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Case Report

Epidural anaesthesia for cesarean section in a patient with repaired ventricular septal defect and severe pulmonary hypertension: A case report

Anupama Kumari[1]*, **Richa Mukeshbhai Tailor**[1], **Sara Mary Thomas**[1]

[1]*Dept. of Anaesthesiology, Smt. Bhikhiben Kanjibhai Shah Medical Institute and Research Centre, Sumandeep Vidyapeeth (Deemed to be University), Vadodara, Gujarat, India*

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ABSTRACT

The management of pregnant women with congenital heart diseases is a complex and challenging task, particularly as these conditions are becoming more common with advancements in medical and surgical treatments. Pulmonary hypertension in pregnancy, classified as class IV by the World Health Organization (WHO), presents a significant hemodynamic burden due to circulatory changes during pregnancy. This condition is associated with a high risk of maternal morbidity and mortality, making careful management essential for optimal outcomes.

A pregnant patient with a repaired large ventricular septal defect (VSD) measuring 14 mm, complicated by severe pulmonary hypertension (75 mm Hg), was planned for a cesarean section. The procedure was performed under epidural anesthesia using a combination of 0.75% Ropivacaine and 2% Lignocaine, with the drug doses titrated to effect.

A well-planned and executed epidural anesthesia, with appropriate selection of epidural drugs and doses, can serve as an effective anesthetic modality for cesarean delivery in patients with cardiac conditions, offering safety and optimal outcomes in complex clinical scenarios.

1. Introduction

Ventricular septal defects are the most common type congenital heart disease (CHD) and is a part of 50% of all CHDs while seen as an isolated defect in 20% of cases.[1]

Advances in early diagnosis and surgical correction have increased the number of patients reaching adulthood. Pregnancy induces significant physiological changes, including alterations in plasma volume, cardiac output, and systemic vascular resistance, which can place added strain on the right ventricle, potentially leading to right-heart failure and cardiovascular collapse. While small or repaired VSDs are generally well tolerated during pregnancy, larger unrepaired VSDs or those with complications such as arrhythmias, heart failure, or pulmonary hypertension pose a higher risk to both maternal and fetal health.

Pregnancy is considered extremely high-risk in patients with Eisenmenger syndrome, and such cases often carry increased maternal and fetal morbidity and mortality.[2] When these patients present for elective or emergency surgeries, a multidisciplinary approach to patient management is essential. This case report highlights specific anesthetic considerations for a primigravida with a corrected large VSD and severe pulmonary hypertension, presenting for a cesarean delivery under epidural anesthesia due to impending fetal distress.

Pregnancy is usually not advised in patients with Eisenmenger syndrome and is considered extremely high-risk pregnancy.[2]

* *Corresponding author*.
E-mail address: aanupama.kumary@gmail.com (A. Kumari).

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When such patients present for elective or emergency surgeries, a multidisciplinary coordinated patient management is very important.

This case report, we discuss specific anesthetic considerations, based on the pathophysiology of a corrected large VSD with severe pulmonary hypertension in a primigravida with impending foetal distress undergoing caesarean delivery under epidural anaesthesia.

2. Case Report

We report a case of a 30 years old primigravida patient with 34 weeks of gestation who was diagnosed to have absent end diastolic flow with two loops of umbilical cord around neck on routine antenatal ultra-sound examination and thus was planned for elective caesarean section. Previous medical records revealed that at the age of 5 years, patient was diagnosed with acyanotic ventricular septal defect with severe pulmonary hypertension for which she got operated (VSD patch repair). Her pre-operative 2 D echocardiogram of that time showed presence of large intact VSD of 14 mm in size with extension to peri membranous septum with bidirectional shunt. There was moderate tricuspid regurgitation and right ventricular systolic pressure (RVSP) was 90 mm Hg. Since then, she was on regular treatment in the form of Tab. Torsemide 5 mg OD, Tab. Digoxin 0.25 mg BD, Tab. Sildenafil 10 mg TDS and Tab. Spironolactone 25mg OD. There was history of breathlessness on exertion otherwise patient was well adjusted to normal life. She also had hypothyroidism and was on regular medication Tab. Thyroxin 50 mcg OD. She suffered primary infertility and conceived via intrauterine insemination (IUI) after three failed IUI. Thus, this was a case of high-risk precious pregnancy.

She had history of dry cough for four days. She also gave history of COVID 19 infection 3 years back with CT severity score of 12/25 for which she was on Bipap support in ICU for 7 days.

2.1. Pre-operative assessment

On general examination, she was averagely built female of 50 kg weight with heart rate of 126 beats/min, blood pressure of 100/60 mm Hg and SpO_2 of 96%. There was no pallor but pedal oedema was present till ankle joints. Airway, back and spine examination was normal. On cardiovascular examination, rhythmic cardiac sound with an accentuated pulmonary component of the second heart sound were found on auscultation. ECG showed supraventricular tachycardia, right axis deviation, right bundle branch block and right ventricular hypertrophy (Figure 1). Two dimensional cardiography showed no residual flow across VSD patch, dilated RA, RV, RVOT, moderate PR, TR and severe pulmonary hypertension (RVSP – 75 mm Hg) and ejection fraction of 55%. Blood investigations revealed haemoglobin 10.3gm%, white blood count 7100/ μL, platelets 1.63 lakh/μL, serum electrolytes, renal and liver functions were within normal limits she had hoarseness of voice for which full HD fibre-optic laryngoscopy revealed left sided vocal cord palsy.

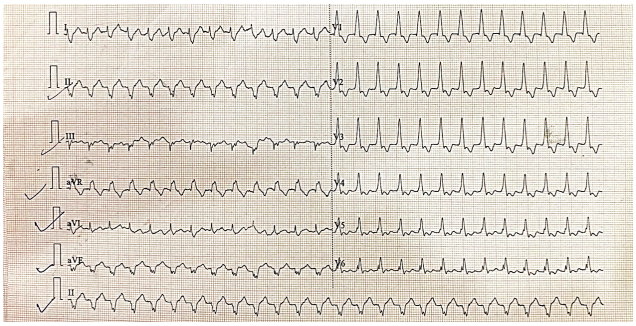

Figure 1: Pre-operative electrocardiogram of the patient

Elective cesarean section of the patient was decided to be taken after 6 hours of fasting in view of impending foetal distress and cardiac disease of mother for proper timely management. Maternal and foetal monitoring was done during this fasting period with preparation to take up the case in emergency also. A high risk informed and written consent was taken from patient and her relatives. Options of anaesthesia techniques were explained to the patient and advantages of regional (epidural) anaesthesia technique and the reason for its selection were explained to the patient and her co-operation was requested. Adequate blood products were made available before the surgery.

2.2. Intra-operative management

In the operation theatre, two intravenous access were secured with 18 gauze cannulas and routine monitors (ECG, pulse oximeter and NIBP) were attached. An arterial line was secured in left radial artery. Premedication was given with Inj. Ranitidine 50 mg of and Inj. Ondansetron 4 mg and preloading with 400 ml Ringer's lactate (RL) solution over 20 min was done.

With aseptic and antiseptic precautions, epidural catheter was placed in L2-L3 intervertebral space using 18 gauze epidural tuohy needle by loss of resistance to air method in sitting position. Epidural space was achieved at 3.5 cm from skin so catheter was fixed at 8.5 cm mark. Epidural test dose was given with 3 ml of 2% lignocaine with adrenaline and heart rate and blood pressure were monitored to rule out intravascular or intrathecal placement of catheter. Once intrathecal and intravascular placement was ruled out, graded epidural was started with Inj. Ropivacaine 0.75% 2.5 ml + Inj. Lignocaine 2% 2.5 ml (total 5 ml) followed by 3 titrated top -up doses of 3ml (1: 1) (Inj. Ropivacaine 0.75% 1.5 ml + Inj. Lignocaine 2% 1.5 ml). Total drug volume was 14 ml. Sensory level of T 4 was achieved after 25 minutes

and then surgery was allowed to be commenced. During this period foetal heart beat assessment was done using foetal doppler machine.

Oxygenation was done with 5 litres/ minute oxygen given via oxygen face mask. Regular beat to beat invasive blood pressure and ECG monitoring was done. Although there was no episode of severe hypotension but prophylactic infusion of Inj. Noradrenaline was started at 8 μg/minute to keep MAP 55-60 mm Hg. Heart rate remained stable between 90- 110 beats per minute without any arrythmias. A healthy, 2.6 kg, male baby was delivered who cried well after birth. His APGAR score was 9/10 and was handed over to paediatrician. 20 units oxytocin was given slowly while carefully monitoring blood pressure and heart rate.

Although the patient did not complain of pain but was anxious so 1 mg of Inj. Midazolam was given to make her relaxed. Total intra-operative input was 1250 ml of crystalloids in form of 1000 ml ringer lactate and 250 ml dextrose normal saline with 450 ml urine output. An arterial blood gas analysis showed pH 7.427, $PaCO_2$ 33 mm Hg, PaO_2 87 mm Hg, SO_2 96%, Lactate 1.8mmol/L, HCO_3 18.7mmol/L, and K+ 4.0mmol/L. Total duration of surgery was 1 hour. At end of surgery, sensory level was T6 with bromage 3 motor block. Noradrenaline infusion was tapered and then stopped and blood pressure was monitored for any incidences of hypotension. Patient was shifted to cardiac ICU for observation and arterial line was removed carefully after few hours.

2.3. Post-operative management

Analgesia was covered with epidural top- ups of 8 ml of 0.2% Inj. Ropivacaine 8 hourly. As per, cardiologist opinion, her cardiac medications were started once oral intake was started. With aseptic and antiseptic precautions, intact epidural catheter was removed after 48 hours and analgesia was covered with oral pain-killers. As the patient was hemodynamically stable, she was shifted to ward on third post-partum day and was subsequently discharged after 7 days.

Table 1 summarizes the monitoring of vital signs at critical points during the cesarean section, including baseline measurements, intraoperative changes, and recovery phase data. Continuous and careful monitoring was essential to ensure maternal and fetal stability throughout the procedure.

3. Discussion

Ventricular septal defects are the most common type of congenital heart diseases (CHD) and are part of 50% of all CHDs while seen as an isolated defect in 20% of cases.[1] Improved imaging, diagnostic methods and advancement in medical and surgical treatment modalities have led to great improvement in the survival and quality of life of these patients. Notably, many females with corrected or uncorrected VSD reach their reproductive age, creating new challenges for cardiologists, obstetricians and anaesthesiologists.

Ventricular septal defects have been associated with the highest risk of maternal death and complications[3] and thus need preconception counselling and skilful management throughout the pregnancy.[2]

Small muscular VSD closes spontaneously but other larger ones require surgical repair. Blood flow across a VSD is bidirectional, mainly from left to right during isovolumetric systole, and minor flow from right to left during isovolumetric diastole. This generates great pressures in the pulmonary artery leading to pulmonary hypertension.

Pulmonary hypertension is defined as mean pulmonary arterial pressure >20 mm Hg according to the 2022 European society of cardiology and the European respiratory society pulmonary hypertension guidelines.[1] This may result in heart failure, arrythmias and even death. It is associated with a 30–56% risk of maternal mortality. As per modified WHO classification of maternal cardiac risk disease, pulmonary hypertension is categorized under class IV in which pregnancy is extremely high risk and should be avoided.[4]

On literature search, various authors have reported different anesthetic management strategies for parturients with VSD and severe pulmonary hypertension undergoing cesarean section. The approaches vary depending on the severity of the condition, the presence of other complications, and the anesthetic techniques used. Table 2 summarizes case reports with different anesthetic management protocols for VSD with pulmonary hypertension in the context of cesarean delivery.[5–11]

None of the existing reports have documented the anesthetic management of a corrected VSD that subsequently developed severe pulmonary hypertension in adulthood. Our patient underwent VSD correction at the age of 5 years and was on regular treatment, but later developed severe pulmonary hypertension (RVSP - 75 mm Hg) in adulthood.

Physiologically, pregnancy itself induces an increase in blood volume and cardiac output to support the growing fetus. However, in parturients with VSD and pulmonary hypertension, this increased workload imposes additional strain on the heart, leading to symptoms such as fatigue, shortness of breath, and palpitations. Moreover, these patients are at an elevated risk of developing pre-eclampsia and are more likely to experience premature labor.[2]

Such patients when present for elective or emergency surgeries, a well-planned and individualised anaesthetic management according to the patient's cardiovascular status and anaesthesiologist's knowledge and experience of the existing anaesthesia options are the key to successful

Table 1: Vital sign monitoring data during key moments

	Before surgery (in pre-op area)	Before Epidural anaesthesia	After Epidural test dose	After achieving T4 sensory level	After baby delivery	End of surgery	Transfer to cardiac ICU	Cardiac ICU 24 hrs
SpO2	94%	96%	98%	98%	98%	99%	98%	98%
HR (beats/min)	114	94	98	92	101	95	96	90
IBP (mm Hg)	106/70	111/74	105/72	98/74	90/60	116/78	124/76	122/72
Note		Preloading was started and oxygenation with face mask @ 5L/min		Inj. Noradrenaline was started at 8 μg/min	20 units Inj. oxytocin infusion started; Inj. Noradranaline infusion rate increased.	Inj. Noradranaline infusion stopped		

outcome.

Both general and regional anaesthesia can be considered for cesarean section in these patients provided appropriate balance between systemic vascular resistance and pulmonary vascular resistance is maintained. It is recommended that increase in PVR should be avoided and preload and cardiac output should be maintained.[12] Intravenous fluids along with vasopressors should be judiciously used. We prepared vasopressors like phenylephrine and norepinephrine to manage systemic hypotension; and nitroglycerin for pulmonary vasodilation. Phenylephrine and norepinephrine both can be used to maintain BP during hypotension in cesarean section, with the advantage of less depression of maternal HR and cardiac output.[13] Nitroglycerin has the ability to dilate the pulmonary artery and is a common drug for the therapy of pulmonary arterial hypertension.[13] Continuous intra-operative invasive blood pressure monitoring helped in timely modification of rate of vasopressor and intravenous fluids infusion. A bolus or a rapid infusion of oxytocin administration may cause hypotension and tachycardia, therefore, we gave a slow and titrated oxytocin infusion after baby delivery. Fortunately, with the best efforts, complications like acute right heart failure, arrhythmias, systemic hypotension could be prevented.

General anaesthesia has been used as anaesthesia modality of choice since many years as it can provide controlled hemodynamics. But it is associated with certain disadvantages such as sudden fall in SVR during administration of inducing agent, difficult airway, pressure response during laryngoscopy and tracheal intubation leading to dysrhythmias, heart failure and increase in pulmonary arterial pressure with nitrous oxide and positive-pressure ventilation.[4] Risk of aspiration in full stomach parturients, intra-operative bleeding, lower neonatal APGAR scores at 1-minute, perioperative nausea and vomiting and post-operative pain are other concerns.

Despite these disadvantages, general anaesthesia may be administered using meticulous drug selection. Some authors have reported successful management of cardiac patients for caesarean section in general anaesthesia.[6,7,14–16]

We chose regional anesthesia over general anesthesia for our patient, given her severe pulmonary hypertension, unilateral vocal cord palsy, and history of dry cough, which could have been worsened by general anesthesia and endotracheal intubation. Although epidural anesthesia (Plan A) was selected, general anesthesia (Plan B) was prepared as a backup, with all necessary drugs and equipment readily available.

Spinal anesthesia was avoided due to the risk of a sudden fall in systemic vascular resistance, which could reverse the shunt. Epidural anesthesia, however, provides gradual sympathetic blockade, reducing hypotension and uteroplacental perfusion compromise. It also offers segmental motor blockade, preserving venous return.

We used a combination of 0.75% Ropivacaine and 2% Lignocaine for epidural anesthesia, titrated to achieve sensory blockade up to the T4 level. Compared to Bupivacaine, Ropivacaine offers superior sensory blockade with a better cardiovascular profile, fewer conduction disturbances, bradycardia, hypotension, and ventricular fibrillation. Lignocaine provides a faster onset. The combination resulted in smooth anesthesia with minimal hypotension.

Various authors have reported successful anesthetic management of cesarean delivery in patients with other cardiac diseases, such as hypertrophic cardiomyopathy, severe mitral stenosis, and peripartum cardiomyopathy, using epidural anesthesia.[16–20] Additionally, other regional anesthesia techniques like continuous spinal and segmental spinal have been explored in cardiac cases.[16]

Y, Smitha et al. reported a case series in which epidural anaesthesia was used in different manner for achieving anaesthetic goals. They used epidural volume extension

Table 2: Case reports by different authors for anesthetic management of VSD with pulmonary hypertension in the context of cesarean delivery

Author	Year	Anomaly	Age (years)	Gestational age	Symptoms	Anaesthetic management
Wang P, et al[5]	2021	Pulmonary Hypertension 75 mm Hg, dilated left ventricle (67 mm), ventricular septal defect (1.7 mm) with a bidirectional shunt.	35	16 weeks	Fatigue and shortness of breath	Continuous epidural anaesthesia with double catheters
Kundalwal, K.A. et al[6]	2018	Large ventricular septal defect of 15 mm with severe pulmonary hypertension of 105 mm Hg and Eeisenmengerisation	22	36 weeks 5 days	Breathlessness at rest	General anaesthesia
Bhatia R, et al[7]	2016	Pulmonary hypertension 144 mm Hg, large Ventricular Septal Defect (VSD) (2.5 cm^2) bidirectional shunt mainly left to right with severe pulmonary stenosis	19	37 weeks	Breathlessness on exertion	General Anaesthesia
Mishra, Gayatri et al[8]	2015	Double-outlet right ventricle (DORV) with large sub-pulmonic ventricular septal defect (VSD), right ventricular hypertrophy, bidirectional shunt and severe pulmonary artery hypertension.	23	37 weeks	Grade III dyspnea	Graded segmental epidural anaesthesia with 2% lignocaine (16 ml)
Mishra L, et al[9]	2014	Large perimembranous VSD of 17 mm size, bidirectional shunt, severe pulmonary artery hypertension, severe tricuspid regurgitation, dilated right atrium, normal biventricular function with ejection fraction of 52%	27	34 weeks	Dyspnea grade I in first trimester, increased to grade III in third trimester.	Epidural Anaesthesia 7 ml lignocaine with adrenaline + 8 ml of bupivacaine with 25 μg of fentanyl
Minicucci, Silvia et al[10]	2012	Complete atrio-ventricular septal defect, Pulmonary artery systolic pressure of 80 mm Hg	29	31 weeks	Hemoptysis followed by sudden respiratory arrest which resolved spontaneously	Spinal Anaesthesia with 11 mg Levobupivacaine + 10 μg fentanyl
V. Kumar[11]	2010	Large atrial septal defect and severe right ventricular dysfunction with moderate pulmonary hypertension. (Diagnosed post-operatively)	33	30 weeks	Presumed amniotic fluid embolism. (Cardio-respiratory arrest – after revival developed aphasia and hemiparesis)	Spinal anaesthesia

technique in high risk cardiac parturients for elective cesarean section, where through combined spinal epidural needle, 5 minutes after intrathecal injection, 8 ml of normal saline was given epidurally. Theory behind this technique is volume effect in epidural space which compresses the subarachnoid space and increase the intrathecal spread of the drug.[21]

Although epidural anesthesia is considered safe and effective for cardiac cases, several factors must be considered. It is a blind procedure where the catheter is positioned in the epidural space, which contains neural tissues, adipose tissue, and blood vessels. This can lead to catheter malalignment and uneven drug distribution, resulting in patchy and unpredictable blocks. Additionally, epidural anesthesia can be time-consuming, particularly in emergency situations, and is technically challenging, as locating the epidural space may be difficult. Expertise is required to perform it effectively. In cases where the patient is on anticoagulant therapy or has a deranged coagulation profile, there is an added risk of epidural venous plexus injury and subsequent hematoma formation. For these reasons, a back-up plan of general anesthesia should always

be prepared as a standby technique.

Ideally, these cases should be well planned in advance to prevent the need for emergent delivery and to ensure that all specialty services are available. Both the mother and baby were doing well upon follow-up.

4. Conclusion

This unusual case of a term pregnant woman with corrected large VSD complicated with arrythmia and pulmonary hypertension presented many anaesthetic challenges. Such cases need management based on structural pathology of the disease and current clinical status of the patient. A coordinated, multidisciplinary team of anesthesiologists, obstetricians, and cardiologists is crucial. This report highlights the safe and effective use of epidural anesthesia with a combination of 0.75% Ropivacaine and 2% Lignocaine in titrated doses for elective cesarean section in cardiac patients, leading to favourable maternal and fetal outcomes.

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6. Conflict of Interest

None.

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Author's biography

Anupama Kumari, Assistant Professor https://orcid.org/0000-0001-5575-6022

Richa Mukeshbhai Tailor, Assistant Professor https://orcid.org/0009-0006-9754-2210

Sara Mary Thomas, Professor and HOD https://orcid.org/0000-0002-6753-8118

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