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COMPARISON OF HYPOTENSION INCIDENCE IN GYNECOLOGICAL VS OBSTETRICS SURGERY UNDER SPINAL ANESTHESIA

Original Research

Tayyab Sohail[1], Saiman[1], Zain1, Haider[1], Aqsa Batool[1]*, Jazbia[2]
[1]Student of BS Anaesthesia Technology, Department of Emerging Allied Health Technology, FAHS, Superior University Lahore, Pakistan.
[2]Lecturer, Department of Emerging Allied Health Technology, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan.
Corresponding Author: Aqsa Batool, Student of BS Anaesthesia Technology, Department of Emerging Allied Health Technology, FAHS, Superior University Lahore, Pakistan, raniurwa322@gmail.com
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ABSTRACT

Background: Spinal anesthesia is widely used in obstetric and gynecological surgeries due to its rapid onset and favorable safety profile. However, it is frequently associated with spinal anesthesia-induced hypotension (SAIH), particularly in obstetric patients where pregnancy-related physiological changes—such as increased blood volume, reduced systemic vascular resistance, and aortocaval compression—heighten the risk. SAIH can significantly compromise maternal hemodynamics and fetal outcomes if not properly managed.

Objective: This study aimed to determine the prevalence and severity of spinal hypotension among obstetric and gynecological patients receiving spinal anesthesia and to evaluate the effect of preventive measures such as fluid therapy, vasopressor use, and patient positioning.

Methods: A prospective observational study was conducted over four months at Sheikh Zayed Hospital, Lahore. A total of 100 female patients aged 18–45 years undergoing either cesarean section (n = 50) or gynecological surgery (n = 50) under spinal anesthesia were enrolled. Baseline systolic and diastolic blood pressures were recorded and compared with readings taken at 5- and 20-minutes post-anesthesia. Hypotension was defined as a drop in systolic blood pressure ≥20% from baseline or <90 mmHg. Management strategies, including the use of vasopressors and fluid preloading or coloading, were documented. Data analysis was performed using SPSS, and intergroup comparisons were made using the Mann-Whitney U test.

Results: Blood pressure readings between groups showed statistically significant differences at all measured intervals ($p < 0.001$). Mean baseline systolic pressure was 128.82 mmHg, which dropped to 107.05 mmHg at 5 minutes and 86.55 mmHg at 20 minutes post-anesthesia. Z-scores ranged from -5.078 to -7.563. Gynecological patients consistently had higher systolic and diastolic values than obstetric patients.

Conclusion: Obstetric patients demonstrated a higher susceptibility to SAIH. Individualized anesthetic plans, including fluid optimization and timely vasopressor use, are essential. Future large-scale studies are warranted to refine preventive protocols and improve perioperative care.

Keywords: Anesthesia, Spinal; Blood Pressure; Drug Therapy; Fluid Therapy; Gynecological Surgical Procedures; Hypotension; Obstetric Surgical Procedures.

INTRODUCTION

Anesthesia, a cornerstone of modern surgical practice, refers to the pharmacologically induced loss of sensation and is broadly classified into local, regional, and general types. Of these, spinal anesthesia, particularly the subarachnoid block, has become a widely preferred technique for procedures involving the lower abdomen and limbs, especially in obstetric and gynecological surgeries. It offers rapid onset, effective sensory and motor blockade, and avoids the risks associated with airway manipulation, making it a safer alternative to general anesthesia for cesarean sections and pelvic procedures (1). However, despite its advantages, spinal anesthesia is frequently associated with a significant adverse event—spinal anesthesia-induced hypotension (SAIH)—a sudden and often profound drop in blood pressure following the administration of anesthetic agents into the subarachnoid space. SAIH is reported to affect up to 75% of parturients undergoing elective cesarean section, posing substantial maternal and fetal risks, including nausea, vomiting, altered consciousness, reduced uteroplacental perfusion, and fetal acidosis (2,3). This hemodynamic instability is primarily due to sympathetic blockade, which causes vasodilation and decreased venous return, particularly in the context of the gravid uterus compressing the inferior vena cava. Bradycardia, another common complication, further compromises cardiovascular stability (4). In contrast, gynecological patients, although also receiving spinal anesthesia for various pelvic surgeries, may experience differing incidences of hypotension, possibly due to physiological and anatomical differences, patient comorbidities, and variations in autonomic tone and intravascular volume status. These distinctions underscore the importance of tailored anesthetic management and indicate a gap in comparative data regarding the incidence and management of SAIH between obstetric and gynecological populations (5,6).

Recent advancements have focused on improving the safety and efficacy of spinal anesthesia through better understanding of sympathetic blockade mechanisms and incorporation of precision medicine approaches. Real-time hemodynamic monitoring, closed-loop vasopressor infusion systems, and individualized dosing protocols represent promising strategies to mitigate the incidence of SAIH (7). Among vasopressors, phenylephrine remains the first-line agent due to its efficacy in maintaining blood pressure with minimal fetal side effects, while norepinephrine has emerged as a favorable alternative owing to its combined alpha and mild beta-agonist properties, offering better heart rate control (8,9). Adjunctive therapies such as ondansetron and esketamine have demonstrated potential in reducing hypotension and enhancing maternal hemodynamic stability (10). Furthermore, the integration of non-pharmacologic measures—including left uterine displacement, preloading or coloading with crystalloids, and the use of mechanical devices like compression stockings—contributes to a multi-modal strategy for hypotension prevention. Emerging research has also begun to explore the role of maternal anxiety, psychological preparedness, and circadian rhythms in influencing spinal anesthesia responses, suggesting that time-of-day and emotional state may modulate the severity of hypotension (11,12). These findings support the inclusion of psychological and chronobiological factors in perioperative planning, reinforcing the need for a holistic approach to anesthetic care. Despite the growing body of literature, inconsistency persists in the reported incidence of spinal hypotension between obstetric and gynecological patients, with few studies offering direct comparative analyses using standardized criteria. Given the potential for adverse maternal and fetal outcomes, and the clinical variability in spinal anesthesia response, there is a compelling need to systematically investigate the differential incidence and contributing factors of spinal hypotension in obstetric versus gynecological surgeries. This study aims to fill this critical gap by comparing the prevalence and characteristics of SAIH across these two populations, thereby informing safer, evidence-based anesthetic practices and enhancing patient outcomes.

METHODS

This observational study was conducted over a six-month period at Sheikh Zayed Hospital, Lahore, with the aim of comparing the incidence and clinical profile of spinal anesthesia-induced hypotension (SAIH) among patients undergoing obstetric versus gynecological surgeries. A total of 100 female patients aged between 18 and 45 years were enrolled and divided equally into two groups: one comprising patients undergoing cesarean sections under spinal anesthesia (obstetric group), and the other including patients receiving spinal anesthesia for gynecological procedures (gynecological group). Participant selection was carried out through purposive sampling approach based on predefined eligibility criteria. Inclusion criteria required participants to be undergoing either emergency or elective obstetric or gynecological surgery under spinal anesthesia. Exclusion criteria included patients receiving general or combined spinal-epidural anesthesia, and those with a history of cardiovascular disorders (such as coronary artery disease or heart failure),

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coagulopathies, or any bleeding disorders. Informed written consent was obtained from all participants prior to enrollment, following a comprehensive explanation of the study's objectives, procedures, and potential risks. Ethical approval for the study was granted by the Institutional Review Board of Sheikh Zayed Hospital, Lahore.

Prior to anesthesia administration, baseline demographic data including age, ASA classification, and initial blood pressure readings were recorded. The type and concentration of bupivacaine (hyperbaric or hypobaric), along with any adjunct medications administered intrathecally, were noted. Hemodynamic parameters—specifically systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP)—were monitored continuously. Measurements were taken every two minutes for the first fifteen minutes after spinal anesthesia and every five minutes thereafter until the end of the surgical procedure. Hypotension was defined as a reduction in SBP by 20% or more from the baseline value or an absolute SBP of less than 90 mmHg. All hypotensive episodes were documented along with their management, including the type and dose of vasopressors used (e.g., phenylephrine or adrenaline). Fluid management strategies (preloading and coloading) employed during the procedure were also recorded. Postoperative outcomes such as blood pressure trends, recovery progress, and need for intensive care unit (ICU) admission were assessed to provide a comprehensive evaluation of the intraoperative and immediate postoperative course.

RESULTS

The study analyzed 100 patients, aged between 18 and 45 years, undergoing spinal anesthesia for either obstetric or gynecological procedures. The primary outcomes focused on systolic and diastolic blood pressure variations, vasopressor use, hypotension severity, comorbidities, management strategies, and post-operative outcomes. Reliability testing of the data collection questionnaire yielded a Cronbach's alpha of 0.862, indicating high internal consistency. The comorbidity profile showed that 79% of patients had no comorbid conditions, while 12% had hypertension, 6% had diabetes mellitus, and 3% had both. The ASA physical status classification indicated that 80% of patients were ASA Class I and 20% were Class II, suggesting a largely healthy surgical cohort. Baseline systolic and diastolic blood pressures averaged 128.82 mmHg (SD = 15.23) and 83.00 mmHg (SD = 8.64), respectively. These values declined at subsequent time points following spinal anesthesia. At five minutes, systolic and diastolic pressures fell to 107.05 mmHg (SD = 18.12) and 70.63 mmHg (SD = 9.74), respectively. Further reductions were noted at twenty minutes post-anesthesia, with mean systolic and diastolic pressures at 86.55 mmHg (SD = 20.60) and 58.80 mmHg (SD = 13.70), indicating a consistent pattern of hypotension.

Hypotension severity was nearly evenly split, with 51% experiencing mild hypotension and 49% experiencing severe hypotension. Vasopressors were administered to 49% of the cohort, while 51% did not require them. Management strategies varied, with 50% receiving fluid therapy, 20% receiving vasopressors alone, and 30% receiving a combination of both. Post-operative outcomes showed that 60% of patients remained stable, while 40% experienced dizziness. Blood pressure comparisons between the obstetric and gynecological groups revealed statistically significant differences at baseline and at both 5- and 20-minutes post-anesthesia. The gynecological group consistently demonstrated higher mean ranks for both systolic and diastolic readings across all time intervals. Mann-Whitney U test results showed significant differences in systolic and diastolic pressures between the groups, with p-values < 0.001 for all comparisons. Z-scores ranged from -5.078 to -7.563, further confirming these differences. Specifically, the obstetric group exhibited a more pronounced decline in blood pressure shortly after spinal anesthesia, highlighting a greater susceptibility to hypotensive events.

Additionally, surgery type was equally distributed, with 50 patients in each group, ensuring comparability. The variable "Type of Surgery" showed a mean of 1.50 (SD = 0.503), confirming the balanced allocation. The mean score for hypotension severity was 1.49 (SD = 0.502), further indicating an evenly distributed sample across severity levels. Normality testing using the Shapiro-Wilk and Kolmogorov-Smirnov tests revealed that most blood pressure variables significantly deviated from a normal distribution ($p < 0.05$), except for baseline diastolic pressure, which had a non-significant p-value of 0.074. These findings suggested the appropriateness of non-parametric statistical tests for further analysis.

Table 1: Reliability Analysis of Data Collection Instrument

Reliability Statistics	
Cronbach's Alpha	N of Items
.862	14

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Table 2: Descriptive Statistics for Comorbidities, ASA Classification, Vasopressor Use, and Hypotension Severity

		Comorbidities1	ASA Class	Vasopressor_Use1	Hypotension_Severity1
N	Valid	100	100	100	100
	Missing	0	0	0	0
Mean		3.49	1.20	.49	1.49
Median		4.00	1.00	.00	1.00
Mode		4	1	0	1
Std. Deviation		1.049	.402	.502	.502
Variance		1.101	.162	.252	.252

Table 3: Descriptive Statistics for Management Strategy, Postoperative Outcome, and Type of Surgery

		Management Strategy1	Post-Op_Outcome1	Types of Surgery
N	Valid	100	100	100
	Missing	0	0	0
Mean		2.10	1.40	1.50
Median		2.00	1.00	1.50
Mode		2	1	1[a]
Std. Deviation		.704	.492	.503
Variance		.495	.242	.253

Table 4: Distribution of Comorbidities, ASA Classification, Vasopressor Use, and Hypotension Severity in Study Population (N = 100)

Variable	Category	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Comorbidities	HTN	12	12.0	12.0	12.0
	DM	6	6.0	6.0	18.0
	Both	3	3.0	3.0	21.0
	None	79	79.0	79.0	100.0
ASA Class	I	80	80.0	80.0	80.0
	II	20	20.0	20.0	100.0
Vasopressor Use	No	51	51.0	51.0	51.0
	Yes	49	49.0	49.0	100.0
Hypotension Severity	Mild	51	51.0	51.0	51.0
	Severe	49	49.0	49.0	100.0

Table 5: Distribution of Management Strategies, Postoperative Outcomes, and Types of Surgery in Study Population (N = 100)

Variable	Category	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Management Strategy	Vasopressors	20	20.0	20.0	20.0
	Fluids	50	50.0	50.0	70.0
	Vasopressors + Fluids	30	30.0	30.0	100.0
Postoperative Outcome	Stable	60	60.0	60.0	60.0
	Dizziness	40	40.0	40.0	100.0
Type of Surgery	Obstetrics	50	50.0	50.0	50.0
	Gynecological	50	50.0	50.0	100.0

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Table 6: Descriptive Statistics for Age and Blood Pressure Measurements at Baseline, 5 Minutes, and 20 Minutes Post-Spinal Anesthesia

		Age	Baseline Systolic BP	Baseline Diastolic BP	Systolic BP After 5 Min	Diastolic BP After 5 Min	Systolic BP After 20 Min	Diastolic BP After 20 Min
N	Valid	100	100	100	100	100	100	100
	Missing	0	0	0	0	0	0	0
Mean		30.39	128.82	83.00	107.05	70.63	86.55	58.80
Median		30.00	125.00	82.00	103.50	69.00	80.00	59.50
Mode		31[a]	120	90	92[a]	68[a]	60[a]	40[a]
Std. Deviation		6.148	15.230	8.643	18.120	9.738	20.604	13.698
Variance		37.796	231.947	74.707	328.351	94.821	424.533	187.636

Table 7: Case Processing Summary for Blood Pressure Variables Across All Time Intervals

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Baseline Systolic BP	100	100.0%	0	0.0%	100	100.0%
Baseline Diastolic BP	100	100.0%	0	0.0%	100	100.0%
Systolic BP After 5 Min	100	100.0%	0	0.0%	100	100.0%
Diastolic BP After 5 Min	100	100.0%	0	0.0%	100	100.0%
Systolic BP After 20 Min	100	100.0%	0	0.0%	100	100.0%
Diastolic BP After 20 Min	100	100.0%	0	0.0%	100	100.0%

Table 8: Descriptive Statistics and Normality Tests for Blood Pressure Measurements at Baseline, 5 Minutes, and 20 Minutes Post-Spinal Anesthesia (N = 100)

Variable	Mean	SD	Min	Max	Skewness	Kurtosis	Shapiro-Wilk p-value	Kolmogorov-Smirnov p-value
Baseline Systolic BP	128.82	15.23	105	170	0.875	0.248	0.000	0.000
Baseline Diastolic BP	83.00	8.64	62	100	-0.097	-0.711	0.074	0.014
Systolic BP After 5 Min	107.05	18.12	78	150	0.462	-0.741	0.001	0.000
Diastolic BP After 5 Min	70.63	9.74	54	89	0.159	-1.175	0.001	0.008
Systolic BP After 20 Min	86.55	20.60	56	130	0.377	-1.225	0.000	0.000
Diastolic BP After 20 Min	58.80	13.70	35	82	0.073	-1.340	0.000	0.001

Table 9: Comparison of Blood Pressure Parameters Between Obstetric and Gynecological Groups Using Mann-Whitney U Test (N = 100)

Parameter	Group	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p-value (2-tailed)
Baseline Systolic BP	Obstetric	34.49	1724.50	449.500	-5.526	0.000
	Gynecological	66.51	3325.50			
Baseline Diastolic BP	Obstetric	33.57	1678.50	403.500	-5.843	0.000
	Gynecological	67.43	3371.50			
Systolic BP After 5 Min	Obstetric	28.59	1429.50	154.500	-7.556	0.000
	Gynecological	72.41	3620.50			
Diastolic BP After 5 Min	Obstetric	28.58	1429.00	154.000	-7.563	0.000
	Gynecological	72.42	3621.00			
Systolic BP After 20 Min	Obstetric	33.16	1658.00	383.000	-5.979	0.000
	Gynecological	67.84	3392.00			
Diastolic BP After 20 Min	Obstetric	35.78	1789.00	514.000	-5.078	0.000
	Gynecological	65.22	3261.00			

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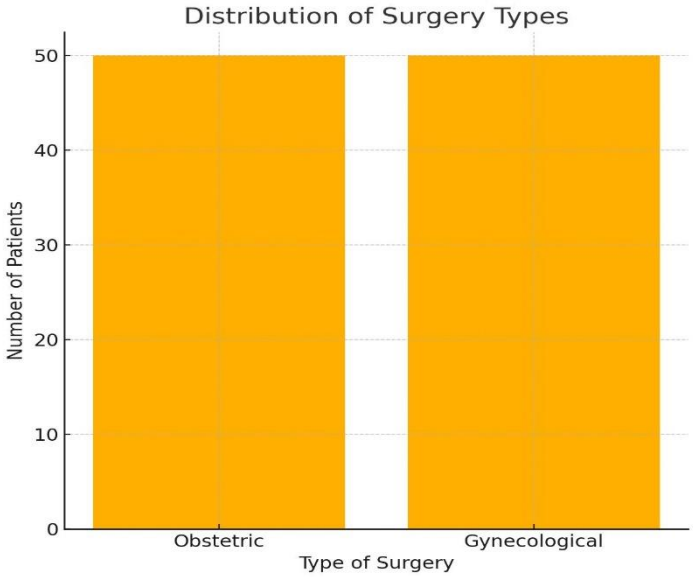

Figure 2 Distribution of Surgery Types

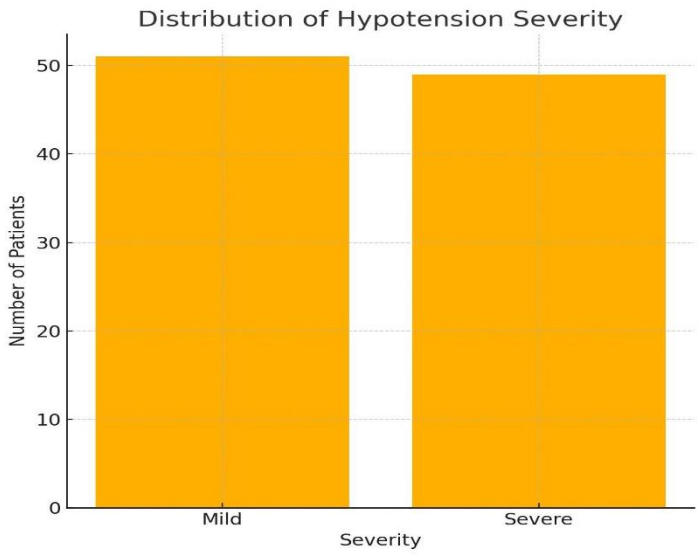

Figure 1 Distribution of Hypotension Severity

DISCUSSION

Spinal anesthesia remains the anesthetic technique of choice for cesarean sections and a wide range of gynecological surgeries due to its rapid onset, efficacy, and superior safety profile for both mother and fetus when compared to general anesthesia. However, spinal anesthesia-induced hypotension (SAIH) continues to be a prevalent and clinically significant complication, often attributed to extensive sympathectomy resulting in vasodilation and reduced systemic vascular resistance. The clinical implications of SAIH are far-reaching, impacting maternal well-being through symptoms such as nausea, dizziness, vomiting, and bradycardia, and compromising fetal outcomes through reduced uteroplacental perfusion, potential hypoxia, and neonatal acidosis (13,14). The current study revealed a balanced distribution of mild and severe hypotensive episodes among the participants, with 49% requiring vasopressor intervention. The incidence of hypotension was more pronounced in the obstetric group, especially within the first five minutes of spinal anesthesia, suggesting heightened susceptibility possibly linked to the physiological changes of pregnancy. These findings align with previous evidence reporting an incidence range of 7.4% to over 70%, which can be attributed to inconsistencies in hypotension definitions and variability in clinical practices across studies (24–26,30). Notably, many investigations have documented multiple definitions for hypotension, which complicates the comparison and synthesis of data across clinical settings and limits the development of standardized management protocols (15-17).

The pathophysiology underlying SAIH primarily involves sympathectomy-induced vasodilation, leading to blood pooling in the lower extremities, reduced venous return, and diminished cardiac output. Activation of the Bezold–Jarisch reflex further intensifies bradycardia and vasodilation, exacerbating the hypotensive response (18). In the present study, the rapid onset of hypotension among obstetric patients and its relatively higher severity underscores the need for proactive hemodynamic surveillance and individualized anesthetic strategies. Non-invasive continuous monitoring of blood pressure and perfusion indices proved essential for early detection, supporting the recommendation to maintain maternal blood pressure within 20% of baseline to safeguard fetal oxygenation and prevent acidosis (19,20). Pharmacological management, particularly the use of vasopressors, was central to treatment. Phenylephrine was the preferred agent due to its potent α1-adrenergic action and favorable fetal outcomes, while norepinephrine emerged as a promising alternative with dual α and weak β activity, potentially minimizing reflex bradycardia. Recent randomized controlled trials support the efficacy of both agents, indicating that norepinephrine may provide comparable hemodynamic stability with fewer side effects (21,22). In this study, a nearly equal proportion of patients received phenylephrine, fluids, or a combination, reflecting the diversity in clinical practice and the importance of tailored approaches based on patient response.

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In addition to vasopressor therapy, non-pharmacological strategies such as fluid coloading, left lateral positioning, and leg elevation were recognized as adjunctive measures to mitigate hypotension. Emerging interventions, including 5-HT3 receptor antagonists like ondansetron and mechanical devices such as obstetric air cushions, offer further avenues for prevention and should be investigated in future studies (23,24). The role of these adjuncts, however, remains insufficiently explored in gynecological populations, which may present different risk profiles due to their typically non-pregnant physiological status. One of the study's strengths was its standardized monitoring protocol and equal representation of obstetric and gynecological patients, allowing direct comparison of hypotension trends and management efficacy across two clinically distinct populations. The reliability of data collection tools, as indicated by a high Cronbach's alpha (0.862), further reinforced the internal consistency and validity of the dataset. However, the study was not without limitations. The sampling strategy was non-randomized, introducing potential selection bias. Furthermore, subgroup analysis of vasopressor uses and postoperative outcomes by surgical category was not performed, limiting the granularity of the comparative findings. The absence of long-term neonatal outcomes or maternal satisfaction data restricts the broader clinical interpretation.

To strengthen future research, larger multicenter studies employing randomized designs are warranted to validate findings and allow for stratified analysis based on patient comorbidities, anesthetic technique variations, and timing of intervention. Investigating the influence of psychological factors, circadian rhythms, and genetic predispositions on the incidence of hypotension may also enhance individualized anesthetic care. Incorporating predictive algorithms using machine learning with real-time hemodynamic data can offer precision-guided vasopressor administration, minimizing adverse events and optimizing maternal-fetal outcomes. Overall, this study contributes valuable insight into the incidence and severity of SAIH in both obstetric and gynecological populations, reinforcing the necessity of vigilant intraoperative monitoring and evidence-based interventions. The integration of pharmacologic and non-pharmacologic strategies, alongside emerging technologies and refined clinical guidelines, remains essential to mitigating the risks of spinal anesthesia-induced hypotension and ensuring safe surgical experiences across diverse patient groups.

CONCLUSION

This study concluded that the frequency and severity of spinal anesthesia-induced hypotension differ notably between obstetric and gynecological patients, with obstetric individuals being more susceptible due to the unique physiological changes of pregnancy. These findings highlight the importance of adopting tailored anesthetic approaches that incorporate preventive strategies such as fluid preloading, timely vasopressor administration, and optimal patient positioning to maintain hemodynamic stability. The results emphasize the need for individualized perioperative care to enhance maternal safety and surgical outcomes. Continued research with larger, methodologically consistent cohorts is essential to further refine clinical protocols and support evidence-based anesthesia practices in these distinct patient populations.

AUTHOR CONTRIBUTION

Author	Contribution
Tayyab Sohail	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Saiman	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Zain	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Haider	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Aqsa Batool*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Jazbia	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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