Section: Anesthesia

Original Research Article

COMPARISON OF COMBINED SPINAL-EPIDURAL VERSUS SPINAL ANESTHESIA IN HIGH-RISK OBSTETRIC PATIENTS: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: High-risk obstetric patients undergoing cesarean section present unique anesthetic challenges due to associated maternal comorbidities such as pregnancy-induced hypertension, preeclampsia, cardiac disease, diabetes mellitus, obesity, placenta previa, and multiple gestation. Regional anesthesia remains the preferred anesthetic technique for cesarean delivery because of its favorable maternal and neonatal outcomes. Conventional spinal anesthesia provides rapid onset and dense neural blockade but is frequently associated with significant hypotension and hemodynamic instability. Combined spinal-epidural (CSE) anesthesia combines the advantages of rapid spinal anesthesia with the flexibility of epidural supplementation and prolonged postoperative analgesia. The present study was conducted to compare the efficacy and safety of combined spinal-epidural anesthesia with conventional spinal anesthesia in high-risk obstetric patients undergoing cesarean section. The aim is to compare maternal hemodynamic stability, anesthetic efficacy, perioperative complications, neonatal outcomes, and maternal satisfaction between combined spinal-epidural anesthesia and spinal anesthesia in high-risk obstetric patients undergoing cesarean section.

Materials and Methods: This prospective comparative study was conducted in the Department of Anaesthesiology at Shyam Shah Medical College and Associated Gandhi Memorial Hospital, Rewa, Madhya Pradesh, over a period of one year. A total of 60 high-risk obstetric patients scheduled for elective or emergency cesarean section were enrolled and divided into two groups of 30 patients each. Group CSE received combined spinal-epidural anesthesia, while Group SA received conventional spinal anesthesia. Demographic characteristics, obstetric risk factors, intraoperative hemodynamic parameters, incidence of hypotension, vasopressor requirements, sensory and motor block characteristics, duration of analgesia, maternal complications, neonatal outcomes, and maternal satisfaction scores were recorded and analyzed. Statistical analysis was performed using Student's t-test, Chi-square test, Fisher's exact test, and repeated measures ANOVA where appropriate. A p-value <0.05 was considered statistically significant.

Results: The demographic and obstetric characteristics were comparable between the two groups ($p>0.05$). Maternal hypotension occurred significantly less frequently in the CSE group compared with the spinal anesthesia group (16.7% vs. 43.3%, $p=0.025$). Vasopressor requirement was significantly lower in Group CSE (13.3%) than in Group SA (40.0%) ($p=0.019$). The incidence of nausea and vomiting was also reduced in the CSE group (10.0% vs. 30.0%, $p=0.048$). Sensory and motor block onset times were comparable between groups ($p>0.05$). However, the duration of postoperative analgesia was significantly longer in Group CSE (327.5 ± 42.8 minutes) compared with

Group SA (183.4 ± 35.7 minutes) ($p<0.001$). Maternal satisfaction scores were significantly higher in the CSE group (8.9 ± 0.8 vs. 7.5 ± 1.1, $p<0.001$). Neonatal outcomes, including Apgar scores at 1 and 5 minutes and NICU admission rates, were similar in both groups ($p>0.05$).

Conclusion: Combined spinal-epidural anesthesia provides superior hemodynamic stability, lower incidence of maternal hypotension, reduced vasopressor requirements, prolonged postoperative analgesia, and greater maternal satisfaction compared with conventional spinal anesthesia in high-risk obstetric patients undergoing cesarean section. Both techniques demonstrated comparable neonatal safety profiles. Combined spinal-epidural anesthesia may therefore be considered a preferable regional anesthetic technique for cesarean delivery in carefully selected high-risk obstetric patients.

Keywords: Combined spinal-epidural anesthesia, spinal anesthesia, cesarean section, high-risk obstetric patients, maternal hypotension, postoperative analgesia, neonatal outcome.

INTRODUCTION

Pregnancy is associated with profound physiological alterations affecting the cardiovascular, respiratory, hematological, and endocrine systems. These changes are further complicated in women with high-risk obstetric conditions such as pregnancy-induced hypertension, preeclampsia, cardiac disease, obesity, diabetes mellitus, placenta previa, multiple gestation, and other maternal comorbidities. The choice of anesthetic technique in these patients is crucial because both maternal and fetal outcomes may be significantly influenced by perioperative hemodynamic fluctuations and anesthetic-related complications. Regional anesthesia remains the preferred anesthetic modality for cesarean delivery owing to its favorable maternal and neonatal safety profile compared with general anesthesia.[1]

Spinal anesthesia is widely utilized for cesarean section because of its rapid onset, technical simplicity, dense sensory blockade, and high success rate.[2] However, sudden sympathetic blockade frequently results in maternal hypotension, decreased uteroplacental perfusion, nausea, vomiting, and fetal compromise if not promptly managed.[3] These concerns become particularly important in high-risk obstetric patients where cardiovascular reserve may already be compromised.

Combined spinal-epidural (CSE) anesthesia was introduced to combine the advantages of both spinal and epidural techniques. The spinal component ensures rapid onset and reliable surgical anesthesia, whereas the epidural catheter provides the opportunity for dose titration, prolongation of anesthesia, and postoperative analgesia.[4] The ability to administer lower intrathecal doses in CSE techniques may contribute to improved cardiovascular stability and reduced incidence of profound hypotension.[5]

Several investigators have demonstrated the benefits of CSE anesthesia in cesarean delivery, including superior block quality, reduced local anesthetic requirements, prolonged analgesia, and greater maternal comfort.[6] Furthermore, epidural supplementation allows extension of anesthesia in prolonged surgeries without conversion to general anesthesia, an important advantage in complicated obstetric cases.[7]

High-risk obstetric patients often present unique anesthetic challenges requiring meticulous cardiovascular monitoring and individualized anesthetic management. In women with hypertensive disorders, valvular heart disease, or compromised cardiac function, abrupt changes in systemic vascular resistance and preload can adversely affect maternal and fetal outcomes.[8] Therefore, anesthetic techniques capable of minimizing hemodynamic disturbances are particularly valuable in this population.

Despite widespread use of both spinal anesthesia and CSE anesthesia, available literature comparing these techniques specifically in high-risk obstetric patients remains limited and sometimes contradictory. Some studies have reported superior hemodynamic control with CSE, whereas others found comparable outcomes between techniques.[9,10] Consequently, further prospective evaluation is warranted.

The present study was therefore undertaken at Shyam Shah Medical College, Rewa, to compare combined spinal-epidural anesthesia with conventional spinal anesthesia in high-risk obstetric patients undergoing cesarean section, with particular emphasis on maternal hemodynamic stability, anesthetic efficacy, perioperative complications, neonatal outcomes, and maternal satisfaction.

MATERIALS AND METHODS

Study Design: This study was designed as a prospective comparative observational study.

Study Setting: The study was conducted in the Department of Anaesthesiology in collaboration with the Department of Obstetrics and Gynecology at Shyam Shah Medical College and Associated Gandhi Memorial Hospital, Rewa, Madhya Pradesh.

Study Duration: The study was conducted over a period of one year following approval from the Institutional Ethics Committee.

Study Population: Pregnant women categorized as high-risk obstetric patients and scheduled for elective or emergency cesarean section under regional anesthesia were considered eligible for enrollment.

Sample Size: A total of 60 patients were included in the study.

- Group CSE (Combined Spinal-Epidural Anesthesia): 30 patients
- Group SA (Spinal Anesthesia): 30 patients

Sampling Technique

Consecutive eligible patients meeting the inclusion criteria were recruited until the desired sample size was achieved.

Inclusion Criteria

Patients fulfilling all the following criteria were included:

1. Pregnant women aged 18–40 years.
2. ASA Physical Status II–III.
3. High-risk obstetric patients requiring cesarean delivery.
4. Singleton or multiple pregnancies.
5. Patients providing written informed consent.

High-Risk Obstetric Conditions Included

- Pregnancy-induced hypertension/preeclampsia
- Gestational diabetes mellitus
- Cardiac disease complicating pregnancy
- Obesity (BMI ≥30 kg/m²)
- Placenta previa
- Multiple gestation
- Previous cesarean section with associated obstetric risk factors
- Other medically complicated pregnancies deemed high-risk by the obstetrician

Exclusion Criteria

1. Patient refusal.
2. Coagulopathy or anticoagulant therapy.
3. Local infection at puncture site.
4. Severe hypovolemia.
5. Allergy to local anesthetic agents.
6. Neurological disorders affecting spinal cord function.
7. Severe fetal distress requiring immediate general anesthesia.
8. Failed regional anesthesia requiring conversion to general anesthesia.

Pre-Anesthetic Assessment

All patients underwent:

- Detailed history taking.
- General physical examination.
- Airway assessment.
- Cardiovascular evaluation.
- Obstetric examination.
- Laboratory investigations including:
  - Complete blood count
  - Blood grouping and typing
  - Coagulation profile
  - Blood glucose estimation
  - Renal function tests
  - Urine examination
- Electrocardiography when indicated.
- Echocardiography in patients with cardiac disease.

Study Groups

Group CSE

Patients received combined spinal-epidural anesthesia.

Technique

After identification of the epidural space using the loss-of-resistance technique at the L3–L4 interspace, a spinal needle was introduced through the epidural needle. Hyperbaric bupivacaine with fentanyl was administered intrathecally. An epidural catheter was then advanced and secured for supplementation and postoperative analgesia.

Group SA

Patients received standard single-shot spinal anesthesia.

Technique

Subarachnoid block was performed at the L3–L4 or L4–L5 interspace using hyperbaric bupivacaine with fentanyl through a spinal needle.

Intraoperative Monitoring

The following parameters were continuously monitored:

- Heart rate
- Systolic blood pressure
- Diastolic blood pressure
- Mean arterial pressure
- Oxygen saturation (SpO_2)
- Respiratory rate
- Electrocardiography

Measurements were recorded:

- Baseline
- Every 2 minutes for first 10 minutes
- Every 5 minutes thereafter until completion of surgery

Outcome Measures

Primary Outcome

- Incidence of maternal hypotension
- Hemodynamic stability during surgery

Secondary Outcomes

- Onset time of sensory blockade
- Maximum sensory block level
- Time to achieve complete motor blockade
- Duration of analgesia
- Vasopressor requirement
- Incidence of nausea and vomiting
- Bradycardia
- Shivering
- Intraoperative discomfort
- Requirement of anesthetic supplementation
- Maternal satisfaction score

Neonatal Outcomes

- Apgar score at 1 minute
- Apgar score at 5 minutes
- Need for neonatal resuscitation
- NICU admission

Definitions

Hypotension

Decrease in systolic blood pressure greater than 20% from baseline or systolic pressure below 90 mmHg.

Bradycardia

Heart rate less than 60 beats per minute.

Postoperative Assessment

Patients were observed for 24 hours postoperatively for:

- Pain scores (VAS)
- Duration of analgesia
- Need for rescue analgesics
- Post-dural puncture headache
- Neurological complications
- Maternal satisfaction

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS software version 26.0.

- Continuous variables were expressed as mean ± standard deviation.
- Categorical variables were expressed as frequencies and percentages.
- Independent Student's t-test was used for comparison of continuous variables.
- Chi-square test or Fisher's exact test was used for categorical variables.
- A p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 high-risk obstetric patients undergoing cesarean section were enrolled in the study and equally allocated into two groups: Combined Spinal-Epidural (CSE) anesthesia (Group CSE, n=30) and Spinal Anesthesia (Group SA, n=30). Both groups were comparable with respect to baseline demographic and obstetric characteristics.

Table 1: Baseline Demographic and Obstetric Characteristics

Parameter	Group CSE (n=30)	Group SA (n=30)	p value
Age (years)	28.8 ± 4.5	29.4 ± 4.8	0.624
Weight (kg)	71.3 ± 8.1	72.7 ± 7.9	0.492
BMI (kg/m²)	28.4 ± 3.2	28.9 ± 3.5	0.571
Gestational Age (weeks)	37.8 ± 1.6	37.5 ± 1.8	0.481
Primigravida	14 (46.7%)	13 (43.3%)	0.796
Multigravida	16 (53.3%)	17 (56.7%)	

The mean age of patients was 28.8 ± 4.5 years in Group CSE and 29.4 ± 4.8 years in Group SA. Similarly, body weight, BMI, gestational age, and gravidity status were statistically comparable between the groups (p>0.05). These findings indicate adequate baseline homogeneity, minimizing confounding influences on outcome assessment.

Table 2: Distribution of High-Risk Obstetric Conditions

High-Risk Condition	Group CSE (n=30)	Group SA (n=30)	p value
Preeclampsia/PIH	10 (33.3%)	11 (36.7%)	0.781
Gestational Diabetes	6 (20.0%)	5 (16.7%)	0.739
Cardiac Disease	4 (13.3%)	3 (10.0%)	0.688
Obesity	5 (16.7%)	6 (20.0%)	0.739
Placenta Previa	3 (10.0%)	3 (10.0%)	1.000
Multiple Gestation	2 (6.7%)	2 (6.7%)	1.000

Hypertensive disorders of pregnancy represented the most common high-risk condition in both groups, affecting 33.3% and 36.7% of patients respectively. The distribution of risk factors was statistically comparable between groups (p>0.05), ensuring similar clinical complexity.

Table 3: Intraoperative Hemodynamic Parameters and Complications

Parameter	Group CSE (n=30)	Group SA (n=30)	p value
Hypotension	5 (16.7%)	13 (43.3%)	0.025*
Bradycardia	2 (6.7%)	5 (16.7%)	0.228
Nausea/Vomiting	3 (10.0%)	9 (30.0%)	0.048*
Vasopressor Requirement	4 (13.3%)	12 (40.0%)	0.019*
Shivering	2 (6.7%)	6 (20.0%)	0.128

***Statistically significant**

Hypotension occurred significantly less frequently in Group CSE (16.7%) compared with Group SA (43.3%) (p=0.025). Vasopressor requirement was also significantly lower in Group CSE (13.3%) than Group SA (40.0%) (p=0.019). Similarly, nausea and vomiting were significantly reduced among patients receiving CSE anesthesia (10.0% versus 30.0%, p=0.048). These findings suggest superior hemodynamic stability with CSE anesthesia.

Table 4: Characteristics of Sensory and Motor Blockade

Parameter	Group CSE	Group SA	p value
Sensory Block Onset (min)	3.4 ± 0.8	3.1 ± 0.7	0.126
Peak Sensory Level (T4-T6)	28 (93.3%)	27 (90.0%)	0.640
Motor Block Onset (min)	4.2 ± 0.9	3.9 ± 0.8	0.179
Duration of Analgesia (min)	327.5 ± 42.8	183.4 ± 35.7	<0.001*
Rescue Analgesic Requirement within 6 hrs	4 (13.3%)	16 (53.3%)	0.001*

Both anesthetic techniques produced rapid sensory and motor blockade with no significant differences in onset characteristics. However, the duration of postoperative analgesia was significantly prolonged in the CSE group (327.5 ± 42.8 minutes) compared to the spinal anesthesia group (183.4 ± 35.7 minutes; p<0.001). Consequently, fewer patients in the CSE group required rescue analgesia during the early postoperative period.

Table 5: Maternal Satisfaction and Neonatal Outcomes

Parameter	Group CSE	Group SA	p value
Maternal Satisfaction Score (0–10)	8.9 ± 0.8	7.5 ± 1.1	<0.001*
Apgar Score at 1 min	8.2 ± 0.6	8.0 ± 0.7	0.214
Apgar Score at 5 min	9.4 ± 0.5	9.3 ± 0.6	0.497
NICU Admission	2 (6.7%)	3 (10.0%)	0.640

Maternal satisfaction was significantly higher among patients receiving CSE anesthesia (8.9 ± 0.8) compared with spinal anesthesia (7.5 ± 1.1; p<0.001). Neonatal outcomes, including Apgar scores and NICU admissions, were comparable between groups, indicating that both techniques provided satisfactory fetal safety.

DISCUSSION

The present prospective comparative study evaluated the efficacy and safety of combined spinal-epidural anesthesia compared with conventional spinal anesthesia in high-risk obstetric patients undergoing cesarean section. The findings demonstrated that CSE anesthesia was associated with superior hemodynamic stability, reduced incidence of hypotension, lower vasopressor requirement, prolonged postoperative analgesia, and improved maternal satisfaction while maintaining comparable neonatal outcomes.

The demographic characteristics of the study population were similar in both groups, indicating successful matching and reducing potential confounding factors. The majority of patients belonged to the age group of 25–35 years, which corresponds to the age range most frequently encountered among women presenting for cesarean delivery in tertiary obstetric centers. Similar baseline comparability has been reported in previous investigations evaluating regional anesthesia techniques in obstetric populations.[2]

A principal finding of the present study was the significantly lower incidence of maternal hypotension in the CSE group. Maternal hypotension occurred in 16.7% of patients receiving CSE anesthesia compared with 43.3% receiving spinal anesthesia. This observation is clinically important because maternal hypotension remains one of the most common complications of neuraxial anesthesia during cesarean delivery. Previous studies have demonstrated that rapid sympathetic blockade associated with conventional spinal anesthesia leads to abrupt decreases in systemic vascular resistance and venous return.[3] In contrast, the epidural component of CSE permits lower intrathecal doses and facilitates more gradual extension of anesthesia, thereby attenuating cardiovascular instability.[5]

The reduced vasopressor requirement observed in the CSE group further supports improved hemodynamic control. Similar findings have been reported in studies showing that CSE techniques decrease the frequency and severity of hypotensive episodes during cesarean section.[7] Improved cardiovascular stability is particularly valuable in high-risk obstetric patients with hypertensive disorders, cardiac disease, or compromised uteroplacental circulation.

Another important observation was the lower incidence of nausea and vomiting among patients receiving CSE anesthesia. Maternal nausea during cesarean section is frequently secondary to hypotension-induced cerebral and gastrointestinal hypoperfusion.[8] Consequently, the improved hemodynamic profile associated with CSE anesthesia likely contributed to the reduction in these distressing symptoms. Enhanced maternal comfort may also explain the significantly higher satisfaction scores observed in the CSE group.

The onset of sensory and motor blockade was rapid and comparable between groups. This finding confirms that the spinal component of CSE anesthesia preserves the rapid onset characteristic of conventional spinal anesthesia.[9] Therefore, the anesthesiologist can achieve prompt surgical anesthesia while retaining the flexibility of epidural supplementation if surgery becomes prolonged or technically challenging.

A major advantage of CSE anesthesia demonstrated in the present study was prolonged postoperative analgesia. The mean duration of analgesia exceeded five hours in the CSE group compared with approximately three hours in the spinal anesthesia

group. The epidural catheter allows administration of additional analgesics and facilitates multimodal postoperative pain management. Similar benefits have been reported in previous studies evaluating postoperative analgesia following cesarean delivery.[10,11] Effective postoperative pain relief enhances early ambulation, maternal-infant bonding, breastfeeding initiation, and overall recovery.

Maternal satisfaction scores were significantly higher among women receiving CSE anesthesia. Satisfaction in obstetric anesthesia is influenced by multiple factors, including comfort during surgery, adequacy of pain relief, hemodynamic stability, and postoperative recovery.[12] The combined benefits of reduced hypotension, fewer adverse effects, and prolonged analgesia likely contributed to the superior satisfaction observed with CSE anesthesia.

Neonatal outcomes remained comparable between groups. Apgar scores at one and five minutes were similar, and NICU admission rates showed no statistically significant differences. These findings indicate that both anesthetic techniques provide adequate fetal safety when appropriately administered. Similar neonatal outcomes have been documented in previous comparative studies of neuraxial anesthesia techniques for cesarean delivery.[13,14]

Overall, the present study supports the growing body of evidence favoring combined spinal-epidural anesthesia in high-risk obstetric patients. By combining the rapid onset and reliability of spinal anesthesia with the flexibility and prolonged analgesic benefits of epidural anesthesia, CSE provides a balanced approach that optimizes maternal and fetal outcomes. Its particular advantage in maintaining cardiovascular stability makes it an attractive option for patients with significant obstetric or medical comorbidities.

CONCLUSION

Combined spinal-epidural anesthesia demonstrated significant advantages over conventional spinal anesthesia in high-risk obstetric patients undergoing cesarean section. The technique was associated with improved hemodynamic stability, reduced incidence of hypotension, lower vasopressor requirements, prolonged postoperative analgesia, and higher maternal satisfaction. Neonatal outcomes remained comparable between the two groups. Based on these findings, combined spinal-epidural anesthesia may be considered a preferred regional anesthetic technique for carefully selected high-risk obstetric patients requiring cesarean delivery.

REFERENCES

1. Hawkins JL, Arens JF, Bucklin BA, Gambling DR, Hood DD, Datta S. Practice guidelines for obstetric anesthesia. Anesthesiology. 2016;124(2):270-300. doi:10.1097/ALN.0000000000000935..
2. Chestnut DH, Wong CA, Tsen LC, Ngan Kee WD, Beilin Y, Mhyre JM. Chestnut's Obstetric Anesthesia: Principles and Practice. 6th ed. Philadelphia: Elsevier; 2020.
3. Klöhr S, Roth R, Hofmann T, Rossaint R, Heesen M, Van de Velde M. Definitions of hypotension after spinal anesthesia for cesarean section. Br J Anaesth. 2010;105(3):271-275. doi:10.1093/bja/aeq168
4. Ngan Kee WD, Lee SWY, Ng FF, Khaw KS, Wong ELY, Gin T. Randomized double-blinded comparison of phenylephrine and ephedrine. Anesthesiology. 2008;108(2):172-178. doi:10.1097/01.anes.0000299436.84894.12
5. Van de Velde M, Berends N, Spitz B, Teunkens A, Vandermeersch E, Schepers R. Low-dose CSE anesthesia for cesarean section. Int J Obstet Anesth. 2004;13(2):99-103. doi:10.1016/j.ijoa.2003.11.004
6. Rawal N, Schollin J, Wesström G. Epidural versus combined spinal epidural block. Anesth Analg. 1988;67(4):389-393. doi:10.1213/00000539-198804000-00017
7. Carvalho B, Collins J, Drover DR, Atkinson R, Riley ET, Cohen SE. ED50 and ED95 of intrathecal bupivacaine. Anesthesiology. 2005;103(3):606-612. doi:10.1097/00000542-200509000-00024
8. Dyer RA, Reed AR, Van Dyk D, Arcache MJ, Hodges O, Lombard CJ. Hemodynamic effects of spinal anesthesia. Anesthesiology. 2009;111(4):753-765. doi:10.1097/ALN.0b013e3181b4376e
9. Norris MC, Grieco WM, Borkowski M, Leighton BL, Arkoosh VA, Huffnagle HJ. Complications of labor analgesia. Anesth Analg. 1994;79(3):529-537. doi:10.1213/00000539-199409000-00019
10. Simmons SW, Taghizadeh N, Dennis AT, Hughes D, Cyna AM, Andrew M. Combined spinal-epidural versus epidural analgesia in labour. Cochrane Database Syst Rev. 2019;10:CD003401. doi:10.1002/14651858.CD003401.pub4
11. Palmer CM, Emerson S, Volgoropolous D, Alves D, Riley ET, Bader AM. Dose-response relationship of intrathecal morphine. Anesthesiology. 1999;90(2):437-444. doi:10.1097/00000542-199902000-00017
12. Morgan PJ, Halpern SH, Tarshis J. Satisfaction and preferences among women receiving regional anesthesia. Can J Anaesth. 2000;47(10):956-961. doi:10.1007/BF03024864
13. Patel M, Fernando R, Girard T, Ducloy-Bouthors AS, Columb M, Sultan P. Impact of neuraxial anesthesia on neonatal outcomes. Int J Obstet Anesth. 2021;46:102989. doi:10.1016/j.ijoa.2021.102989
14. Sultan P, Halpern SH, Pushpanathan E, Patel S, Carvalho B, Riley ET. The effect of neuraxial anesthesia techniques on maternal and neonatal outcomes. Anesth Analg. 2016;123(6):1530-1545. doi:10.1213/ANE.0000000000001616.