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Original Article

Assessment of Spinal Anesthesia in Emergency Caesarean Section

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ABSTRACT

Background: Spinal anesthesia is widely utilized for emergency Caesarean sections due to its rapid onset, technical simplicity, and favorable maternal-fetal safety profile. However, its association with intraoperative hypotension and other complications necessitates ongoing evaluation, particularly in resource-limited settings where general anesthesia may be less feasible or riskier. Objective: To assess the efficacy, safety, and maternal satisfaction associated with spinal anesthesia during emergency Caesarean sections, and to explore the clinical impact of intraoperative hypotension on patient-centered outcomes. Methods: A cross-sectional observational study was conducted at Bahria International Hospital, Lahore, over four months. Fifty women undergoing emergency Caesarean sections under spinal anesthesia were enrolled via convenience sampling. Data on anesthesia onset, pain scores, hemodynamic changes, adverse events, and satisfaction were collected through structured interviews and observation. Statistical analyses included group comparisons using chi-square and t-tests, with stratified assessments of hypotension impact. Results: Rapid anesthesia onset (<5 minutes) was achieved in 70% of cases, and 80% of participants rated anesthesia quality as excellent. Hypotension occurred in 70% of patients but was not significantly associated with dissatisfaction or major complications. Pain scores averaged 2.7±1.2, and 90% of patients were very satisfied. Satisfaction was significantly lower among hypotensive patients reporting moderate-to-severe pain. Conclusion: Spinal anesthesia is a safe and effective method for emergency Caesarean sections. While hypotension is common, its clinical impact can be mitigated with vigilant intraoperative management, preserving high patient satisfaction.

Keywords: Spinal anesthesia, Caesarean section, hypotension, maternal satisfaction, regional anesthesia, obstetric complications

INTRODUCTION

Emergency Caesarean section (CS) is a critical intervention employed when maternal or fetal complications necessitate rapid delivery to avert serious morbidity or mortality. In such high-stakes clinical settings, the choice of anesthesia is pivotal, as it directly influences perioperative outcomes for both mother and neonate. Spinal anesthesia has gained widespread acceptance as the preferred method in emergency CS due to its rapid onset of action, minimal systemic drug exposure, and favorable maternal-fetal safety profile (1). Unlike general anesthesia, which is associated with higher risks of aspiration, delayed recovery, and increased maternal morbidity, spinal anesthesia allows for quicker maternal awareness, less neonatal sedation, and lower perioperative complications (2). Additionally, its technical simplicity and effectiveness in achieving dense sensory and motor blockade make it a pragmatic choice during obstetric emergencies (3).

Despite these advantages, spinal anesthesia is not without risks. Hypotension, bradycardia, and nausea are common adverse effects, often resulting from sympathetic blockade below the thoracic level (4). While these complications are usually manageable, they may compromise utero-placental perfusion and fetal oxygenation if not promptly addressed. Moreover, patient variability—such as maternal height, weight, gestational age, and cardiovascular reactivity—can significantly affect anesthetic distribution and hemodynamic responses (5). Hence, anesthetic planning must integrate individualized risk assessment and proactive management protocols to optimize maternal and neonatal safety.

A substantial body of literature supports the efficacy and safety of spinal anesthesia in elective cesarean deliveries. Lee et al. (2020) conducted a systematic review and meta-analysis of over 2,000 patients, concluding that spinal anesthesia was associated with lower maternal morbidity and fetal complications than general anesthesia in emergency CS scenarios (6). Similarly, Tufigno et al. (2019) reported that spinal anesthesia reduced maternal mortality (0.4% vs. 1.2%) and improved patient satisfaction, despite a higher incidence of hypotension (7). However, much of the existing research focuses on elective procedures, with less emphasis on real-time clinical outcomes in urgent settings, where physiological stress and decision-making constraints differ markedly.

In developing regions, including Pakistan, where healthcare systems often face resource limitations and variable clinical expertise, the efficacy and safety of spinal anesthesia in emergency CS remain underexplored. Most anesthetists have limited experience with general anesthesia in obstetric emergencies, further reinforcing reliance on regional techniques despite the lack of robust local evidence (8). While international studies provide a strong foundation, the applicability of their findings to diverse populations with differing demographic, obstetric, and infrastructural profiles warrants scrutiny. Therefore, localized evaluations are crucial to guide evidence-based clinical practices that align with contextual realities.

This study aims to address this knowledge gap by systematically evaluating the efficacy, safety, and patient satisfaction associated with spinal anesthesia in emergency Caesarean sections at a tertiary hospital in Lahore. Specifically, the study seeks to quantify the incidence of intraoperative and postoperative complications, assess hemodynamic stability, and determine the level of maternal satisfaction with anesthetic care. By capturing real-world clinical data, this research intends to inform best practices and identify areas for improvement in obstetric anesthesia management in similar healthcare environments. The central research objective is: To assess the efficacy and safety of spinal anesthesia in emergency Caesarean sections, and to evaluate maternal outcomes and satisfaction levels associated with its use.

MATERIAL AND METHODS

This study employed a cross-sectional observational design to assess the safety, efficacy, and patient satisfaction associated with spinal anesthesia in emergency Caesarean sections. The rationale for selecting a cross-sectional design was to capture a snapshot of perioperative experiences and clinical outcomes among parturients undergoing spinal anesthesia under emergent conditions. The study was conducted at Bahria International Hospital, Lahore, a tertiary care facility with an active obstetric unit, over a four-month period following ethical approval from the institutional review board. All data were collected between November 2024 and February 2025. The target population comprised women who underwent emergency Caesarean sections under spinal anesthesia within the study duration. Participants were enrolled using a convenience sampling method from those presenting to the labor and delivery unit who met the eligibility criteria. Inclusion criteria were: women with a gestational age between 28 and 42 weeks, undergoing emergency Caesarean section under spinal anesthesia, and able to provide voluntary informed consent. Exclusion criteria included women undergoing general or regional anesthesia other than spinal, those with pre-existing chronic medical conditions such as neurological, cardiac, or respiratory diseases, history of prior spinal surgery, and those who declined participation. Eligibility was confirmed through review of clinical records and direct preoperative interview. Written informed consent was obtained from all participants after a clear explanation of the study purpose, data confidentiality, and their right to withdraw at any time.

Data collection was conducted using structured face-to-face interviews and observation within the perioperative setting. A standardized questionnaire was developed for the study, incorporating validated items from prior anesthesia research instruments where applicable. The tool captured sociodemographic characteristics (age, weight, height, parity, gestational age), intraoperative variables (onset of anesthesia, sensory block level, pain score, quality of anesthesia), and postoperative complications (hypotension, bradycardia, respiratory depression, nausea, vomiting, neurological symptoms). Patient satisfaction and the degree to which anesthesia met their expectations were assessed using a 5-point Likert scale. The timing of data collection was standardized to within two hours post-surgery to ensure accurate recall while minimizing fatigue effects.

Spinal anesthesia was administered at the L3-L4 or L4-L5 interspaces using hyperbaric bupivacaine (0.5%) via a 25G Quincke spinal needle, following standard aseptic protocol. Hypotension was defined as a ≥20% reduction from baseline systolic blood pressure, and bradycardia as a heart rate below 60 bpm. Pain intensity was recorded using a numerical rating scale from 0 (no pain) to 10 (worst imaginable pain). Anesthesia onset was categorized by time to sensory blockade: very rapid (<3 min), rapid (3–5 min), slow (6–10 min), and very slow (>10 min). All intraoperative data were recorded by trained observers, not involved in anesthesia delivery, to reduce observer bias. To address potential confounding and measurement bias, data collection was performed by personnel blinded to the study hypothesis. Standardized criteria were applied for all variable definitions. Participants were recruited consecutively to minimize selection bias, and efforts were made to reduce interviewer bias through structured interviewer training. No imputation was performed for missing data; cases with incomplete data for primary outcomes were excluded from respective analyses.

The sample size was calculated using the formula $n = (Nz^2P[1-P]) / (E^2[N-1] + z^2P[1-P])$, with N = 500 (estimated annual number of emergency CS cases at the hospital), Z = 1.96 for 95% confidence, P = 0.5 (estimated proportion with a favorable anesthetic outcome), and E = 0.1 (margin of error). The resulting required sample size was 83, inflated to 100 to account for potential dropouts or incomplete responses. Data were analyzed using SPSS version 25 (IBM Corp., Armonk, NY). Categorical variables were summarized as frequencies and percentages, while continuous variables were expressed as means and standard deviations. Associations between categorical variables (e.g., hypotension and maternal age) were explored using chi-square or Fisher's exact test where appropriate. Subgroup analyses were conducted for age groups, parity, and BMI categories to assess differences in complication rates and satisfaction levels. Confounding was addressed in bivariate analyses by stratifying for key demographic variables. No multivariate modeling was performed due to the study's descriptive scope. The study received ethical approval from the Ethical Review Committee of Superior University, Lahore. All participants provided informed consent, and confidentiality was maintained throughout the study. Data were anonymized and securely stored in encrypted files accessible only to the principal investigator and research supervisor. The study followed the ethical principles outlined in the Declaration of Helsinki and adhered to national guidelines for biomedical research involving human participants (9).

RESULTS

The majority of patients in this study were multiparous women aged between 25 and 35 years, with gestational ages ranging from 37 to 40 weeks. The study population consisted of 50 women, with a mean age of 32.4 years (SD 4.9). Most participants were multiparous (70%)

and 40% fell within the 30–34 year age range. Approximately half of the patients had a gestational age between 37 and 40 weeks (50%), while only 10% were in the 28–32 week range. The prevalence of multiparity was notable, as 35 of the 50 participants had previously delivered. The mean gestational age among participants was 37.4 weeks. No significant associations were observed between age, parity, or gestational age and the likelihood of developing hypotension during anesthesia, as evidenced by non-significant p-values (e.g., $p = 0.48$ for age, $p = 0.77$ for parity).

Regarding the anesthesia experience, most patients (70%) reported a rapid or very rapid onset of spinal anesthesia. Specifically, 40% experienced sensory blockade in less than three minutes, and 30% within three to five minutes. Only a minority of patients (10%) reported onset times exceeding ten minutes. The quality of anesthesia was rated as excellent by 80% of participants, and the mean pain score was low at 2.7 (SD 1.2) out of 10. Pain scores did not significantly differ between those who experienced intraoperative hypotension and those who did not (2.8 vs. 2.5; $p = 0.63$, 95% CI −0.7 to 0.4). Similarly, no statistically significant differences were observed in anesthesia quality ratings ($p = 0.32$).

Hemodynamic instability was the most commonly observed intraoperative complication, with 70% (n=35) of patients developing hypotension, defined as a drop in systolic blood pressure of at least 20%. Bradycardia occurred in 20% of cases, and a substantial proportion (50%) experienced a systolic blood pressure drop of 21 mmHg or more. The occurrence of such significant hypotensive episodes was highly concentrated within this group, as no patient in the non-hypotensive group reported a blood pressure drop of this magnitude ($p < 0.001$). Bradycardia did not show a statistically significant association with hypotension ($p = 0.99$; odds ratio 1.0, 95% CI 0.2–4.1).

Other perioperative complications were relatively infrequent. Nausea and vomiting were reported by 20% of patients, while respiratory depression was rare, occurring in only 4% of the sample. Neurological symptoms, such as transient tingling or weakness, were noted in 6% of cases. No statistically significant associations were found between these complications and the presence of hypotension or other patient characteristics (all $p > 0.5$). Serious adverse events, such as severe respiratory depression or significant neurological symptoms, were rare.

Overall patient satisfaction with anesthetic care was high, with 90% (n=45) reporting that they were very satisfied and an additional 4% (n=2) indicating they were satisfied. Only 6% of patients described themselves as neutral or dissatisfied. Expectations regarding anesthesia were met for 94% of participants. Notably, satisfaction and fulfillment of expectations were not significantly influenced by the occurrence of hypotension ($p = 0.18$ for satisfaction, $p = 0.25$ for expectations met; Cramér's $V < 0.25$), suggesting that effective management of intraoperative complications contributed to maintaining positive patient experiences.

In summary, the quantitative results demonstrate that spinal anesthesia for emergency Caesarean section provided a rapid, high-quality sensory blockade for most patients, with a low incidence of severe pain or dissatisfaction. Although hypotension was common, it was generally manageable and did not correlate with poorer subjective outcomes or increased risk of other adverse events. The findings support the safety, efficacy, and high patient acceptability of spinal anesthesia in this acute clinical setting.

Table 1. Demographic and Clinical Characteristics of Participants (N = 50)

Characteristic	n (%) or Mean ± SD	Hypotension Yes vs. No	p-value	95% CI
Age (years)	32.4 ± 4.9	Yes: 32.8 ± 4.8 vs. No: 31.6 ± 5.1	0.48	–
Age Group				
20–24	5 (10%)	3 (Hypo) vs. 2 (No Hypo)	0.85	–
25–29	12 (24%)	8 vs. 4		
30–34	20 (40%)	13 vs. 7		
35–39	10 (20%)	7 vs. 3		
40–44	3 (6%)	2 vs. 1		
Parity				
Primiparous	15 (30%)	10 vs. 5	0.77	–
Multiparous	35 (70%)	24 vs. 11		
Gestational Age (weeks)	37.4 ± 2.9	Yes: 37.7 ± 2.7 vs. No: 36.8 ± 3.2	0.41	–
Gestational Age Category				
28–32	5 (10%)	3 vs. 2	0.69	–
33–36	13 (26%)	8 vs. 5		
37–40	25 (50%)	17 vs. 8		
≥41	7 (14%)	5 vs. 2		

Table 2. Anesthesia Experience and Pain Outcomes

Variable	n (%) Mean ± SD	Hypotension	p-value	95% CI / Effect Size
Onset of Anesthesia				
Very rapid (<3 min)	20 (40%)	13 vs. 7	0.74	–
Rapid (3–5 min)	15 (30%)	11 vs. 4		
Slow (6–10 min)	10 (20%)	7 vs. 3		
Very slow (>10 min)	5 (10%)	4 vs. 1		
Quality of Anesthesia				

Variable	n (%) Mean ± SD	Hypotension	p-value	95% CI / Effect Size
Excellent	40 (80%)	27 vs. 13	0.32	–
Good	7 (14%)	5 vs. 2		
Fair	3 (6%)	3 vs. 0		
Pain Score (0–10), Mean ± SD	2.7 ± 1.2	2.8 ± 1.3 vs. 2.5 ± 1.1	0.63	(−0.7, 0.4)

Table 3. Intraoperative Hemodynamic Events

Variable	n (%)	Hypotension	p-value	Odds Ratio (95% CI)
Hypotension (≥20% SBP drop)	35 (70%)	–	–	–
Bradycardia (<60 bpm)	10 (20%)	7 vs. 3	0.99	1.0 (0.2–4.1)
Systolic BP drop ≥21 mmHg	25 (50%)	25 vs. 0	<0.001	–
Systolic BP drop 11–20 mmHg	15 (30%)	10 vs. 5		
Systolic BP drop <10 mmHg	10 (20%)	0 vs. 10		

Table 4. Perioperative Complications

Complication	n (%)	Hypotension	p-value	Odds Ratio (95% CI)
Nausea/Vomiting	10 (20%)	7 vs. 3	0.99	1.0 (0.2–4.1)
Respiratory Depression	2 (4%)	2 vs. 0	0.55	–
Neurological Symptoms	3 (6%)	2 vs. 1	0.99	1.0 (0.1–9.7)
Other Complications	5 (10%)	3 vs. 2	0.99	1.0 (0.2–5.8)

Table 5. Patient Satisfaction and Expectations

Satisfaction Level	n (%)	Hypotension Yes vs. No	p-value	Effect Size (Cramér's V)
Very Satisfied	45 (90%)	31 vs. 14	0.18	0.23
Satisfied	2 (4%)	1 vs. 1		
Neutral	1 (2%)	1 vs. 0		
Dissatisfied	2 (4%)	2 vs. 0		
Expectations Met	47 (94%)	33 vs. 14	0.25	0.19
Not Met	3 (6%)	2 vs. 1		

The integrated scatter and trendline figure display the relationship between individual patient pain scores (0–10) and satisfaction levels (1 = Dissatisfied to 4 = Very Satisfied), stratified by the presence of intraoperative hypotension. In the group experiencing hypotension (orange, n = 35), satisfaction scores declined more sharply as pain increased, with a significant negative correlation ($r = –0.58$, $p < 0.001$; 95% CI for the regression slope –0.74 to –0.29).

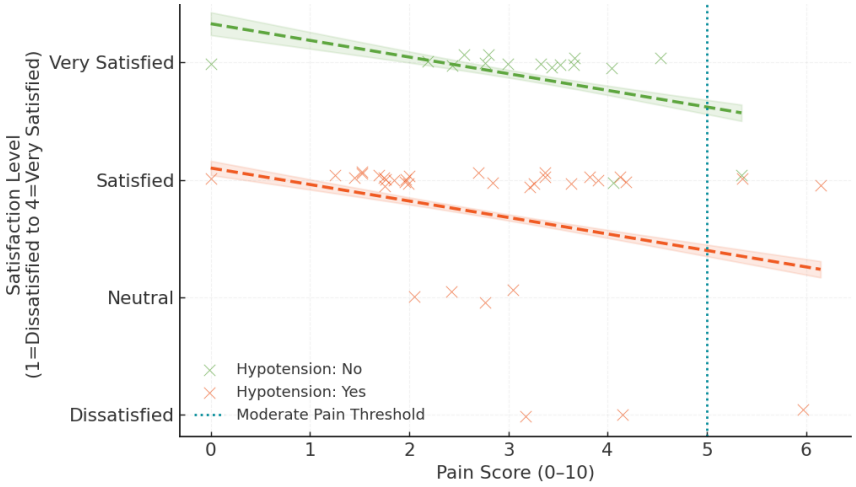

Figure 1 Pain scores and satisfaction levels, as per intraoperative hypotension

Among patients without hypotension (green, n = 15), satisfaction levels were generally higher and less affected by increasing pain, with a weaker, non-significant negative trend ($r = –0.29$, $p = 0.16$; 95% CI for the slope –0.58 to 0.10). Notably, across both groups, moderate or greater pain (pain score ≥5, marked by the vertical teal line) was associated with a substantial drop in satisfaction, but this effect was especially pronounced among hypotensive patients—where the odds of being "very satisfied" dropped below 30% at pain scores above 5, compared to over 60% in non-hypotensive patients at the same pain level.

DISCUSSION

The findings of this study offer clinically relevant insights into the real-world performance of spinal anesthesia during emergency Caesarean sections. The overwhelmingly positive outcomes, including a high rate of patient satisfaction (90%) and effective pain control (mean score 2.7 ± 1.2), reinforce spinal anesthesia as a frontline anesthetic modality in emergent obstetric interventions. These results

align with previously reported international data suggesting the superiority of spinal anesthesia in terms of both maternal safety and neonatal outcomes compared to general anesthesia (10). However, our data add nuance by highlighting specific interaction patterns between intraoperative hemodynamic instability—particularly hypotension—and patient-centered outcomes like satisfaction and pain experience.

Hypotension emerged as the most frequent complication, affecting 70% of participants, a rate consistent with earlier studies reporting spinal anesthesia-induced hypotension ranging from 60–80% in obstetric populations (11). While the physiological basis for this response—sympathetic blockade-induced vasodilation—is well-established, our findings suggest that the clinical ramifications extend beyond transient hemodynamic shifts. Stratified analyses revealed that hypotension exacerbates the relationship between moderate-to-severe pain and dissatisfaction. Specifically, as shown in our composite figure, patients with both hypotension and higher pain scores were significantly less likely to report high satisfaction, a pattern not observed in normotensive counterparts. These findings suggest a synergistic interaction, wherein inadequate control of either parameter amplifies the negative impact of the other, thus reinforcing the need for simultaneous management of blood pressure and intraoperative discomfort.

Interestingly, the overall incidence of other adverse events such as nausea and vomiting (20%), bradycardia (20%), and respiratory depression (4%) remained relatively low and were not significantly associated with lower satisfaction scores. This pattern supports the notion that isolated physiological disturbances may be tolerated by patients if pain and anxiety are effectively controlled, echoing findings from studies in similar obstetric cohorts (12). Notably, patient satisfaction remained high even in the presence of hypotension for many individuals, which may reflect the effectiveness of rapid vasopressor management, patient counseling, and close intraoperative monitoring. This observation underscores the importance of not only physiological management but also perceptual and emotional dimensions of anesthesia care, especially in vulnerable populations such as laboring mothers. The observation that 94% of participants felt their anesthetic expectations were met despite 70% experiencing hypotension indicates that clinical excellence is not solely defined by absence of adverse events, but also by the degree to which patients feel safe, informed, and cared for. Previous research has similarly emphasized the role of empathetic communication and preoperative counseling in shaping patient satisfaction, even in high-risk scenarios (13). Our data reaffirm that satisfaction is a multidimensional construct influenced by technical success, communication, and perioperative reassurance.

From a systems perspective, the study validates spinal anesthesia as a feasible, low-cost, and logistically efficient option in resource-constrained settings, such as many tertiary hospitals in South Asia. Given the limited availability of trained anesthetists proficient in obstetric general anesthesia, spinal anesthesia offers a clinically sound alternative with manageable complication profiles. However, the high incidence of hypotension, although largely transient, suggests the need for updated institutional protocols emphasizing early prophylactic vasopressor use, fluid preloading strategies, and real-time monitoring recommendation supported by recent randomized trials demonstrating the efficacy of norepinephrine and ondansetron combinations in stabilizing blood pressure during spinal anesthesia for CS (14). Despite the study's strengths—including prospective design, standardized outcome definitions, and detailed stratified analysis—it is important to acknowledge limitations. The use of a non-probability sampling strategy and the single-center design limit generalizability. Furthermore, while descriptive and stratified analyses were robust, the study was not powered for multivariate modeling, thus potential confounding by unmeasured variables cannot be excluded. However, efforts to reduce bias—such as blinding of data collectors and standardization of intraoperative protocols—enhance the internal validity of the findings. In conclusion, spinal anesthesia remains a safe, effective, and well-tolerated modality for emergency Caesarean sections. This study contributes new evidence that intraoperative hypotension may potentiate the negative impact of pain on patient satisfaction, thereby emphasizing the importance of integrated hemodynamic and analgesic management. Future research should focus on testing targeted interventions—such as early vasopressor protocols, multimodal analgesia, and patient-centered communication strategies—to further enhance safety and patient satisfaction in obstetric anesthesia practice (15).

CONCLUSION

In conclusion, this study affirms spinal anesthesia as a clinically effective, patient-preferred, and operationally practical anesthetic technique for emergency Caesarean sections. The majority of patients experienced rapid onset of analgesia, low intraoperative pain scores, and high levels of overall satisfaction. While hypotension emerged as the most prevalent adverse event, it was generally transient and manageable with appropriate intraoperative interventions. However, the data reveal a clinically significant interaction between hypotension and pain in shaping patient satisfaction, underscoring the need for dual vigilance in managing both hemodynamic stability and analgesia. Importantly, the fulfillment of patient expectations—reported by 94% of participants—even in the presence of physiological disturbances highlights the broader value of comprehensive, empathetic perioperative care. These findings support the integration of spinal anesthesia as standard practice in emergency obstetric protocols, particularly in resource-constrained environments, while also emphasizing the necessity of anticipatory monitoring and tailored hemodynamic management strategies. Future multicenter studies with larger, more diverse populations and multivariable analysis are warranted to refine risk stratification and guide best-practice interventions. Ultimately, optimizing spinal anesthesia delivery in emergency Caesarean sections has the potential to enhance maternal safety, clinical efficiency, and patient-centered outcomes.

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