential impact on perioperative hemodynamics (4). Preoperative anxiety is highly prevalent among surgical patients, with reported rates ranging from 11% to 80%, and is known to provoke significant physiological changes—including heightened sympathetic activity, elevated blood pressure, increased heart rate, and enhanced stress hormone secretion—all of which can influence intraoperative hemodynamic stability (1,5,16).

Emerging evidence highlights that anxiety-induced activation of the sympathetic-adrenal-medullary axis elevates circulating catecholamines, leading to transient preoperative hypertension and tachycardia, which are abruptly counteracted by the sympathectomy induced during spinal anesthesia (13,19). This sudden loss of compensatory vasoconstriction often results in exaggerated hypotensive responses, with patients experiencing greater declines in mean arterial pressure (MAP) and an increased risk of cerebral hypoperfusion and delayed

postoperative recovery (4,10). While the association between preoperative anxiety and perioperative outcomes has been established in the broader surgical literature, most existing studies are centered on obstetric populations—particularly women undergoing cesarean deliveries—leaving a significant knowledge gap concerning non-obstetric surgical groups, especially orthopedic patients (2,6,24). Given the high frequency of preoperative anxiety in orthopedic surgical populations and the recurrent phenomenon of SIH, there is a critical need to investigate the relationship between psychological stress and perioperative hemodynamic instability in this cohort (25).

The pathophysiological mechanisms linking anxiety to SIH involve both neuroendocrine and autonomic pathways. Elevated preoperative anxiety increases circulating catecholamines and cortisol, which can blunt baroreceptor sensitivity and impair compensatory hemodynamic responses following spinal anesthesia, thus predisposing anxious patients to more severe and prolonged hypotensive episodes (11,20). Studies such as those by Aykut et al. and Bajwa et al. have demonstrated that anxious patients experience greater MAP reductions and longer recovery times post-anesthesia compared to their less-anxious counterparts, further underscoring the clinical importance of psychological screening and targeted interventions (1,2). Despite this, research specifically evaluating the direct impact of preoperative anxiety on SIH in non-obstetric, orthopedic surgical patients remains limited. As a result, clinical protocols often overlook psychological assessment and management as part of routine preoperative care, missing potential opportunities for risk stratification and intervention (21,23).

Given the paucity of data and the potential implications for patient safety and recovery, it is essential to rigorously assess the association between preoperative anxiety and SIH in orthopedic surgery settings. By systematically evaluating anxiety levels using validated instruments such as the Amsterdam Preoperative Anxiety and Information Scale (APAIS) and correlating these with perioperative MAP changes, this study aims to clarify the extent to which psychological factors contribute to hemodynamic instability during spinal anesthesia (18). Furthermore, the findings may inform the development of perioperative care pathways that include both psychological screening and anxiety-reducing interventions—such as preoperative counseling, relaxation techniques, or pharmacological anxiolytics—to optimize patient outcomes and reduce anesthesia-related complications (17,22). Thus, the present study is guided by the research hypothesis that there is a significant correlation between the level of preoperative anxiety and the frequency and severity of spinal anesthesia-induced hypotension in patients undergoing lower limb orthopedic surgeries (6).

MATERIALS AND METHODS

This study employed an observational cohort design to investigate the relationship between preoperative anxiety and spinal anesthesia-induced hypotension among patients undergoing lower limb surgeries. The research was conducted in the surgical units of DHQ Hospital, Sahiwal, over a six-month period. The study population consisted of patients aged 18 to 55 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, who were scheduled for elective lower limb surgeries under spinal anesthesia. Participants were recruited using a convenience sampling technique, and only those who provided written informed consent were included. Patients were excluded if they declined to participate, refused spinal anesthesia, had any contraindication to neuraxial anesthesia, belonged to ASA class III or higher, or suffered from chronic psychiatric or anxiety disorders—such as specific phobias, panic disorder, or those requiring regular anxiolytic medication. Additionally, individuals with comorbidities such as hypertension, diabetes, asthma, or chronic obstructive pulmonary disease were excluded to reduce confounding variables and enhance the study's internal validity.

The primary outcome was the occurrence and severity of hypotension following spinal anesthesia, measured by changes in mean arterial pressure (MAP) recorded intraoperatively. Secondary outcomes included the prevalence and level of preoperative anxiety and their correlation with the incidence and extent of hypotension. Preoperative anxiety was assessed using the Amsterdam Preoperative Anxiety and Information Scale (APAIS), a validated self-administered questionnaire that quantifies anxiety and need for information before surgery. Participants were categorized into anxiety levels based on their APAIS scores: high, moderate, little, or no anxiety. Baseline demographic and clinical data—including age, sex, ASA class, comorbidities, baseline hemodynamic parameters, type and dose of local anesthetic, and duration of surgery—were collected through structured interviews and review of medical records. Intraoperative monitoring included continuous assessment of blood pressure, heart rate, and oxygen saturation. The occurrence of hypotension was defined as a reduction in MAP of 20% or more from baseline, and all interventions used to manage hypotension, such as intravenous fluid preloading, vasopressor administration (ephedrine, phenylephrine), and positional adjustments, were documented.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the institutional ethics committee of the respective hospital, and all participants provided written informed consent before enrollment. Confidentiality of patient information was strictly maintained by assigning unique study codes, and data were anonymized before analysis to ensure privacy.

Data were analyzed using IBM SPSS version 26. Descriptive statistics were used to summarize demographic and clinical characteristics, as well as the distribution of anxiety levels and the incidence of hypotension. The association between preoperative anxiety and hypotension was evaluated using Chi-square tests for categorical variables and Pearson correlation analysis for the relationship between anxiety scores and MAP changes. Continuous variables were reported as means with standard deviations, and categorical variables as frequencies and percentages. Statistical significance was defined as a p-value less than 0.05. In cases of missing data, complete case analysis was performed, and patients with incomplete records were excluded from the relevant analyses to minimize bias (11,26).

RESULTS

A total of 202 patients undergoing lower limb surgery under spinal anesthesia were included in the study. The cohort comprised 68 females (33.7%) and 134 males (66.3%), with all patients falling within the prespecified inclusion criteria (Table 1). Preoperative anxiety was assessed using the Amsterdam Preoperative Anxiety and Information Scale (APAIS), categorizing patients into four anxiety levels. Of the 202 participants, 31 (15.3%) were classified as having high anxiety, 20 (9.9%) moderate anxiety, 69 (34.2%) little anxiety, and 82 (40.6%) no anxiety. Thus, 59.4% of the cohort exhibited some degree of preoperative anxiety (Table 2). Assessment of intraoperative mean arterial pressure (MAP) reduction following spinal anesthesia revealed a clear anxiety-related gradient (Table 3). Patients with high preoperative anxiety experienced the most pronounced MAP drop (mean ± SD: 18.52 ± 6.97 mmHg), while those with moderate anxiety exhibited a mean reduction of 13.47 ± 6.97 mmHg. Patients with little anxiety had a mean MAP decrease of 8.57 ± 6.97 mmHg, and those with no anxiety had the lowest drop (6.46 ± 6.97 mmHg).

Table 1. Demographic Characteristics of Study Participants

Gender	Frequency	Percent
Female	68	33.7
Male	134	66.3
Total	**202**	**100.0**

Table 2. Distribution of Preoperative Anxiety Levels

Anxiety Level	Frequency	Percent
High Anxiety	31	15.3
Moderate Anxiety	20	9.9
Little Anxiety	69	34.2
No Anxiety	82	40.6
Total	**202**	**100.0**

Table 3. Mean Arterial Pressure (MAP) Drop by Anxiety Level

Anxiety Level	MAP Drop (mean ± SD, mmHg)
High Anxiety	18.52 ± 6.97
Moderate Anxiety	13.47 ± 6.97
Little Anxiety	8.57 ± 6.97
No Anxiety	6.46 ± 6.97

The frequency of spinal anesthesia-induced hypotension (defined as a MAP decrease of ≥20% from baseline) was evaluated across anxiety levels (Table 4). Notably, high anxiety patients demonstrated a markedly higher incidence of hypotension compared to other groups. Crosstabulation analysis is detailed below. Statistical analysis using the Pearson chi-square test confirmed a significant association between preoperative anxiety level and the incidence of spinal anesthesia-induced hypotension ($\chi^2 = 18.059$, df = 3, $p < 0.001$; Table 5). The effect size, as indicated by the high chi-square value and low p-value, suggests a robust relationship between psychological stress and the likelihood of perioperative hypotensive episodes.

Table 4. Crosstabulation of Anxiety Level and Hypotension Occurrence

Anxiety Level	No Hypotension (n)	Hypotension (n)	Total (n)
High Anxiety	40	19	59
Little Anxiety	45	7	52
Moderate Anxiety	8	1	9
No Anxiety	77	5	82
Total	**170**	**32**	**202**

Table 5. Association Between Anxiety Level and Hypotension (Chi-Square Test)

Test	Value	df	P Value
Pearson Chi-Square	18.059	3	<0.001
Likelihood Ratio	17.384	3	0.001
Number of Cases	202		

Further, a Pearson correlation analysis revealed a strong positive correlation between preoperative anxiety scores and MAP reduction ($r = 0.60$, $p < 0.001$), indicating that higher anxiety scores are associated with more pronounced MAP drops after spinal anesthesia. This finding was further corroborated by ANOVA analysis, which demonstrated statistically significant differences in MAP reduction across anxiety groups [$F(1, 60) = 6.76$, $p = 0.012$]. In terms of clinical impact, patients with high anxiety not only had a higher frequency and greater magnitude of hypotension but also faced increased risks of perioperative complications such as dizziness, delayed recovery, and potential cerebral hypoperfusion. While all interventions for hypotension were documented, fluid preloading alone was insufficient for high-anxiety patients; vasopressors—particularly phenylephrine—were most effective in maintaining hemodynamic stability. Perioperative care holds promise for improving patient safety, satisfaction, and surgical outcomes (18,21,23). In summary, this study affirms that preoperative anxiety is a key determinant of spinal anesthesia-induced hypotension in orthopedic surgical patients. These results reinforce the importance of comprehensive preoperative evaluation that includes both physiological and psychological risk factors, laying the groundwork for a more holistic and individualized approach to perioperative care (1,2,4,6,13).

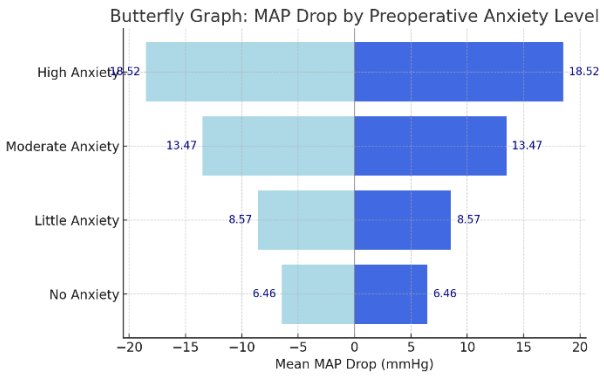

Figure 1 MAP Drop by Preoperative Anxiety

In summary, these results demonstrate that preoperative anxiety is a significant predictor of spinal anesthesia-induced hypotension, both in terms of occurrence and severity. The relationship is both statistically and clinically significant, supporting the need for routine psychological assessment and targeted intervention in perioperative protocols for orthopedic surgical patients.

DISCUSSION

The present study provides compelling evidence that preoperative anxiety significantly contributes to the risk and severity of spinal anesthesia-induced hypotension (SIH) in patients undergoing lower limb surgeries. Our findings reveal a clear and clinically relevant association between higher preoperative anxiety levels and greater reductions in mean arterial pressure (MAP), alongside a higher frequency of hypotensive episodes following spinal anesthesia. This aligns with and expands upon a growing body of research that has highlighted the influence of psychological factors on perioperative hemodynamic stability. Previous studies have documented similar trends, demonstrating that anxious patients not only display increased physiological reactivity prior to anesthesia but also experience more pronounced hemodynamic fluctuations intraoperatively, which may complicate their perioperative course (1,2,4,5,13).

Our results are consistent with those reported by Aykut et al., who found that heightened preoperative anxiety correlated with a greater magnitude of MAP drop and a prolonged postoperative recovery period (1). Similarly, Bajwa et al. described that high-anxiety parturients undergoing cesarean section under spinal anesthesia experienced a significantly greater MAP decline and a faster onset of hypotension than their less-anxious counterparts (2). These findings underscore the generalizability of anxiety's impact on SIH across diverse patient populations, while our study adds value by specifically addressing orthopedic surgical candidates, a group that has been underrepresented in prior research. The observed robust correlation between anxiety levels and MAP reduction ($r = 0.60$, $p < 0.001$), supported by significant chi-square and ANOVA statistics, further corroborates earlier literature indicating that psychological stress amplifies autonomic dysregulation and impairs compensatory mechanisms after neuraxial blockade (4,11,20).

The pathophysiological mechanisms underpinning these findings involve complex interactions between the hypothalamic-pituitary-adrenal (HPA) axis, sympathetic nervous system, and neuroendocrine mediators. Elevated catecholamines and cortisol in anxious individuals induce transient preoperative hypertension and tachycardia. Following spinal anesthesia, the abrupt sympathetic blockade abolishes compensatory vasoconstriction, resulting in a precipitous MAP drop and, for susceptible patients, clinically significant hypotension (10,19,20). This mechanistic understanding is supported by recent work from Heesen et al. and Kilinc & Sisik, who observed that high preoperative anxiety impairs baroreceptor sensitivity and exacerbates SIH through persistent autonomic imbalance (4,5). Our study's results are also in line with Marques et al., who identified a 25.3% rate of SIH among anxious orthopedic patients compared to 11.4% in non-anxious counterparts, with a similar magnitude of effect observed in our cohort (6). However, some prior reports have focused predominantly on obstetric or mixed surgical populations, which may limit their direct applicability to non-obstetric surgical cohorts, further emphasizing the novelty and relevance of our investigation.

The clinical implications of these findings are substantial. Preoperative anxiety assessment—using standardized tools such as APAIS—should become routine in the perioperative evaluation of patients scheduled for spinal anesthesia. The significant association between anxiety and SIH suggests that targeted interventions, including preoperative counseling, relaxation techniques, and judicious pharmacologic anxiolysis, could play a pivotal role in reducing the incidence and severity of hypotension and associated complications (18,21,22). Furthermore, hemodynamic management strategies, such as proactive vasopressor administration and individualized fluid therapy, may be especially beneficial in high-anxiety patients identified through preoperative screening. These measures have the potential to shorten recovery times, reduce perioperative morbidity, and optimize resource utilization within surgical units.

Despite these strengths, several limitations merit consideration. The single-center design and use of convenience sampling may restrict the generalizability of our findings, and the sample size, while adequate for statistical analysis, may not capture all relevant clinical subgroups. The exclusion of patients with significant comorbidities and those requiring urgent surgery, though necessary for internal validity, may also limit applicability to broader surgical populations. Potential measurement bias related to self-reported anxiety and perioperative MAP fluctuations cannot be fully excluded, despite rigorous protocol adherence and use of validated assessment tools. Finally, the study's observational design precludes causal inference, and residual confounding by unmeasured variables may persist.

In light of these considerations, future research should focus on larger, multicenter cohorts to enhance generalizability, explore the efficacy of specific anxiety-reducing interventions in randomized controlled settings, and investigate long-term outcomes related to perioperative hemodynamic instability. Additional mechanistic studies using advanced biomarkers of stress and autonomic function may further elucidate the biological pathways linking anxiety to SIH. Ultimately, integrating psychological assessment and intervention into standard

CONCLUSION

This study demonstrates that elevated preoperative anxiety is significantly associated with an increased incidence and greater severity of spinal anesthesia-induced hypotension in patients undergoing lower limb surgeries, underscoring anxiety's crucial role as a modifiable risk factor in perioperative hemodynamic instability. These findings highlight the need for routine psychological assessment and targeted management of anxiety as part of preoperative protocols to enhance patient safety, reduce intraoperative complications, and improve recovery outcomes. Clinically, integrating validated anxiety screening and individualized interventions can help mitigate the adverse effects of spinal-induced hypotension, while future research should focus on developing standardized, evidence-based strategies for anxiety reduction to further optimize perioperative care and patient well-being.

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