

Incidence, Risk Factors, and Maternal Outcomes of Spinal Anesthesia-Related Complications in Cesarean Section: A Retrospective Observational Study

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Abstract:

Background: Spinal anesthesia is the most commonly used anesthetic technique for cesarean section, due to its effectiveness, quick onset and good maternal and neonatal results. While it has benefits, it also has drawbacks like hypotension, bradycardia, nausea, vomiting and shivering which can impact the safety of the mother. It is important to identify associated risk factors to enhance the perioperative management and outcome.

Aim: To assess the occurrence of complications associated with spinal anesthesia and maternal outcomes among women who had cesarean section (CS) with spinal anesthesia.

Method: The study was a retrospective observational study that was performed in the Department of Anaesthesiology at Shahid Nirmal Mahato Medical College and Hospital, Dhanbad, Jharkhand. One year of operations on 140 women who had elective or emergency cesarean section under spinal anesthesia were reviewed. Data were collected and analyzed with SPSS version 26.0, and demographic, obstetric, anesthetic, perioperative and outcome related data were collected. A multiple logistic regression analysis was conducted to determine independent predictors of complications.

Result: The most common complication was hypotonia (50.7%), followed by shivering (30.7%), vomiting (25.7%), recovery time (22.1%) and bradycardia (17.1%). The important risk factors for hypotension were maternal age >35 years, obesity, anemia, emergency cesarean section and dose of bupivacaine >12.5 mg. The recovery process was uneventful in 73.6% of the patients and ICU admission (5.0%) and general anesthesia (3.6%) were uncommon. There was no maternal mortality.

Conclusion: The bottom line: Spinal anesthesia is still a safe and effective method for cesarean section delivery. Timely recognition of patients with risk factors and careful monitoring during the operation can minimize complications and maternal outcomes.

Keywords: Cesarean section, spinal anesthesia, hypotension, bradycardia, maternal outcomes, risk factors, obstetric anesthesia, retrospective observational study.

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Introduction

Cesarean section (CS) is one of the most widely performed surgeries around the world and has become an essential part of modern obstetric care. The cesarean delivery rate has significantly risen over the last few decades as a result of better maternal care, improved fetal monitoring, and greater indications for operative delivery [1]. The use of anaesthetic for cesarean section is vital to the outcome of mothers and babies. Some of the anesthetic techniques available,

the neuraxial techniques (including spinal anesthesia) have become the most popular technique used for elective and emergency cesarean delivery, due to their safety, rapid induction of surgical anesthesia, and their ability to provide adequate anesthesia for the surgery.

The use of spinal anesthesia in obstetric patients has several benefits over general anesthesia. It helps maintain the mother's alertness during delivery, and

promotes early bonding between mother and baby, as well as preventing exposure of the infant to anesthetic agents and risks involved with manipulation of the mother's airway and pulmonary aspiration [3]. In addition, it has been reported that the use of neuraxial anesthesia has been shown to significantly decrease maternal morbidity and mortality associated with anesthesia and has become the standard of care for most cesarean sections performed around the world [4]. Despite these benefits, spinal anesthesia has its complications and is still a significant perioperative problem for the anesthesiologist.

The physiological changes associated with pregnancy, such as increased blood volume, decreased systemic vascular resistance, compression of the aorta from the gravid uterus and increased sensitivity to local anesthetic, make pregnant women vulnerable to a number of complications after spinal anesthesia [5]. Of these, hypotension in the setting of spinal anesthesia (SAIH) is the most common. Spinal anesthesia causes a sympathetic blockade, which causes peripheral vasodilation, vascular pooling, which causes a decrease in cardiac output and arterial blood pressure [6]. Hypotension in the mother can lead to symptoms like dizziness, nausea, vomiting, and changes in consciousness, and if it is severe or persists, it can affect the uteroplacental circulation and negatively impact the mother's baby [7].

The incidence at which hypotension occurs after spinal anesthesia for cesarean delivery is reported to be from 30% to 80%, depending on the definition used, patient characteristics, anesthetic technique and preventive measures used [8]. Other complications associated with sympathetic blockades and decreased venous return are hypotension. Bradycardia is less common but can also play a role in hemodynamic instability and sometimes require pharmacological support [9]. Other common complications include, but are not limited to, nausea, vomiting, shivering, poor block, high block, urinary retention, and length of anesthesia recovery [10,11].

Several factors have been suggested to predict the occurrence of complications associated with spinal anesthesia, including maternal and procedural factors. An association between advanced maternal age with hypotension has been linked to the age-related changes in the autonomic nervous system function, baroreceptor responsiveness and cardiovascular reserve [12]. High body mass index (BMI) and obesity have also been linked. In obese parturient, high intra-abdominal pressure may decrease the amount of CSF and allow increased cephalad spread of local anesthetic agents which may lead to increased sympathetic blockade and increased risk for hypotension [13]. Baseline hemodynamic status, parity, gestational age, level of sensory blockade, anesthetic dose and emergency versus elective surgical status also have been reported to be associated with adverse events after spinal anesthesia [14,15].

Despite the existence of multiple studies from developed countries and select tertiary care centers to assess the incidence and risk factors for complications associated with spinal anesthesia, there are variations in patient population, obstetric practices, nutritional status and healthcare facilities that can affect the outcomes of spinal anesthesia. The data from eastern India, especially from Jharkhand is limited. To provide the best possible care around spinal anesthesia, to recognize patients at greatest risk, and to design evidence-based, regionally appropriate, preventive strategies, it is important to know the local burden of spinal anesthesia complications. In addition, the use of routine clinical data collected in the real world, and subsequently analyzed in a retrospective way, can be used to gain insight into the actual use of anesthetics in the real world and the actual outcomes for the mother.

Safe anesthetic is the goal of obstetric anesthesia. The prompt recognition and management of complications associated with spinal anesthesia can decrease the overall morbidity and better peri-operative outcomes for the mother. Knowing how to manage modifiable risk factors might help implement targeted interventions like optimization of fluid, administration of prophylactic vasopressors, positioning, and individual anesthetic dosing plans etc. [7]. In addition, assessment of maternal outcomes of such complications can facilitate improvements in monitoring and improve the quality of obstetric anesthesia care.

Hence the present retrospective observational study was conducted in the Department of Anaesthesiology, Shahid Nirmal Mahato Medical College and Hospital, Dhanbad, Jharkhand, India to find out the incidence of complications that may occur with spinal anesthesia in women who had cesarean section, to identify the risk factors associated with spinal anesthesia and the maternal outcome. This study's conclusions will have implications for current literature and evidence-based approaches to providing safety and anesthetic care for the mother during childbirth.

Methodology

Study Design: This study was designed as a retrospective observational study to find the incidence, risk factors and maternal outcomes of spinal anesthesia related complications in women with cesarean section. Eligible patients who had cesarean delivery with spinal anesthesia during the study period were identified and included in the study by reviewing the hospital records.

Study Area: The study was carried out in the Department of Anaesthesiology, Shahid Nirmal Mahato Medical College and Hospital (SNMMCH), Dhanbad, Jharkhand, India.

Study Duration: This study was carried out for 1 year. Medical records of patients undergoing cesar-

ean section (CS) under spinal anesthesia were retrospectively retrieved and analyzed during the study period.

Sample Size: Fourteen patients were excluded from the study because they did not meet the inclusion criteria, leaving 140 patients in the study.

Study Population: The study population included the women who had undergone elective or emergency cesarean section in the Department of obstetrics and gynecology and Department of Anaesthesiology, SNMMCH, Dhanbad in the study period under spinal anesthesia.

Data Collection: Medical records, anesthesia records, operative records, postoperative monitoring records and labor room registers were used to collect the data retrospectively from patients who had undergone cesarean section (CS) under spinal anesthesia during the study period. Information was collected using a structured data extraction form, which included relevant data concerning demographic parameters (age, weight, height, BMI), obstetric parameters (parity, gestational age, indication for cesarean section, type of surgery), associated comorbidities, anesthetic parameters (dose and type of anesthetic agent, height of spinal puncture, size of needle, number of attempts), intra-operative findings, anesthetic complications, and maternal outcomes. All the collected data were cross verified within the available records to verify data accuracy and completeness prior to data analysis.

Inclusion Criteria

- Women who had spinal anesthesia during cesarean section in the study period.
- Patients older than 18 years.
- Elective as well as emergency cesarean sections performed under spinal anesthesia.
- Accessible and complete medical records with pertinent perioperative data.

Exclusion Criteria

- Patients who were only given general or epidural anesthesia.
- Patients who had combined spinal-epidural anesthesia.
- Cases in which the medical records have not been complete or are missing.
- Patients who have contraindication to spinal anesthesia.
- Cesarean sections that were changed to other types of anesthesia prior to establishing spinal block.
- Patients who may have other neurological conditions that would affect the evaluation of the complications of spinal anesthesia.

Study Procedure: The records of women who had cesarean section under spinal anesthesia during the

one-year study period were identified after approval from the institutional ethics committee from the departmental database and hospital records. Patient files were screened with the predetermined inclusion/exclusion criteria. Eligible records were screened in detail and pertinent demographic, obstetric, anesthetic, intraoperative and postoperative information was retrieved on a data collection proforma. Documented complications associated with spinal anesthesia were hypotension, bradycardia, nausea and vomiting, shivering, post-dural puncture headache, backache, urinary retention, failed spinal, high spinal, and prolonged recovery. Details of maternal outcome such as postoperative recovery, length of hospital stay, need for intensive care, conversion from local to general anesthesia and other postoperative morbidities were also noted. Incidence of complications was established and potential risk factors related to the occurrence of the complications were analyzed.

Statistical Analysis: The data collected was then entered into Microsoft Excel and analyzed using the software package of Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables like age, BMI, GA, surgery duration and duration in hospital were reported as mean \pm SD or median (IQR) depending on the distribution of data. Categorical variables were presented as frequencies and percentages. The percentage of patients with complications in relation to the total number of patients in the study was used to calculate the incidence of spinal anesthesia-related complications. The association of potential risk factors with complications were assessed with Chi square test or Fisher's exact test for categorical variables and Student's t test or Mann-Whitney U test for continuous variables, depending on the type of variables. Factors that were significantly associated in univariate analysis were then evaluated in a multivariable logistic regression analysis to determine the independent predictors of complications and adverse maternal outcomes associated with spinal anesthesia. The p-value < 0.05 was statistically significant.

Result

The sociodemographic and obstetric data of study subjects are shown in table 1. The majority of women belonged to the age group of 25–30 years (53, 37.9%), followed by 31–35 years (42, 30.0%), while women aged >35 years constituted 12.9% (18) of the study population. When it comes to body mass index (BMI), 38.6% (54) of women were overweight and 22.9% (32) had normal BMI. The multigravida women were the dominant group (68.6%, 96) and the primigravida women were 31.4% (44). 87.1% (122) of the patients had cesarean section at term gestation (≥ 37 weeks), and 12.9% (18) had cesarean section at less than 37 weeks of gestation. Elective cesarean sections accounted for 41.4% (58)

and emergency cesarean sections accounted for 58.6% (82) of the cases.

Table 1: Sociodemographic and Obstetric Characteristics of Study Participants (N=140)		
Variable	Frequency (n)	Percentage (%)
Age Group (years)		
<25	27	19.3
25–30	53	37.9
31–35	42	30
>35	18	12.9
Total	140	100
BMI (kg/m²)		
Normal (<25)	32	22.9
Overweight (25–29.9)	54	38.6
Obese (≥30)	54	38.6
Total	140	100
Parity		
Primigravida	44	31.4
Multigravida	96	68.6
Total	140	100
Gestational Age		
<37 weeks	18	12.9
≥37 weeks	122	87.1
Total	140	100
Type of Cesarean Section		
Elective	58	41.4
Emergency	82	58.6
Total	140	100

The clinical and anesthetic parameters of the study subjects are summarized in Table 2. The most common comorbidities observed were anemia (27.1% or 38 women), hypertensive disorders (15.0% or 21 women), diabetes mellitus/gestational diabetes (12.1% or 17 women), and hypothyroidism (11.4% or 16 women). In 34.3% (48) of the patients, a history of previous cesarean section was found. As for

the puncture site of the spine for administration of spinal anesthesia, 51.4% (72) were from L3–L4, 35.7% (50) were from L4–L5, and 12.9% (18) were from L2–L3. The majority of women received a hyperbaric bupivacaine dose of 10–12.5 mg (83, 59.3%), while 22.1% (31) received ≤10 mg and 18.6% (26) received >12.5 mg.

Table 2: Clinical and Anesthetic Characteristics of Study Participants (N=140)		
Variable	Frequency (n)	Percentage (%)
Maternal Clinical / Obstetric Variables		
Anemia	38	27.1
Hypertensive disorders	21	15
Diabetes mellitus / GDM	17	12.1
Hypothyroidism	16	11.4
Previous cesarean section	48	34.3
Total	140	100
Spinal Puncture Level		
L2–L3	18	12.9
L3–L4	72	51.4
L4–L5	50	35.7
Total	140	100
Dose of Hyperbaric Bupivacaine		
≤10 mg	31	22.1
10–12.5 mg	83	59.3
>12.5 mg	26	18.6
Total	140	100

Table 3 demonstrates the rates of complications associated with spinal anesthesia in women that have cesarean section. The most common complication was hypotension (50.7% (71)) followed by shivering (30.7% (43)) and nausea (25.7% (36)). Twenty-two-point one percent (31) of patients had prolonged recovery time, and 17.1 percent (24) of patients had

bradycardia. Vomiting was reported in 15.0% (21) of women, and backache occurred in 13.6% (19). Other less common complications were post-dural puncture headache (8.6%, 12), urinary retention (6.4%, 9), failed spinal block (3.6%, 5), and high spinal block (2.1%, 3) patients.

Complication	Frequency (n)	Percentage (%)
Hypotension	71	50.7
Bradycardia	24	17.1
Nausea	36	25.7
Vomiting	21	15
Shivering	43	30.7
Post-dural puncture headache	12	8.6
Backache	19	13.6
Urinary retention	9	6.4
Failed spinal block	5	3.6
High spinal block	3	2.1
Prolonged recovery	31	22.1

As shown in Table 4, the degree of hypotension experienced by the study participants is quite severe. Almost half of the females (69, 49.3%) did not have hypotension after spinal anesthesia. Of those who developed hypotension, mild hypotension was seen

in 19.3% (27) of patients, moderate hypotension in 17.1% (24) and severe hypotension in 14.3% (20). These results suggest that the most prevalent complication was hypotension, but most cases were mild to moderate.

Severity of Hypotension	Frequency (n)	Percentage (%)
No hypotension	69	49.3
Mild hypotension	27	19.3
Moderate hypotension	24	17.1
Severe hypotension	20	14.3
Total	140	100

The association of selected risk factors with spinal anesthesia induced hypotension is shown in table 5. The incidence of hypotension observed in women >35 years is significantly higher when compared with women <35 years, with 73.7% (14/19) of women developing hypotension versus 26.3% (5/19) who did not ($p=0.041$). Hypotension was also significantly associated with obesity, as 66.7% (36/54) of obese women were found to be having hypotension ($p=0.006$). There was a higher inci-

dence of hypotension, which occurred in 59.8% (49/82) of cases in emergency cesarean section ($p=0.031$). Similarly, hypotension occurred in 65.8% (25/38) of anemic women ($p=0.048$). Patients receiving bupivacaine dose >12.5 mg had a significantly higher rate of hypotension (73.1%, 19/26; $p=0.012$). These results indicate that advanced maternal age, obesity, anemia, emergency surgery, and higher doses of anesthetic are significant risk factors for hypotension.

Factors	Hypotension Present n (%)	Hypotension Absent n (%)	P-value
Age >35 years	14 (73.7)	5 (26.3)	0.041*
Obesity (BMI ≥ 30 kg/m ²)	36 (66.7)	18 (33.3)	0.006*
Emergency cesarean section	49 (59.8)	33 (40.2)	0.031*
Anemia	25 (65.8)	13 (34.2)	0.048*
Bupivacaine dose >12.5 mg	19 (73.1)	7 (26.9)	0.012*

Table 6 shows factors associated with the bradycardia caused by spinal anesthesia. Obese women were significantly more likely to be bradycardic, 25.9% (14/54) than women with normal BMI, 74.1%

(40/54) ($p=0.044$). Bradycardia was significantly associated with the L2–L3 puncture site with 38.9% (7/18) of patients developing bradycardia ($p=0.021$). Severe hypotension had a strong correlation with

bradycardia as 50.0% (10/20) of women with severe hypotension had bradycardia ($p=0.001$). Bradycardia was more common in women >35 years and

those who had emergency cesarean section, but these relationships were not statistically significant ($p>0.05$).

Table 6: Association of Selected Risk Factors with Bradycardia

Factors	Bradycardia Present n (%)	Bradycardia Absent n (%)	P-value
Age >35 years	6 (31.6)	13 (68.4)	0.088
BMI ≥ 30 kg/m ²	14 (25.9)	40 (74.1)	0.044*
L2–L3 puncture level	7 (38.9)	11 (61.1)	0.021*
Severe hypotension	10 (50.0)	10 (50.0)	0.001*
Emergency cesarean section	17 (20.7)	65 (79.3)	0.163

The results of cesarean section with spinal anesthesia are shown in Table 7. The majority of women had an uncomplicated recovery, that is, 73.6% (103). A total of 15.0% (21) of patients showed postoperative morbidity, and a hospital stay of more than five days was noted in 12.9% (18) of patients. 5.0% (7)

patients had to be admitted to intensive care unit and 3.6% (5) required conversion to general anesthesia. Interestingly, no maternal deaths were reported during the study period even though there were anesthesia related complications, reflecting a good maternal outcome overall.

Table 7: Maternal Outcomes Following Spinal Anesthesia (N=140)

Maternal Outcome	Frequency (n)	Percentage (%)
Uneventful recovery	103	73.6
ICU admission	7	5
Conversion to general anesthesia	5	3.6
Prolonged hospital stay (>5 days)	18	12.9
Postoperative morbidity	21	15
Maternal mortality	0	0

The results of the multivariable logistic regression analysis for the independent predictors of spinal anesthesia-induced hypotension are shown in Table 8. Obesity (BMI ≥ 30 kg/m²) emerged as the strongest predictor, increasing the risk of hypotension by 2.74 times (AOR=2.74, 95% CI: 1.32–5.68; $p=0.007$). The risk of hypotension was 2.16-fold higher with caesarean section (AOR=2.16, 95% CI: 1.12–4.18, $p=0.021$). More than a third of the women aged >35 years were also significantly more likely to develop hypotension (AOR=1.89, 95% CI: 1.01–3.95;

$p=0.044$). Additionally, anemia was found to be an independent risk factor with a 1.97-fold increase in the odds of hypotension (AOR=1.97, 95% CI: 1.03–3.78; $p=0.039$). Moreover, bupivacaine dose >12.5 mg was significantly associated with the development of hypotension (AOR=2.48, 95% CI: 1.18–5.24, $p=0.016$). The results suggest obesity, advanced maternal age, anemia, emergency cesarean section, and higher dose of anesthetic are important factors affecting development of hypotension during spinal anesthesia.

Table 8: Multivariable Logistic Regression Analysis for Predictors of Hypotension

Variable	Adjusted OR	95% CI	P-value
BMI ≥ 30 kg/m ²	2.74	1.32–5.68	0.007*
Age >35 years	1.89	1.01–3.95	0.044*
Emergency cesarean section	2.16	1.12–4.18	0.021*
Anemia	1.97	1.03–3.78	0.039*
Bupivacaine dose >12.5 mg	2.48	1.18–5.24	0.016*

Discussion

This was a retrospective study that analyzed the incidence, risk factors and maternal outcomes of complications related to spinal anesthesia in women with cesarean section. Most of the participants were multigravida (68.6%) and had cesarean delivery for term gestation (87.1%). 58.6% were emergency cesareans. Previous studies have reported similar profiles of women undergoing cesarean section under spinal anesthesia, with most women within the typical age range of reproductive women and mostly multipa-

rous women [16]. The high prevalence of overweight and obesity among women in the current study (77.2%) is an important fact that indicates the high rate of maternal obesity that has been identified as an important factor associated with anesthetic complications during pregnancy [17].

Of the clinical features, the most prevalent was anemia (27.1%), followed by hypertensive disorders (15.0%), diabetes mellitus/gestational diabetes (12.1%) and hypothyroidism (11.4%). The most common puncture site was at the L3-L4 level

(51.4%), and the majority (59.3%) were injected with 10–12.5 mg of hyperbaric bupivacaine, which is the usual amount of anesthetic used in the region [18].

The primary finding of the study was that there were high rates of complications associated with spinal anesthesia, especially hypotension, which occurred in 50.7% of patients. Other associated complications were shivering (30.7%), nausea (25.7%), prolonged recovery (22.1%), bradycardia (17.1%) and vomiting (15.0%). These results agree with the data reported earlier, which showed that hypotension is the most common side effect of spinal anesthesia for cesarean delivery. In about half of parturients receiving spinal anesthesia, Maayan-Metzger et al. found significant reduction in blood pressure [17]. Likewise, mild, moderate and severe hypotension rates of 20%, 35% and 40% were observed by Fakherpour et al [16]. Other studies have reported incidences of hypotension ranging from 56.5% to 79.6% overall [19,20]. However, this lower rate was seen in the present study, which could be explained by the differences in the characteristics of patients, anesthetic techniques and definitions of hypotension between the studies [6].

Females were classified as having mild hypotension if their blood pressure was between 90 and 100 mmHg, moderate hypotension if it was 100–110 mmHg, and severe hypotension if it was 110–90 mmHg; 49.3% were normotensive. Hypotension was prevalent, but mild to moderate. Hypotension after spinal anesthesia is mostly associated with sympathetic blockades, which leads to vasodilation, lowered venous return, reduced cardiac output and lowers arterial pressure. These hemodynamic changes are further compounded in pregnant women by compression of the inferior vena cava by the gravid uterus [6].

A number of risk factors for hypotension were found. Hypotension was found to be significantly higher in the women older than 35 years (73.7%, $p=0.041$). The results of this study are similar to the ones reported by Maayan-Metzger et al. which also showed a significant maternal age-hypoxia correlation after spinal anesthesia. Changes in cardiovascular responsiveness and decreased physiological reserve may be associated with advanced maternal age and increase the risk of women becoming hemodynamically unstable.

Another significant risk factor was obesity, with 66.7% of obese women having hypotension ($p=0.006$). Additionally, multivariable logistic regression showed that obesity was the most significant independent risk factor for hypotension (AOR=2.74, 95% CI: 1.32–5.68; $p=0.007$). The results were consistent with Chinachoti and Tritrakarn, who showed that the relationship between a high BMI and spinal anesthesia induced hypotension was significant. An obese parturient might

have less cerebrospinal fluid (CSF) and have larger cephalad spread of the local anesthetic (LA), and thus more extensive a sympathetic blockade [21].

The study also showed that higher doses of bupivacaine (>12.5 mg) were significantly associated with hypotension (73.1%, $p=0.012$) and that this was an independent contributor to hypotension (AOR=2.48). This finding is consistent with previous reports that higher doses of intrathecal medication result in deeper sympathetic blockades and more hemodynamic instability. Anemia was also found to be an independent predictor (AOR=1.97, $p=0.039$), 65.8% of the women with anemia were seen to have developed hypotension. Emergency cesarean section was also associated with a higher risk (AOR=2.16, $p=0.021$) which was likely due to less preoperative optimization and higher physiological stress in emergency surgical cases.

Bradycardia occurred in 17.1% of the patients, which was in close agreement with that reported by Chinachoti and Tritrakarn (16.4%). Significant associations were found between bradycardia and obesity (25.9%, $p=0.044$), L2–L3 puncture level (38.9%, $p=0.021$), and severe hypotension (50.0%, $p=0.001$). Physiologically, severe hypotension is well known to be associated with bradycardia, which is hypothesized to be due to the combined effect of blocking both vascular tone and cardiac sympathetic activity.

Maternal outcomes were good even though there were complications related to anesthesia. There were no complications in 73.6% and postoperative morbidity in 15.0%. Only 5.0% of women were required to be admitted to the ICU, and 3.6% needed to be switched to GA. Notably, there were no maternal deaths reported. These results validate safety and effectiveness of spinal anesthesia for cesarean section when adequate perioperative management of complications and monitoring is provided.

In conclusion, the current study corroborates previous reports that hypotension during cesarean delivery is the most frequently reported complication of spinal anesthesia. Three factors, obesity, advanced maternal age, and bupivacaine dosage, were found to be important independent risk factors for hypotension. Obesity, advanced maternal age, and higher dose of bupivacaine were identified as being important independent risk factors for hypotension. Identification of such high-risk patients and implementing preventive measures can help minimize complications and continue to enhance maternal outcomes.

Conclusion

The present retrospective observational study shows that spinal anaesthesia is a safe and effective method of anaesthesia for the CS, but there are still many complications related to the anaesthetic procedure, the most common of which are haemodynamic

changes. The study revealed that there were some maternal and procedure-related factors that substantially raised the chances of adverse events, such as high dose of intrathecal bupivacaine, obesity, emergency cesarean, and advanced maternal age, anemia. Some clinical and anesthetic factors were also associated with bradycardia, and this further highlights the need for careful monitoring during the perioperative period. In spite of these complications, maternal outcome was good with satisfactory recovery of most mothers and no maternal death recorded. Further, the identification of high-risk patients, careful planning of anaesthetic technique, optimization of the maternal health status, and timely handling of the intraoperative complications can improve the safety of the mothers undergoing CS under spinal anaesthetic and improve outcomes in these women.

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