Section: Anaesthesiology

Original Research Article

REGIONAL ANAESTHESIA AS A PREFERRED ANAESTHETIC TECHNIQUE IN CARDIAC DISEASE COMPLICATING PREGNANCY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Cardiac disease complicating pregnancy presents significant challenges for anaesthetic management, with maternal heart disease estimated to affect 1–6% of all pregnancies. Advances in cardiopulmonary care have enabled more women with cardiac anomalies to attempt pregnancy, but anaesthetic induction agents often depress myocardial function and reduce sympathetic tone, posing risks during delivery. Central neuraxial anaesthesia (CNA) induces sympathetic blockade, which can be advantageous but also carries the risk of hypotension. This study evaluates the safety and efficacy of regional anaesthesia, specifically neuraxial techniques, in pregnant women with mild cardiac disease undergoing lower segment caesarean section (LSCS) at a tertiary care hospital.

Materials and Methods: A prospective observational study was conducted at the Obstetrics Operation Theater, Department of Anaesthesiology, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India, over six months (September 2025 to February 2026). Thirty pregnant women with mild cardiac lesions (mitral stenosis, mitral regurgitation, mild aortic stenosis/regurgitation, atrial/ventricular septal defects corrected in childhood) and no hospital admissions for cardiac symptoms during pregnancy were included. Patients received either spinal or epidural anaesthesia. Hemodynamic parameters, block characteristics, and maternal and fetal outcomes were recorded. Statistical analysis was performed using Student's t-test and chi-square test, with $p < 0.05$ considered significant.

Results: Neuraxial anaesthesia was safely administered in all 30 patients, with 60% receiving epidural and 40% spinal anaesthesia. Hemodynamic parameters (heart rate, systolic and diastolic blood pressure, SpO_2) remained stable intraoperatively and postoperatively. No significant maternal or fetal complications were observed. Comparative analysis between groups showed no statistically significant differences in hemodynamic stability or block characteristics. The duration of sensory and motor blockade was longer with bupivacaine compared to lignocaine ($p = 0.01$), but both agents provided effective anaesthesia.

Conclusion: Regional anaesthesia, particularly neuraxial techniques, can be safely and effectively used in pregnant women with mild cardiac disease undergoing LSCS. The evidence suggests no significant difference in long-term outcomes between general and regional anaesthesia in this population, but regional techniques offer advantages in hemodynamic stability and reduced perioperative morbidity.

Keywords: Pregnancy heart disease; regional anaesthesia; neuraxial anaesthesia; caesarean section; cardiac disease in pregnancy; hemodynamic stability.

INTRODUCTION

Cardiac disease remains a leading cause of maternal morbidity and mortality worldwide, particularly as advances in cardiopulmonary care have enabled more women with congenital or acquired heart disease to attempt pregnancy. In India, the prevalence of maternal heart disease is estimated at 1–6% of all

pregnancies, with rheumatic heart disease and congenital malformations being the most common etiologies. The physiological changes of pregnancy—including increased blood volume, cardiac output, and reduced systemic vascular resistance—can unmask or exacerbate underlying cardiac pathology, complicating both pregnancy and delivery.[1,2,6]

Anaesthetic management in this population is complex. Many induction agents depress myocardial contractility and reduce sympathetic tone, increasing the risk of hemodynamic instability. Central neuraxial anaesthesia (CNA), encompassing spinal, epidural, and combined spinal-epidural (CSE) techniques, induces sympathetic blockade up to the T4 level, resulting in venovasodilation and potential hypotension. However, CNA also offers the advantage of avoiding the myocardial depressant effects and airway risks associated with general anaesthesia (GA).[1,3,7]

Risk stratification is essential in planning anaesthetic care for pregnant women with cardiac disease. Tools such as the CARPREG I and II scores and the modified World Health Organization (mWHO) classification help identify patients at increased risk for adverse cardiac events during pregnancy and delivery. Invasive monitoring is generally reserved for those with severe disease or high-risk lesions, such as pulmonary hypertension or significant shunts.[4,6]

The choice of anaesthetic technique must be individualized, considering the type and severity of cardiac lesion, the patient's functional status, and the anticipated hemodynamic response to anaesthesia and surgery. While no single technique is universally indicated or contraindicated for all cardiac lesions, regional anaesthesia—when carefully titrated—can minimize the adverse effects of increased cardiac output due to pain or anxiety during labour and delivery.[1,2,3]

This study was conducted to evaluate the safety and efficacy of regional anaesthesia, specifically neuraxial techniques, in pregnant women with mild cardiac disease undergoing LSCS at a tertiary care hospital in India. The primary objective was to assess intraoperative hemodynamic stability and maternal and fetal outcomes associated with regional anaesthesia in this high-risk population.[2,3,5]

MATERIALS AND METHODS

Study Design and Setting

A prospective observational study was conducted at the Obstetrics Operation Theater, Department of Anaesthesiology, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India, over a six-month period from September 2025 to February 2026.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics and Scientific Committee of Andhra Medical College. All participants provided written informed consent prior to inclusion in the study. The study was conducted in accordance with the Declaration of Helsinki and relevant national guidelines.

Patient Selection

Inclusion Criteria

- Pregnant women aged 20–40 years with mild cardiac lesions (mitral stenosis [MS], mitral regurgitation [MR], mild aortic stenosis [AS], mild aortic regurgitation [AR], atrial septal defect [ASD], ventricular septal defect [VSD] corrected in childhood).
- No hospital admissions for cardiac symptoms during pregnancy.
- ASA physical status II.
- Scheduled for lower segment caesarean section (LSCS).

Exclusion Criteria

- Refusal of regional anaesthesia.
- Infection at the injection site.
- Known drug sensitivity to local anaesthetics.
- Hospital admissions during pregnancy for cardiac symptoms.
- Severe cardiac lesions (e.g., pulmonary hypertension, right-to-left shunts, coarctation of the aorta).

Preoperative Assessment

All patients underwent detailed preoperative evaluation, including:

- Clinical history and physical examination.
- 2D echocardiography to assess cardiac function and lesion severity.
- Electrocardiogram (ECG).
- Routine laboratory investigations.

Risk stratification was performed using the CARPREG I and II scores and the mWHO classification (see Table 1).

Anaesthetic Technique

Patients received oral midazolam (0.25–0.5 mg) for anxiolysis the night before surgery. On arrival in the operating theatre, standard monitoring was initiated (ECG, non-invasive blood pressure, pulse oximetry). A suitable peripheral vein was cannulated, and intravenous Ringer's lactate was infused at 10 ml/kg over 20 minutes prior to regional anaesthesia.

Regional Anaesthesia

- Patients were positioned in the left lateral position for lumbar puncture.
- Spinal anaesthesia (SA) was performed at the L3–L4 or L4–L5 interspace using a 25G Quincke needle, with the distal port facing laterally. Local anaesthetic was injected over 10–15 seconds.
- Epidural anaesthesia was performed using an 18G Tuohy needle, with catheter placement confirmed by loss of resistance to air.
- Patients were placed supine immediately after injection.

The choice between spinal and epidural anaesthesia was based on patient characteristics and anaesthesiologist discretion.

Intraoperative Monitoring and Management

- Sensory block was assessed by pinprick using a 27G short bevel dental needle.
- Motor block was graded using the modified Bromage scale (0 = full movement; 1 = inability to raise extended leg, can bend knee; 2 = inability to bend knee, can flex ankle; 3 = no movement).
- Hemodynamic parameters (arterial pressure, heart rate, SpO_2) were recorded at baseline and at 2, 5, 10, 15, 20, 25, and 30 minutes, then every 30 minutes until block regression.
- Hypotension (defined as a >30% decrease in systolic pressure from baseline) was treated with IV bolus of 5 ml/kg Ringer's lactate and, if needed, mephentermine (6 mg/ml) or phenylephrine, depending on clinical condition.
    - Fluids were administered to replace intraoperative losses.

Data Collection

Data collected included:

- Demographic characteristics (age, weight, height, gravida status).
- Type and severity of cardiac lesion.
- Type of anaesthesia administered.
- Hemodynamic parameters (heart rate, systolic and diastolic blood pressure, SpO_2).
- Block characteristics (onset, duration, recovery time of sensory and motor block).
- Incidence of adverse events (hypotension, bradycardia, backache, post-dural puncture headache).
- Maternal and fetal outcomes.

Statistical Analysis

A convenient sample size of 30 was chosen. Data were analyzed using Student's t-test for continuous variables and chi-square test for categorical variables. Numerical variables were presented as mean ± standard deviation (SD); categorical variables as frequency and percentage. A p-value < 0.05 was considered statistically significant. Statistical analysis was performed using SPSS software.

RESULTS

Patient Characteristics

A total of 30 pregnant women with mild cardiac disease were included. The mean age was 28.6 ± 4.2 years. The majority were multigravida (60%), with the remainder primiparous (40%).

Table 1: Gravida Status

Gravida	Frequency	Percentage
Primiparous	12	40%
Multigravida	18	60%
Total	30	100%

Cardiac Lesion Distribution

The most common cardiac lesions were mild MR (10%), mild MR/mild AS (10%), post VSD closure (13%), and post ASD closure (10%). Other lesions included mild TR/PAH, mild LV dysfunction, and Eisenmenger syndrome. [Table 2]

Table 2: Type of Heart Disease

Type of Heart Disease	Frequency	Percentage
Mild MR	3	10%
Mild MR/mild AS	3	10%
Post VSD closure	4	13%
Post ASD closure	3	10%
Mild TR/PAH	2	7%
Mild LV dysfunction	2	7%
Eisenmenger syndrome	1	3%
Others	12	40%
Total	30	100%

Anaesthetic Technique

Epidural anaesthesia was administered to 18 patients (60%), while 12 patients (40%) received spinal anaesthesia.

Table 3: Type of Anaesthesia

Type of Anaesthesia	Frequency	Percentage
Epidural	18	60%
Spinal	12	40%
Total	30	100%

Hemodynamic Parameters

Hemodynamic parameters remained stable throughout the perioperative period. Mean heart rate ranged from 79.3 to 82.55 bpm; mean systolic blood pressure from 120.0 to 124.9 mmHg; mean diastolic blood pressure from 74.1 to 79.0 mmHg; mean SpO_2 from 98.8% to 99.3%.

Table 4: Hemodynamic Parameters (Selected Time Points)

Time Point	HR (bpm)	SBP (mmHg)	DBP (mmHg)	SpO_2 (%)
Baseline	80.10	124.25	79.00	98.80
5 min	80.50	120.50	78.85	99.25
15 min	82.55	124.90	76.30	99.30
30 min	80.55	123.70	74.10	99.00
60 min	80.80	122.40	77.30	98.90

Block Characteristics

The duration of sensory and motor blockade was significantly longer with bupivacaine compared to lignocaine ($p = 0.01$).

Table 5: Duration of Sensory and Motor Blockade

Group	Sensory Block (min, mean ± SD)	Motor Block (min, mean ± SD)
Lignocaine (L)	36.36 ± 2.62	26.28 ± 3.06
Bupivacaine (B)	46.76 ± 5.91	37.10 ± 4.63
p-value	**0.01**	**0.01**

Maternal and Fetal Outcomes

No significant maternal or fetal complications were observed. There were no cases of hypotension requiring vasopressor support beyond protocol, no bradycardia, no post-dural puncture headache, and no adverse neonatal outcomes.

Comparative Analysis

Comparative analysis between groups (lignocaine vs. bupivacaine) showed no statistically significant differences in hemodynamic stability or block characteristics, except for the longer duration of sensory and motor blockade with bupivacaine.

Table 6: Comparison of Hemodynamic Changes Between Groups

Variable	Group L (Mean ± SD)	Group B (Mean ± SD)	p-value
Pulse rate	78.12 ± 9.18	85.38 ± 8.89	0.30
Systolic BP	112.78 ± 26.77	115.44 ± 8.54	0.50
Diastolic BP	74.0 ± 8.14	74.74 ± 5.62	0.59
SpO_2	99.54 ± 0.50	99.76 ± 0.43	0.21

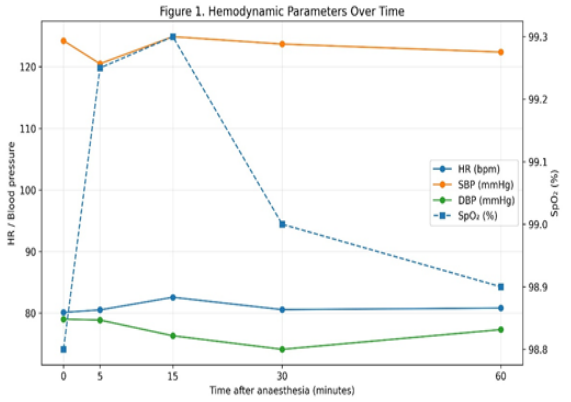

Figure 1: Hemodynamic Parameters Over Time

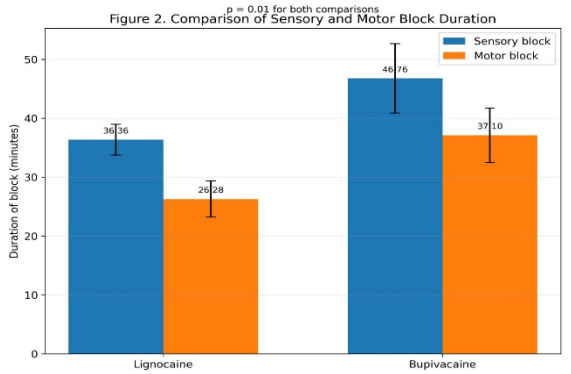

Figure 2: Comparison of Sensory and Motor Block Duration

Bar graph comparing mean duration of sensory and motor block between lignocaine and bupivacaine groups.

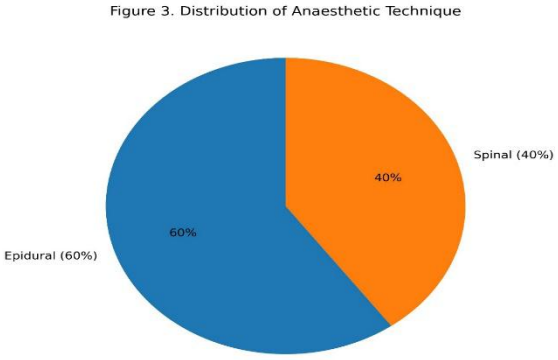

Figure 3: Distribution of Anaesthetic Technique

Pie chart showing proportion of patients receiving epidural (60%) versus spinal (40%) anaesthesia.

DISCUSSION

Epidemiology and Risk Stratification

Cardiac disease complicating pregnancy is a significant contributor to maternal morbidity and mortality, particularly in low- and middle-income countries where rheumatic heart disease remains prevalent. The physiological adaptations of pregnancy—including increased blood volume, cardiac output, and reduced systemic vascular resistance—can unmask or worsen underlying

cardiac pathology, especially in women with limited cardiac reserve.[1,2,6]

Risk stratification is essential for guiding management. The CARPREG I and II scores and the mWHO classification are validated tools for predicting maternal cardiac risk during pregnancy and delivery. In this study, only women with mild lesions and low risk scores were included, reflecting a population likely to tolerate the hemodynamic changes of pregnancy and regional anaesthesia.[4,6]

Anaesthetic Considerations

The choice of anaesthetic technique in pregnant women with cardiac disease must be individualized, considering the type and severity of lesion, functional status, and anticipated hemodynamic response. General anaesthesia carries risks of myocardial depression, arrhythmia, and airway complications, while regional anaesthesia—when carefully titrated—can provide effective analgesia and minimize sympathetic stimulation from pain or anxiety.[1,2,7]

Neuraxial Techniques:

- **Spinal Anaesthesia:** Offers rapid onset but may cause sudden hypotension, particularly in preload-dependent lesions (e.g., severe aortic or mitral stenosis). In this study, spinal anaesthesia was safely administered to selected patients with mild lesions.
- **Epidural Anaesthesia:** Allows for gradual, titratable onset, providing greater hemodynamic stability. Epidural anaesthesia was the preferred technique in 60% of cases.
- **Combined Spinal-Epidural (CSE):** Combines the rapid onset of spinal with the flexibility of epidural, allowing for individualized dosing and extension of block as needed.

Recent guidelines and expert consensus recommend neuraxial techniques as the preferred approach for most parturients with cardiac disease, except in cases of severe fixed cardiac output lesions or contraindications to regional anaesthesia.[1,3,6]

Hemodynamic Management

Maintaining hemodynamic stability is paramount. In this study, careful preloading with crystalloids, slow titration of local anaesthetics, and vigilant monitoring allowed for stable heart rate, blood pressure, and oxygen saturation throughout the perioperative period. Hypotension was rare and managed effectively with fluids and, when necessary, vasopressors (mephentermine or phenylephrine).[1,2,8]

Vasopressor Choice:

- **Phenylephrine** is preferred for treating hypotension during neuraxial anaesthesia, as it increases systemic vascular resistance without causing tachycardia, which is beneficial in patients with stenotic lesions.
- **Mephentermine** and other indirect sympathomimetics may be used, but caution is advised due to potential tachycardia and increased myocardial oxygen demand.

Maternal and Fetal Outcomes

No significant maternal or fetal complications were observed in this study. This aligns with published literature indicating that, in well-selected patients with mild cardiac disease, regional anaesthesia is associated with favorable outcomes. The duration of sensory and motor blockade was longer with bupivacaine, but both agents provided effective anaesthesia without adverse effects.[2,3,5]

Comparative Literature:

Meta-analyses and large cohort studies have demonstrated that regional anaesthesia is associated with lower rates of maternal morbidity, improved neonatal Apgar scores, and reduced need for respiratory support compared to general anaesthesia in caesarean delivery.[5,9]

Specific Cardiac Lesions

Mitral Stenosis: The most common valvular lesion in pregnancy, often of rheumatic origin. Anaesthetic goals include maintaining low-normal heart rate, avoiding tachycardia, and preventing sudden drops in systemic vascular resistance. Epidural or sequential CSE techniques are preferred.

Mitral Regurgitation and Aortic Regurgitation: Generally well tolerated in pregnancy. Regional anaesthesia is preferred, as the decrease in systemic vascular resistance reduces regurgitant flow.

Aortic Stenosis: Fixed cardiac output lesions require careful titration of anaesthesia. Epidural is preferred over spinal; general anaesthesia may be necessary in severe cases.

ASD/VSD (Corrected): Pregnancy is well tolerated in the absence of pulmonary hypertension. Both regional and general anaesthesia are appropriate.

Eisenmenger Syndrome: High maternal mortality; regional anaesthesia requires extreme caution and invasive monitoring.

Postpartum Care

The immediate postpartum period is critical, especially in women with limited cardiac reserve or pulmonary hypertension. Hemodynamic shifts and autotransfusion from the contracting uterus can precipitate decompensation. Invasive monitoring and critical care support may be necessary in high-risk patients.[1,6]

Limitations

The main limitation of this study is the small sample size (n=30), which limits the power to detect rare adverse events. The study population was restricted to women with mild cardiac lesions and no recent hospital admissions for cardiac symptoms, limiting generalizability to higher-risk populations. The observational design precludes direct comparison with general anaesthesia or more severe cardiac disease.[10,11,12]

CONCLUSION

This prospective observational study demonstrates that regional anaesthesia, particularly neuraxial techniques, can be safely and effectively used in pregnant women with mild cardiac disease

undergoing lower segment caesarean section. Hemodynamic parameters remained stable, and no significant maternal or fetal complications were observed. The findings support current guidelines recommending regional anaesthesia as the preferred technique in this population, provided that careful patient selection, risk stratification, and vigilant intraoperative monitoring are employed.

Further research with larger, multicenter cohorts and inclusion of higher-risk patients is warranted to confirm these findings and refine anaesthetic management strategies for cardiac disease complicating pregnancy.

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