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Case Series

Anaesthesia Section

Peripartum Anaesthetic Management of Newly Diagnosed Pulmonary Hypertension: A Case Series

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ABSTRACT

Newly diagnosed Pulmonary Hypertension (PH) in pregnancy can result in significant health concerns and complications in anaesthesia management for caesarean section delivery. Here, the authors, describe the cases of three pregnant patients who were scheduled for emergency caesarean sections with a new diagnosis of PH. These patients presented with nonspecific symptoms of dyspnoea on exertion and lower extremity swelling, which initially were believed to be due to changes occurring during normal pregnancy. Further evaluation, including echocardiography, revealed different degrees of PH with preserved Left Ventricular Ejection Fraction (LVEF). All patients underwent combined spinal and epidural anaesthesia for their surgical procedure. A low-dose spinal anaesthetic was administered with epidural boluses to achieve analgesia. The sympathetic blockade was managed judiciously to maintain stable blood pressure. Norepinephrine was administered to all patients in order to support right ventricular function, and supplemental oxygen was administered as needed. Blood pressure was closely monitored throughout. In the postoperative period, all three patients were transferred to the intensive care unit for close monitoring. The postoperative course for all patients was uneventful, and they were discharged without complications. This experience emphasises the importance of early recognition of unusual symptoms in pregnancy, early echocardiography, neuraxial anaesthesia, and vigilant monitoring and collaboration in order to achieve a successful outcome for women newly diagnosed with PH.

Keywords: Caesarean section, Combined spinal epidural anaesthesia, Haemodynamic monitoring, Pregnancy complications, Right ventricular function

INTRODUCTION

Newly diagnosed PH during pregnancy is a serious clinical challenge for both the obstetrician and the anaesthesiologist. The symptoms at presentation are often mild and include dyspnoea on exertion and pedal oedema, which are easily disregarded as changes related to pregnancy. Many women are asymptomatic, and diagnosis is delayed until late pregnancy, by which time stress to the heart has exacerbated the symptoms. PH is considered a World Health Organisation (WHO) class IV lesion. Pregnancy in patients with PH increases the risk of right heart failure, arrhythmias, and mortality [1-3].

Early diagnosis and a multidisciplinary approach are crucial after the identification of PH during pregnancy, even if it is a chance finding. During anaesthesia management, precise adjustments of anaesthesia and close monitoring of blood flow are necessary to prevent sudden drops in blood pressure while ensuring adequate blood flow to maintain proper oxygenation [4,5]. The present case series describes three parturients in whom PH was diagnosed unexpectedly late in pregnancy. All received Combined Spinal-Epidural (CSE) anaesthesia for caesarean delivery, and the strategies of perioperative management used to achieve a stable outcome are discussed.

CASE SERIES

Case 1

The patient was a 27-year-old primigravida at 38 weeks of gestation, scheduled for an elective caesarean delivery due to breech presentation. She had an uncomplicated antenatal course till 36 weeks when she developed new-onset exertional dyspnoea Modified Medical Research Council (mMRC) grade I and mild bilateral pedal oedema. She denied any chest pain, palpitations, or syncope. Mild pallor, loud P2, and no murmurs were present on clinical examination. Oxygen saturation was 96% on room air. Physical examination findings were considered disproportionate for normal pregnancy-related changes, and an echocardiogram showed the presence of moderate PH with an estimated Pulmonary Artery Systolic Pressure (PASP) of 55 mmHg, mild Right Ventricular (RV) dilatation, and preserved LVEF of 64%. She had no previous medical history and was not on any medication. Pre-anaesthetic examination revealed a pulse rate of 86/min, blood pressure of 118/76 mmHg, with no symptoms of orthopnea or jugular venous distension. All routine laboratory parameters were within normal limits. She was assessed as an American Society of Anaesthesiologists (ASA) class III. A CSE technique with invasive blood pressure monitoring was planned to enable slow titration of the block height and avoid sudden sympathetic blockade. The CSE was preferred over General Anaesthesia (GA) to avoid the increase in pulmonary vascular resistance and sympathetic stimulation associated with laryngoscopy and positive-pressure ventilation in a patient with moderate PH.

Case 2

The 31-year-old multigravida at 37 weeks, with no previous remarkable medical history, was admitted for an emergency caesarean delivery due to a non-reassuring foetal heart rate and complaints of a ten-day history of progressive shortness of breath and orthopnea that had worsened over the last 48 hours (mMRC grade III). On physical examination, there was mild cyanosis of the lips and fingers, a systolic murmur at the left sternal border, and an oxygen saturation of 93% on room air. A bedside echocardiogram showed severe PH with PASP 68 mmHg, moderate RV dilatation, and Tricuspid Regurgitation (TR) but preserved LVEF. She did not have any prior diagnosis of any heart disease. Pre-anaesthetic evaluation revealed a blood pressure of 112/70 mmHg and a heart rate of 98 beats/min. No jugular venous distension was noted. Arterial blood gas revealed mild respiratory alkalosis. Given the severity of PH and symptomatic status, she was classified as ASA physical status IV.

She was considered a high-risk case for GA, and a carefully titrated CSE technique with invasive arterial monitoring was planned to maintain haemodynamic stability and oxygenation throughout delivery. In view of severe PH with symptomatic dyspnoea, CSE was chosen over GA to prevent peri-intubation haemodynamic instability, hypoxia, and right ventricular decompensation.

Case 3

A 25-year-old primigravida at 36 weeks of gestation, with no previous medical history, presented with spontaneous Premature Rupture Of Membranes (PROM) and reduced effort tolerance over the last two weeks. She complained of breathlessness on mild exertion and easy fatigability but denied chest pain, palpitations, or syncope (mMRC grade II). The antenatal visits were normal with no history of cardiac disease. Examination revealed a loud P2 and trace pedal oedema, with an oxygen saturation of 94% on room air. Given the recent onset of symptoms, she was subjected to transthoracic echocardiography, which showed severe PH with an estimated PASP of 72 mmHg, dilated RV, moderate TR, and LVEF of 65%. The pre-anaesthetic assessment revealed blood pressure of 116/74 mmHg, a heart rate of 90/min, and clear lung fields. All the laboratory investigations were within normal limits. She was assessed as ASA class III. A multidisciplinary team discussion was held, and it was planned to perform a CSE under invasive arterial pressure monitoring with cautious, incremental dosing, along with early vasopressor support. CSE was selected over GA to allow gradual titration of neuraxial blockade and maintenance of haemodynamic stability, thereby minimising right ventricular strain in severe PH.

[Table/Fig-1] Summarises the perioperative management, intraoperative course, and postoperative outcomes of the three patients.

DISCUSSION

The PH in pregnancy represents one of the most complicated and high-risk clinical situations in obstetric anaesthesia. A fixed high pulmonary vascular resistance, combined with profound physiological changes in pregnancy, predisposes to right ventricular failure, arrhythmia, and circulatory collapse. The challenge is greatly enhanced in conditions when PH is unexpectedly diagnosed late in gestation due to the limited time remaining for optimisation, risk stratification, and institution of targeted therapy. The pregnancy-mediated haemodynamic alterations, notably an increase in blood volume and cardiac output along with a decline in systemic vascular resistance, further elevate pulmonary pressures and impose a heavy burden on the right ventricle [6,7].

The intrapartum and early postpartum periods are especially precarious because auto-transfusion from uterine contractions and sudden changes in preload can quickly overwhelm a pressure-loaded right heart. From an anaesthetic perspective, maintaining right ventricular function requires adequate coronary perfusion pressure, avoidance of sudden decreases in systemic vascular resistance, and avoidance of any other factors that could increase pulmonary vascular resistance. Hypoxia, hypercarbia, acidosis, pain, shivering, and high intrathoracic pressures can all provoke pulmonary vasoconstriction. Aggressive volume loading increases right ventricular distension and septal shift, potentially impairing left ventricular filling and overall cardiac output. There is a fine balance between maintaining adequate preload and avoiding overload [1,3,7].

Neuraxial anaesthesia is ideal for caesarean delivery in patients with PH. CSE anaesthesia, in which a low dose of local anaesthetic is administered intrathecally, offers the advantage of predictable anaesthesia with a slow onset of sympathetic block secondary to incremental epidural supplementation, thus increasing safety by minimising abrupt sympathetic blockade and hypotension. The ability to titrate epidural medications will permit tight haemodynamic control, which can be subtly tailored to meet surgical needs while maintaining cardiovascular stability. Administration of low-dose norepinephrine early in the course will mitigate the decrease in systemic vascular resistance associated with neuraxial anaesthesia and support right ventricular perfusion. Norepinephrine was used as the first-line vasopressor as it effectively restores systemic vascular

Parameters	Case 1	Case 2	Case 3
Type of surgery	Elective caesarean for breech	Emergency caesarean for foetal distress	Emergency caesarean for PROM with foetal distress
Monitoring	ECG, SpO_2, invasive arterial line	ECG, SpO_2, invasive arterial line	ECG, SpO_2, invasive arterial line
Anaesthetic technique	CSE (L3–L4)	CSE (L2-L3)	CSE (L3-L4)
Intrathecal drug	1 mL 0.5% hyperbaric bupivacaine + 10 µg fentanyl	0.8 mL 0.5% hyperbaric bupivacaine + 10 µg fentanyl	0.8 mL 0.5% hyperbaric bupivacaine + 10 µg fentanyl
Epidural supplementation	3 mL aliquots of 0.25% bupivacaine to T6	2-3 mL aliquots of 0.25% bupivacaine to T6	3 mL aliquots of 0.25% bupivacaine to T5
Vasopressor used	Norepinephrine infusion (0.02-0.05 µg/kg/min)	Norepinephrine infusion (0.03-0.05 µg/kg/min)	Norepinephrine infusion (0.03-0.05 µg/kg/min)
Intraoperative course	MAP maintained 70-80 mmHg, SpO_2 >96%, stable	MAP 70-80 mmHg, SpO_2 >95%, stable	MAP 70-80 mmHg, SpO_2 >96%, stable
Uterotonic regimen	Oxytocin 3 U slow infusion over 10 min	Oxytocin 3 U slow infusion over 10 min	Oxytocin 3 U slow infusion over 10 min
APGAR scores (1 minute/5 minute)	8/9	7/9	8/9
Intraoperative ine Fluids and Urine Output	Ringer's lactate output -1500 mL, Urine -180 mL	Ringer's lactate output -1700ml, Urine -230ml	Ringer's lactate output -1700 mL, Urine -170 mL
Postoperative analgesia	Epidural infusion 0.1% bupivacaine + fentanyl (5 mL/h)	Epidural infusion 0.1% bupivacaine + fentanyl (5 mL/h)	Epidural infusion 0.1% bupivacaine + fentanyl (5 mL/h)
ICU stay	24 hours	48 hours	72 hours
Postoperative complications	None	None	None
Outcome	Discharged Postoperative Day (POD) 4. A follow-up done three months later revealed a stable status. The patient was asked to continue follow-up with the cardiology department.	Discharged POD 5. A follow-up three months later revealed a stable status. The patient was asked to continue follow-up with the cardiology department.	Discharged POD 7. A follow-up three months later revealed a stable status. The patient was asked to continue follow-up with the cardiology department.

[Table/Fig-1]: Perioperative management and outcomes in the three cases.
PROM: Prelabor (or Premature) Rupture of Membranes; ECG: Echocardiography; SpO^2: Oxygen saturation; MAP: Mean Arterial Pressure; ICU: Intensive care unit

resistance and mean arterial pressure while exerting minimal increase in pulmonary vascular resistance, thereby preserving right ventricular perfusion. Alternative agents such as phenylephrine or ephedrine were avoided due to their potential to worsen PH or induce tachycardia. At the same time, low-dose vasopressin may be considered as an adjunct in refractory hypotension [2,8].

Continuous invasive arterial monitoring is essential for monitoring even minimal blood pressure fluctuations and guiding the necessary swift adjustments of vasopressors. Supplemental oxygen should always be provided in order to avoid desaturation and hypoxic pulmonary vasoconstriction. Selection and management of uterotonics also need equal caution. Intravenous oxytocin bolus induces severe vasodilation, hypotension, and tachycardia, which are poorly tolerated in these patients. A slow infusion of a minimum effective dose is therefore preferred for maintaining uterine tone without compromising haemodynamics [1,2,9,10].

Control of postoperative pain is another significant factor in determining stability. Continuous epidural analgesia using dilute local anaesthetic and opioid combinations assures excellent pain relief, reduces sympathetic activation, and prevents increases in pulmonary vascular resistance associated with pain and anxiety. The postpartum period remains the time of highest risk for decompensation because sudden changes in haemodynamics, auto-transfusion from involution of the uterus, and mobilisation of extravascular fluid occur. Monitoring in the intensive care setting is required for at least 24-72 hours, with continuous monitoring of oxygenation, rhythm, and blood pressure. Other requirements include gradual mobilisation, avoidance of excessive fluids, and vigilant management of anaemia and infection to prevent adding to right ventricular strain [6,8,11].

Parturients between 25 and 31 years of age and at 36 to 38 weeks of gestation with newly diagnosed moderate to severe PH and preserved LVEF delivered their infants by caesarean section under CSE. Haemodynamics were tightly controlled by the use of low-dose intrathecal bupivacaine with stepwise epidural supplementation and preventive norepinephrine infusion, thereby maintaining systemic blood pressure and oxygenation, and avoiding abrupt sympathetic blockade. In all three cases, neonates scored between 7 and 8 at one minute and between 8 and 9 at five minutes in the APGAR (Appearance, Pulse, Grimace, Activity, Respiration) scoring system, indicating good neonatal outcomes despite maternal cardiovascular risks. These findings align with those described by Lertkovit S and Nivatpumin P who reported that the use of graded CSE with invasive monitoring, pulmonary vasodilators during the perioperative period, and preparedness for extracorporeal support resulted in stable maternal haemodynamics and the successful delivery of neonates [12]. Similarly, Sumarli A et al., and Kumari A et al., demonstrated that by carefully adjusting neuraxial anaesthesia, along with invasive monitoring and cautious administration of vasopressors, the occurrence of hypotension, hypoxia, and RV failure could be effectively averted [8,11]. The anaesthetic difficulties that arise in such scenarios are related to the need to prevent sudden drops in systemic vascular resistance. It is also important to avoid situations that can lead to hypoxia, hypercarbia, acidosis, or pulmonary vasoconstriction due to pain. Preload should be balanced to prevent overloading of the right ventricle, and it is recommended to administer uterotonics slowly to avoid abrupt haemodynamic changes. The use of continuous invasive monitoring, early vasopressor support, cautious fluid management, and postoperative intensive care goes a long way in reducing maternal morbidity and maintaining neonatal stability, thereby highlighting the importance of multidisciplinary planning in pregnant women with PH [8,11,12]. Anaesthetic management in similar cases in previous studies have been given in [Table/Fig-2] [1-3,8,11,12].

Study	Case description	Anaesthetic management	Takeaway points
Current Case Series Case [1-3]	Three obstetric patients (25-31 years, 36-38 weeks) with moderate-severe PH (PASP 55-72 mm Hg) and preserved LVEF underwent elective/emergency caesarean section for obstetric indications.	CSE with invasive arterial line; low-dose intrathecal 0.5% hyperbaric bupivacaine (0.8-1 mL) + fentanyl 10 µg; graded epidural 0.25% bupivacaine to T5-T6; norepinephrine infusion (0.02-0.05 µg/kg/min); oxytocin 3 U slow infusion; postoperative epidural analgesia and ICU monitoring 24-72 h.	Graded neuraxial block with invasive monitoring and low-dose vasopressor infusion maintains haemodynamic stability. Avoid rapid sympathectomy, hypoxia, and hypercarbia. Administer oxytocin slowly and ensure multidisciplinary, ICU-based care.
Lertkovit S and Nivatpumin P 2022, Thailand [12]	27-year-old G2P1A0 at 31 weeks with SLE and severe PAH (PAP 68/17 mm Hg, mPAP 37 mm Hg); functional class III; caesarean in cardiac OR with ECMO standby.	CSE: intrathecal 0.5% heavy bupivacaine 4 mg + fentanyl 20 µg + morphine 200 µg; graded epidural 2% lidocaine + adrenaline + fentanyl 30 µg to T4; invasive monitoring (PA catheter, FloTrac); iloprost + sildenafil pre-op; milrinone (0.3-0.5 µg/kg/min); oxytocin 40 U infusion; postoperative epidural analgesia; uneventful recovery.	Successful graded CSE with ECMO standby. Pulmonary vasodilators and inotropes optimised RV function. Avoid single-shot spinal and rapid haemodynamic shifts. Reinforces the need for pre-op optimisation and invasive monitoring in severe PAH.
Sumarli A et al., 2024, USA [11]	31-year-old G3P1112 with SLE-associated Group-1 PH (PASP 68-89 mm Hg) on IV treprostinil and tadalafil; planned 34-week caesarean with cardiothoracic standby.	Pre-placed lumbar epidural; continued i.v. treprostinil + inhaled NO (20 ppm) via HFNC; invasive arterial + PA catheter monitoring; CPB standby; incremental epidural lidocaine (2%, 400 mg) to T6; oxytocin/misoprostol slow infusions; epidural morphine for analgesia; uneventful recovery.	Careful, incremental epidural dosing, combined with the continuation of pulmonary vasodilators and multidisciplinary readiness, ensured stability. Avoided GA; highlights the benefit of preplanning and coordinated peripartum PH care.
Kumari A et al., 2025, India [8]	30-year-old primigravida (34 weeks) with corrected VSD patch repair (operated at 5 years) and severe PH (RVSP 75 mm Hg); also hypothyroid and history of COVID-19; scheduled elective Caesarean for absent end-diastolic flow with cord around neck.	Graded epidural anaesthesia at L2-L3 with 0.75% ropivacaine + 2% lignocaine (total 14 mL) titrated to T4; invasive arterial line; oxygen 5 L/min via mask; prophylactic norepinephrine 8 µg/min infusion; oxytocin 20 U slow infusion; minimal sedation (midazolam 1 mg); postoperative epidural top-ups (0.2% ropivacaine 8 mL q8h); stable ICU recovery and discharge on day 7.	Demonstrates safe use of a graded epidural in corrected congenital HD with severe PH. Ropivacaine- lignocaine mix provided haemodynamic stability and a smooth onset. Avoided GA due to Vocal cord palsy and PH. Reinforces the importance of an individualised, well-prepared, multidisciplinary approach.

[Table/Fig-2]: Anaesthetic management in similar cases [1-3,8,11,12].

CONCLUSION(S)

Newly diagnosed PH in pregnancy is a challenge to both the anaesthesiologist and the obstetrician due to the risks of right heart failure and haemodynamic instability. A carefully titrated regional anaesthesia technique, such as CSE anaesthesia, the use of invasive arterial blood pressure monitoring, and pre-emptive vasopressors, allows for controlled haemodynamic management during caesarean delivery. Prevention of factors that increase pulmonary vascular resistance, slow administration of uterotonics, and close postoperative monitoring are imperative. Early recognition,

individually tailored anaesthetic planning, and multidisciplinary coordinated care remain the cornerstones for accomplishing safe maternal and foetal outcomes.

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