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FREQUENCY OF FAILED SPINAL ANESTHESIA IN OBSTETRIC PATIENTS UNDERGOING CESAREAN SECTION

Original Research

Syed Israr Muaziz[1]*, Muhammad Javed Khan[2], Umbrin Naz[2], Syed Hassan Iftikhar[3]
[1]Post Graduate Resident, Department of Anesthesia, Khyber Teaching Hospital, Peshawar, Pakistan.
[2]Assistant Professor, Department of Anesthesia, Khyber Teaching Hospital, Peshawar, Pakistan.
[3]Resident Physician, Department of Medicine, Hayatabad Medical Complex, Pakistan.
Corresponding Author: Syed Israr Muaziz, Post Graduate Resident, Department of Anesthesia, Khyber Teaching Hospital, Peshawar, Pakistan.
Israrmuaziz@gmail.com

Acknowledgement: The authors extend their gratitude to the Anesthesiology Department of Khyber Teaching Hospital, Peshawar, for their support and cooperation in conducting this study.
Submission Date: 26/01/25 Acceptance Date: 05/03/25 Publication Date: 10/03/25

Conflict of Interest: None Grant Support & Financial Support: None

ABSTRACT

Background: Spinal anesthesia is the preferred technique for cesarean sections due to its rapid onset, effective analgesia, and reduced risks compared to general anesthesia. However, spinal anesthesia failure can necessitate conversion to general anesthesia, posing significant clinical and medicolegal concerns. Various factors, including patient physiology, procedural conditions, and anesthetic expertise, contribute to failure. Understanding these determinants is essential for optimizing anesthesia management and improving maternal outcomes. This study aims to evaluate the frequency of failed spinal anesthesia in obstetric patients undergoing cesarean sections and identify associated risk factors.

Objective: To determine the incidence of failed spinal anesthesia in cesarean section patients and analyze its association with patient demographics, ASA classification, type of surgery, and body weight.

Methods: This prospective study was conducted over six months in the Anesthesiology Department of Khyber Teaching Hospital, Peshawar. A total of 203 obstetric patients scheduled for elective or emergency cesarean sections were enrolled using a non-probability consecutive sampling method. Spinal anesthesia was administered with hyperbaric bupivacaine (0.5%) using a standardized protocol. Failure was defined as a Visual Analog Scale (VAS) score >3 upon incision testing and a Modified Bromage Score >2 at 10 minutes post-administration. Data on age, ASA classification, type of cesarean section, and body weight were collected. Statistical analysis was performed using SPSS version 25, with chi-square tests assessing associations, considering a p-value <0.05 as statistically significant.

Results: Spinal anesthesia failed in 9 patients (4.4%) out of 203, while 194 (95.6%) had a successful block. Emergency cesarean sections exhibited a significantly higher failure rate of 7 (3.4%) compared to elective cases at 2 (1.0%) ($p = 0.004$). Patients weighing 71–75 kg had a higher failure incidence (6 cases, 3.0%) than those in the 65–70 kg range (3 cases, 1.5%) ($p < 0.001$). ASA classification did not significantly influence failure rates, with ASA I at 2 (1.0%), ASA II at 6 (3.0%), and ASA III at 1 (0.5%) ($p = 0.18$).

Conclusion: The study identified a low overall failure rate of spinal anesthesia, with emergency cesarean sections and higher patient weight as the primary risk factors. These findings emphasize the importance of tailored anesthetic approaches in high-risk cases to reduce failure rates and enhance maternal safety.

Keywords: Anesthesia failure, cesarean section, emergency surgery, failed spinal block, obstetric anesthesia, spinal anesthesia, surgical complications.

INTRODUCTION

Cesarean delivery is a surgical procedure involving the birth of a baby through incisions in the abdominal wall and uterus. It has evolved significantly since its earliest recorded performance in AD 1020, becoming one of the most commonly performed surgical interventions worldwide. In the United States alone, over one million cesarean deliveries occur annually, a trend driven by factors such as increasing maternal age, advancements in medical technology, and evolving obstetric practices. In 2022, more than 3.66 million births were documented in the US, with 32.2% being cesarean deliveries. While efforts are ongoing to reduce unnecessary cesarean procedures through initiatives promoting vaginal birth after cesarean and encouraging natural labor, experts predict that a substantial reduction is unlikely in the near future (1-4). Spinal anesthesia is the preferred anesthetic technique for cesarean sections due to its rapid onset, predictability, and superior postoperative analgesia. Compared to general anesthesia, it reduces the risks associated with airway management difficulties and neonatal drug exposure. However, spinal anesthesia is not infallible and may fail either partially or completely, necessitating the use of adjuvant medications or conversion to general anesthesia. Such failures not only pose significant clinical challenges but also carry medicolegal implications, with discomfort during cesarean sections under spinal anesthesia being a primary reason for litigation in obstetric anesthesia (5,6). The failure rate of spinal anesthesia varies, with some studies reporting rates as low as 0.5% when using low-dose hyperbaric bupivacaine with narcotic adjuvants for elective cesarean sections (5,6). Nevertheless, the Saving Mothers Report highlights that among 92 anesthesia-related maternal deaths, 79% were associated with spinal anesthesia, with 14% of these fatalities occurring due to complications following conversion to general anesthesia (7,8).

Despite the widespread use of spinal anesthesia in obstetric practice, data on its failure rate in the Pakistani population remains insufficient. Understanding the frequency and factors contributing to spinal anesthesia failure is essential for optimizing anesthetic techniques and improving patient safety. The findings of this study will help address this knowledge gap, guiding training initiatives to enhance the proficiency of anesthetic management during cesarean deliveries in the local population.

METHODS

This study was conducted in the Department of Anesthesiology at Khyber Teaching Hospital, Peshawar, from July 23, 2024, to January 23, 2025, following approval from the Institutional Review Board (498/DME/KMC). A total of 203 patients were included, with the sample size determined using the World Health Organization (WHO) sample size formula, considering a 95% confidence level, a 3% margin of error, and an estimated 5% failure rate of spinal anesthesia. A non-probability consecutive sampling technique was used for patient selection (9). The study included female patients aged 18 to 45 years scheduled for elective or emergency cesarean sections. Eligible participants had an American Society of Anesthesiologists (ASA) Physical Status classification of I to III and normal renal and hepatic function. Exclusion criteria included a body mass index (BMI) below 20 or above 35, known allergies to anesthetic agents such as epinephrine, bupivacaine, lidocaine, ropivacaine, dexamethasone, propofol, sufentanil, atracurium, ketorolac, nalbuphine, ketamine, or ondansetron, as well as chronic opioid use (more than three times per week). Patients with contraindications to spinal anesthesia, incomplete medical records, or lack of follow-up were also excluded to maintain data integrity (10).

After obtaining written informed consent, demographic details, including age, and type of cesarean section (elective or emergency), were documented. Standardized anesthetic protocols were followed, using the same brand of spinal needle and hyperbaric bupivacaine (0.5%) for all patients. The procedure was performed by a single consultant anesthesiologist via a midline lumbar puncture at the L2-3, L3-4, or L4-5 interspaces, with hyperbaric bupivacaine doses ranging from 1.8 mL to 2 mL. Patients were positioned in a wedge-supported supine posture immediately after drug administration. The sensory block was assessed using cold and touch sensation loss, while the pain response was evaluated with a non-tooth forceps pinch at the incision site by the surgeon. Motor blockade was measured using the Modified Bromage Score. Spinal anesthesia failure was defined as a Visual Analog Scale (VAS) score exceeding 3 at the incision site and a Modified Bromage Score above 2 after 10 minutes. Patients meeting this criterion were converted to general anesthesia (11). All data were systematically recorded by the principal investigator using a structured form. Statistical analysis was performed using SPSS version 25. Categorical variables, including ASA classification, type of cesarean section, and spinal anesthesia failure rates, were expressed as frequencies and percentages, while continuous variables such as age and weight were reported as means with standard deviations. Failed spinal anesthesia rates were analyzed in relation to patient characteristics, including age, ASA classification, type of

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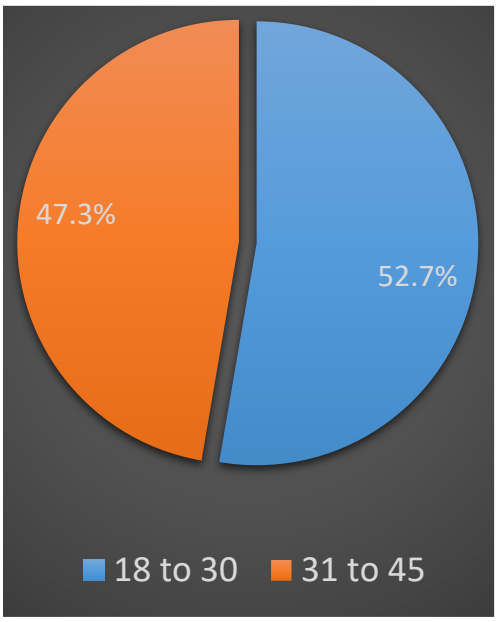
cesarean section, and weight. Post-stratification analysis was conducted using the chi-square test, with a p-value of less than 0.05 considered statistically significant (12).

RESULTS

The study analyzed 203 obstetric patients undergoing cesarean section, with a mean age of 30.99 ± 8.30 years and a mean weight of 68.36 ± 2.22 kg. Among them, 107 (52.7%) were aged between 18 and 30 years, while 96 (47.3%) were between 31 and 45 years. The distribution of ASA classification showed that 96 (47.3%) patients were ASA I, 77 (37.9%) were ASA II, and 30 (14.8%) were ASA III. Elective cesarean sections comprised 135 (66.5%) of the cases, while 68 (33.5%) were emergency procedures. The overall failure rate of spinal anesthesia was 9 (4.4%), while successful spinal anesthesia was achieved in 194 (95.6%) cases. Stratification of failed spinal anesthesia according to age groups revealed a failure rate of 4 (2.0%) in patients aged 18–30 years and 5 (2.5%) in those aged 31–45 years ($p = 0.611$). ASA classification was not significantly associated with failure, as failure rates were 2 (1%) in ASA I, 6 (3%) in ASA II, and 1 (0.5%) in ASA III ($p = 0.18$). Emergency cesarean sections demonstrated a higher rate of failed spinal anesthesia, with 7 (3.4%) failures compared to 2 (1.0%) in elective procedures, indicating a statistically significant difference ($p = 0.004$).

Patient weight was also found to have a significant impact on spinal anesthesia failure. Among patients weighing 65–70 kg, the failure rate was 3 (1.5%), whereas those in the 71–75 kg weight range experienced a higher failure rate of 6 (3.0%) ($p < 0.001$). These findings suggest that while ASA classification and age may not significantly influence spinal anesthesia failure, factors such as the urgency of surgery and patient weight may contribute to an increased likelihood of failure.



Age distribution of the patients (Years)

Table 1: Clinical Features of the Patients

Clinical features		Percentage	Frequency
ASA status	I	96	47.3
	II	77	37.9
	III	30	14.8
Type of cesarean section	Elective	135	66.5%
	Emergency	68	33.5%

Table 2: Frequency of Failed Spinal Anesthesia

Failed spinal anesthesia	Frequency	Percent
Yes	9	4.4
No	194	95.6
Total	203	100.0

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Table 3: Stratification of failed spinal anesthesia with age, ASA status, type of cesarean section and weight

Parameters		Failed spinal anesthesia				P value
		Yes		No		
		Frequency	Percent	Frequency	Percent	
Age distribution (Years)	18 to 30	4	2.0%	103	50.7%	0.61
	31 to 45	5	2.5%	91	44.8%	
ASA status	I	2	1.0%	94	46.3%	0.18
	II	6	3.0%	71	35.0%	
	III	1	0.5%	29	14.3%	
Type of cesarean section	Elective	2	1.0%	133	65.5%	0.004
	Emergency	7	3.4%	61	30.0%	
Weight (Kg)	65 to 70	3	1.5%	160	78.8%	0.0001
	71 to 75	6	3.0%	34	16.7%	

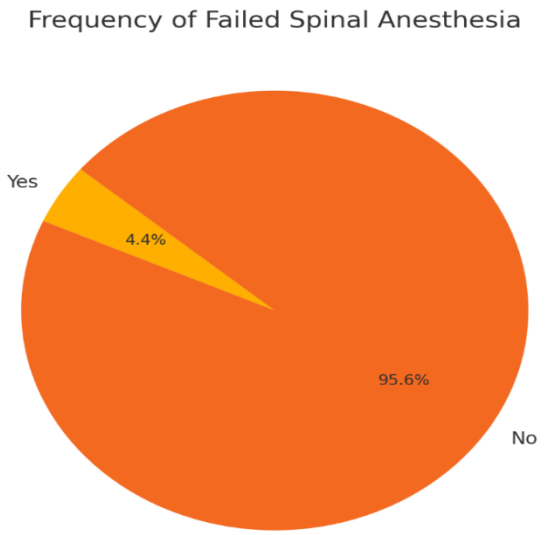

Figure 1 Frequency of Failed Spinal Anesthesis

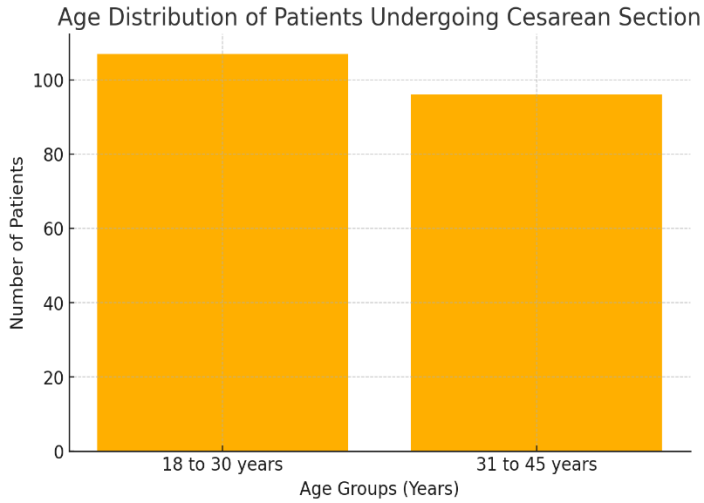

Figure 2 Age Distribution of Patients Undergoing Cesarean Section

DISCUSSION

The findings of this study provide critical insights into the incidence and contributing factors of failed spinal anesthesia in obstetric patients undergoing cesarean section. The observed failure rate of 4.4% aligns with previous local reports documenting a 3% failure rate, suggesting consistency in regional anesthesia outcomes. However, higher failure rates reported in international studies, such as a 19.5% failure rate in a prospective observational study, emphasize the role of sample size, patient characteristics, and healthcare system variations in influencing anesthesia success (9,10). Differences in institutional protocols, anesthetist expertise, and patient demographics may explain these disparities (13). The association between ASA classification and spinal anesthesia failure remains inconclusive. While this study did not find a statistically significant correlation between ASA status and failure rates, other investigations have highlighted the influence of BMI and anesthetist experience rather than ASA classification in determining anesthesia success (11). The physiological

compromise in higher ASA groups could theoretically affect anesthetic spread, but conflicting evidence suggests that factors such as procedural expertise and patient positioning may play a more critical role. The lack of a direct association in this study suggests that ASA classification alone may not be a reliable predictor of anesthesia failure, necessitating a broader assessment of patient-related and technical variables (14).

Emergency cesarean sections exhibited a higher failure rate of 3.4% compared to 1.0% in elective cases, a pattern consistent with global literature. Studies have demonstrated that emergency procedures are associated with an increased likelihood of anesthesia failure, with reported failure rates reaching as high as 11.7% in certain cohorts (12). The urgency of emergency surgeries may contribute to suboptimal patient positioning, time constraints, and increased physiological stress, all of which can alter cerebrospinal fluid dynamics and impact anesthetic distribution. A multi-center study further established emergency surgery as a strong predictor of failure, reinforcing the need for refined anesthesia protocols in these high-risk cases (13). Structured training, optimized dosing strategies, and the potential use of combined spinal-epidural techniques in emergency settings could enhance anesthesia success and mitigate failure risks (15). Patient weight demonstrated a significant influence on spinal anesthesia failure, with failure rates rising from 1.5% in patients weighing 65–70 kg to 3.0% in those between 71–75 kg. This finding aligns with studies indicating that a higher BMI increases the likelihood of anesthesia failure, likely due to altered drug distribution and variability in block height (14). However, conflicting reports have suggested that needle size and operator experience play a more critical role than BMI alone (15). The inconsistencies across studies may stem from variations in dosing protocols, as fixed-dose regimens risk underdosing heavier patients, whereas weight-adjusted approaches can improve efficacy. Future research should focus on refining dosing guidelines tailored to body weight and composition to minimize anesthesia failure rates in heavier individuals (16-18).

Anesthetist experience remains a crucial determinant of spinal anesthesia outcomes, particularly in teaching hospitals and training environments. Although this study did not explicitly assess the role of experience, previous investigations have identified a higher failure rate in procedures performed by less experienced practitioners (11). Evidence suggests that anesthetists with fewer years of experience have significantly greater failure rates, reinforcing the importance of structured training programs, simulation-based learning, and supervised clinical exposure in reducing procedural errors (13). Strengthening competency-based anesthesia education and ensuring the presence of experienced personnel during high-risk cases could substantially improve anesthesia success rates (19). The strengths of this study include its well-defined criteria for spinal anesthesia failure and its systematic approach to assessing potential contributing factors. However, certain limitations must be acknowledged. The study did not account for anesthetist experience as a variable, which could have provided valuable insights into skill-related influences on failure rates. Additionally, the exclusion of patients with extreme BMI values may limit the generalizability of findings, as higher BMI has been associated with increased failure rates in previous research. Furthermore, the study did not differentiate between partial and complete failures of spinal anesthesia, which could have provided a more nuanced understanding of the severity and management of anesthesia failure (20).

The findings of this study reinforce the multifactorial nature of spinal anesthesia failure, shaped by patient physiology, procedural circumstances, and technical proficiency. The lower failure rate observed compared to some international studies may be attributed to differences in population characteristics, anesthetic protocols, or more stringent failure criteria. However, the consistent identification of emergency surgery and higher patient weight as risk factors highlights their universal relevance in anesthesia practice. Future research should focus on optimizing weight-based dosing protocols, refining emergency anesthesia strategies, and integrating competency-based training programs to enhance anesthesia success rates and minimize failure-associated complications.

CONCLUSION

This study highlights the occurrence of spinal anesthesia failure in obstetric patients undergoing cesarean delivery, emphasizing the influence of emergency procedures and higher patient weight as key contributing factors. While ASA classification did not significantly impact anesthesia outcomes, the findings reinforce the need for tailored anesthetic approaches in high-risk cases. The study underscores the importance of optimizing perioperative management strategies, refining dosing protocols, and prioritizing expertise in emergency settings to enhance anesthesia success and improve patient safety.

AUTHOR CONTRIBUTIONS

Author	Contribution
Syed Israr Muaziz1*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Javed Khan	Critical Review Has given Final Approval of the version to be published
Umbrin Naz	Manuscript Review
Syed Hassan Iftikhar	Manuscript Review

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