

# Successful Management of a Parturient with Patent Foramen Ovale Presented for Elective Cesarean Section: A Case Report

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## Abstract

**Introduction:** Patent foramen ovale (PFO) is a congenital anomaly found in 25–30% of the general population, typically asymptomatic until the physiological alterations of pregnancy heighten the risk of cerebral infarction. Pregnant women with PFO are at an increased risk of complications impacting the brain, heart, lungs, and peripheral vasculature, with stroke being the predominant concern.

**Case presentation:** We report a case of successful anaesthetic management of a 32-year-old parturient with pre-eclampsia and PFO presenting for cesarean section. Pre-anesthetic evaluation, diagnosis, and management of PFO were crucial to avoid complications. Spinal-epidural anaesthesia was chosen to minimize cardiopulmonary compromise, and hemodynamic parameters were maintained throughout the procedure. Postoperatively, the patient was monitored in the intensive care unit and received thromboprophylaxis.

**Conclusions:** This case highlights the importance of early identification of PFO in pregnancy, vigilant monitoring of hemodynamic parameters, and the prevention of thrombosis throughout pregnancy and the postpartum period.

**Keywords:** PFO, Caesarean section, Preeclampsia, Thromboprophylaxis

## Introduction

Patent foramen ovale (PFO), seen in around 25–30% of the general population, is a congenital anomaly due to the failure of closure of the inter-atrial connection [1]. It is usually an asymptomatic right-to-left shunt and remains unrecognized until physiologic changes of pregnancy set in (such as hypercoagulation) which makes the parturient prone to cerebral infarction. The incidence of an ischemic stroke may be as high as 3.8–5 in 100,000 pregnancies [2]. Pregnant women are at 3 times more risk for ischemic and hemorrhagic stroke and at 5 times more risk for venous thromboembolism (VTE) than non-pregnant women, so early identification is essential to avoid complications [3].

PFO is a mobile valvular structure that can become more active during pregnancy. They are more prone to complications affecting multiple organs including the brain, heart, lung, and peripheral vasculature, of which stroke is the most common. Hence, early diagnosis of PFO is essential to avoid long-term complications. The right-to-left shunting is precipitated by transient elevations of right-sided pressures. Pulmonary hypertension and pulmonary embolism (PE) have also been found to be common comorbidities seen in pregnant patients with PFO. Hence, the plan of anaesthesia should be such that hemodynamic parameters are well maintained without any added risk of thrombosis. We report the successful management of one such parturient who presented for cesarean section (CS). On thorough research of the literature, we could not find a reported case

of a parturient with pre-eclampsia along with PFO.

## Case Report

A 32-year-old G4P3L1, 39-week unbooked case with previous three lower segment CSs (LSCS), no fresh complaints, and no significant past medical history presented to our hospital for elective LSCS. Her previous three childbirths were conducted under spinal anaesthesia with an uneventful anaesthetic course. She had a bad obstetric history in her previous pregnancies as newborns died after birth. On conducting her pre-anesthetic evaluation, there were no significant clinical findings on examination; the laboratory investigations were unremarkable except for high blood pressure (BP). She had repeated readings of increased BP, and a pulse rate of 115 bpm. The patient's electrocardiogram (ECG) was done, and it showed ventricular premature beats and pulsus bigeminy. Pre-eclampsia was diagnosed, and therapy was initiated with antihypertensives (Tablet labetalol 100 mg PO twice daily). Her repeat ECG showed sinus tachycardia of 101 bpm. Following this, a 2D echocardiogram (ECHO) was done which showed a PFO <2 mm in size, mild tricuspid regurgitation, ejection fraction- 55–60%, right ventricular systolic pressure (RVSP) = 19 + right atrial pressure (RAP) (since usually RAP taken as 4 mmHg, so RVSP should be approximately 24 mmHg), normal chambers size, normal left ventricular function, and no clots. The cardiologist opined that no active intervention was required. The patient was posted for elective cesarean section. Informed written consent was taken.

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COVID-19 reverse transcription polymerase chain reaction test done as per institutional protocol was reported negative.

In the pre-operative area, the patient was conscious and oriented, the systemic examination was normal, and she had a BP of 148/95 mmHg and heart rate of 86/min. The plan of anaesthesia was combined spinal epidural and phenylephrine was kept ready as a vasopressor to be used in the event of hypotension. Injection labetalol was also kept ready because the patient was also diagnosed with pregnancy-induced hypertension (PIH). After administering aspiration prophylaxis and antibiotics, the patient was wheeled into the operating room with a wedge placed underneath for left uterine displacement. Monitors were attached. An ambient temperature of 28°C in the operation theatre was maintained. The intravenous cannula was secured, and lines were kept free of air bubbles. On the operating table, her pulse rate was 82/min and regular, her BP was 145/100 mmHg and her SpO<sub>2</sub> was 99% on room air. ECG showed normal sinus rhythm. Coload with 500 mL Ringer lactate was done over 15 min and under all aseptic precautions, epidural plus spinal anaesthesia was given with 1.8 mL of 0.5% hyperbaric bupivacaine injected in subarachnoid space. An adequate level of block till T6 dermatome was achieved and a pillow was kept below the shoulder to restrict the height of the block, oxygen was provided through a face mask and surgery commenced. Hemodynamic parameters were well maintained, and vasopressors were not required. After the delivery of the baby, an oxytocin infusion of 10 units was started, no bolus was given and it was discontinued as soon as the uterine tone was achieved. The child cried immediately after birth and was handed over to a pediatrician. The initial assessment was done and the child was shifted to a non-intensive care unit (NICU) as it was a high-risk pregnancy. After uterine closure, an epidural test dose of 3 mL lignocaine with adrenaline was given followed by another bolus of 3 mL. The intraoperative period was uneventful. The surgery lasted for 2 h and at the end of the surgery, 6 mL of 0.25% bupivacaine was given through the epidural catheter. The approximate blood loss was 800 mL, urine output was 200 mL, and maintenance fluid administered was restricted to 10 mL/kg body weight per hour.

The patient was shifted to the ICU. The epidural catheter was removed the next morning and low molecular weight heparin was started in the ICU for prophylaxis for deep vein thrombosis. After 2 days of observation in the ICU patient was transferred to the ward.

### Discussion

PFO is an inter-atrial septal defect, which is a benign finding in the neonatal period, and its persistence in adulthood is usually associated with a right to left shunt. This can either be symptomatic or asymptomatic. The right-to-left shunt can be precipitated by momentary elevation in right-sided pressures or due to PE. PFO is considered a risk factor for cryptogenic stroke, systemic arterial embolism, VTE, and migraine. Among these, cryptogenic stroke is the most frequently encountered, seen mostly in PFO with atrial septum aneurysm or with atrial fibrillation [4, 5]. PFO-associated stroke is seen more commonly in pregnancy as physiological changes of pregnancy related to heart and peripheral vasculature render the female more susceptible to thromboembolism. Therefore, early identification of PFO is important, and detailed pre-anesthetic

evaluation is required. This case had an additional risk factor for stroke which is pre-eclampsia, mostly associated with hemorrhagic stroke. Therefore, extra caution must be exercised during all three trimesters and in the postpartum period since stroke has been reported even after 6 weeks postpartum in these patients [6]. A thorough cardiac workup including 12-lead ECG to rule out any rhythm abnormality and detect atrial fibrillation is to be done. 2D ECHO is particularly useful for diagnosing abnormalities of the inter-atrial septum, assessing PFO features, such as atrial septal aneurysm, to check for the size of PFO, the degree of shunting, and detecting any clot in atria and valvular abnormalities if any. Major hematological changes occur in pregnancy such as increased platelet consumption, enhanced clotting, and fibrinolysis. The concentration of most of the coagulation factors changes during pregnancy including factors 1, 7, 8, 9, 10, and 12 which increase, and factors 11 and 13 which decrease [7]. The concentrations of factors 2 and 5 remain unchanged. These elevated levels of coagulation factors reach normal values about 2 weeks after delivery [8]. The fibrinolytic system is also altered during pregnancy: Tissue-type plasminogen activators and its fast inhibitors as well as placenta-type plasminogen activators increase during pregnancy [9]. One h after delivery concentrations of tissue-type plasminogen activator and inhibitor decrease abruptly, and the placenta-type plasminogen activator remains elevated for some more days. These above-mentioned changes make the patient more prone to deep vein thrombosis as pregnancy is a hypercoagulable state in itself. Hypercoagulability panel blood testing can be done to stratify clotting risk. In our case, we did a coagulation profile and D-dimer, and the reports were in the normal range. For patients who are at high risk of thrombosis, thromboprophylaxis with low molecular weight heparin should be considered. This patient had a bad obstetric history; she was G4P3L1 with three previous cesarean sections, and had lost two children soon after birth which according to the history given by the mother pointed toward congenital anomalies. Since she had an increased risk of bleeding intraoperatively, after discussion with the obstetrician and cardiologist and weighing risk and benefit, pre-operative thromboprophylaxis was not started (since ECHO findings suggested the PFO was small in size) [10, 11].

Maximum effort should be taken to reduce the risk of emboli formation. In the operating room, intravenous lines and circuits should be free from bubbles, and air filters should be used to minimize the risk of air embolism. Pregnant women have a 4–5 times higher risk for VTE and a further increased risk in the postpartum period compared with non-pregnant women. Pregnancy-associated VTE manifests as deep vein thrombosis in 80% of cases. Compared to vaginal delivery, cesarean section doubles the deep venous thrombosis risk. VTE in co-occurrence with PFO may upsurge the risk of paradoxical emboli. Hence, short-term anticoagulation treatment can be considered to prevent future adverse events.

Epidural anesthesia with the lower range of normal dose spinal was planned since it causes minimal cardiopulmonary compromise in patients. Epidural space was identified using the loss of resistance technique using 3 mL of normal saline to avoid the chance of embolus formation using air. Low-dose spinal anaesthesia is beneficial as it prevents rapid sympathectomy which can result in a sudden decrease in systemic vascular resistance (SVR) (which needs to be avoided in

PFO). Combined spinal epidural anaesthesia also offers some benefits in reducing thrombotic events in patients undergoing cesarean section, including those with a PFO. It provides rapid and effective pain relief, allowing early ambulation and reduced immobility. These are important factors in preventing thrombotic events. It also reduces the need for systemic opioids, which are also associated with an increased risk of VTE. Parturients have a greater risk for aspiration, and changes in SVR and can also have increased pulmonary vascular resistance during the administration of general anaesthesia with rapid sequence intubation. Moreover, positive pressure ventilation can decrease venous return, so general anaesthesia is better avoided in these patients [12].

While managing cases with the right-to-left shunt, systemic hypotension can increase the degree of shunting, so the anaesthetist should be cautious regarding the prevention of hypotension and immediate treatment should be commenced in the event of a hypotensive episode. To minimize the incidence of hypotension low dose of the spinal anaesthetic drug should be administered, the level of block kept at T6, and a low dose of oxytocin should be given after delivery. Since our patient had a case of pre-eclampsia as well, we followed restricted fluid therapy to avoid pulmonary edema and fluid overload, and adequate hydration was maintained.

Other important morbidities associated with PFO in pregnancy are PE and pulmonary hypertension. In many reports, PE is a concurrent finding with PFO [13, 14, 15]. PE can occur due to venous clotting, and it can cause elevated pulmonary pressure that can lead to right-to-left shunting. Even pulmonary hypertension can lead to the sudden opening of PFO [12]. PE is considered to be a major complication that can lead to 10% of pregnant women's deaths [16]. Hence, endovascular closure can be considered after the delivery of the fetus. However, in the present case, patient had a small defect that required only vigilant monitoring and no active intervention required during

the postpartum period. A multidisciplinary team is quintessential for managing such high-risk patients; a team comprising obstetricians, cardiologists, anesthesiologists, and neonatologists is advocated. The obstetrician would manage the delivery; cardiologist would assess and monitor the cardiac condition pertaining to the risk associated with PFO as well as thromboprophylaxis. Anesthesiologists would ensure perioperative care with respect to safe anaesthetic techniques, intensive monitoring, and adequate analgesia both in intraoperative and post-operative period while a neonatologists would be prepared to address any potential complications for the newborn. Collaboration among these specialists is critical for optimizing both maternal and fetal outcomes. This again reiterates the importance of vigilant thorough workup of patients, especially since patients are already in a hyper-coagulable state and there might be a need for anticoagulation.

### Conclusion

PFO typically presents as an asymptomatic defect but can surface during pregnancy due to associated physiological changes; more so in a patient with PIH. These patients may present with arrhythmia and are at a heightened risk of stroke, PE, and pulmonary hypertension. Therefore, a high index of suspicion and pre-operative echocardiography would help clinch the diagnosis. Vigilant monitoring of hemodynamic parameters and thrombosis prevention throughout pregnancy and postpartum is essential. Thus, a multidisciplinary approach is required in pre-operative period itself to avoid intraoperative and post-operative complications and ensure a good neonatal outcome.

**Key Message:** A parturient presenting with PIH and arrhythmia on ECG should be thoroughly investigated (including ECHO). If a PFO is diagnosed, a multidisciplinary team should further evaluate and manage the patient perioperatively for achieving a good maternal and fetal outcome.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his/her consent for his/her images and other clinical information to be reported in the Journal. The patient understands that his/her name and initials will not be published, and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

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