The Anesthetic Management of a Pre-Term Parturient Undergoing Urgent Cesarean Delivery for Fetal Complications within 30 Days of Drug-Eluting Stent Placement: A Case Report and Literature Review

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Abstract:

Cardiomyopathy in pregnancy is a prevalent disease we encounter as obstetric anesthesiologists, and can be a major cause of maternal perinatal morbidity and mortality if not appropriately managed, particularly during the antepartum period[1]. The gold standard of care remains neuraxial anesthesia with adequate labor analgesia and vaginal delivery if feasible[2]. However, this technique is not always appropriate as women may present with contraindications to neuraxial anesthesia, such as women on anticoagulation. This is particularly noted in women who have known cardiac disease, as women who undergo coronary interventions prior to labor are managed with chemical anticoagulation. General anesthetic consideration for this population takes into account not only cardiac techniques but the implications on fetal wellbeing[2]. Although maternal outcomes remain our priority as the safety of the mother is necessary for fetal survival, improving fetal status at birth is ideal. In this particular paper, we discuss the challenges we faced in a parturient who underwent percutaneous coronary intervention during her pregnancy, and required urgent cesarean section within 30 days of receiving a drug-eluting stent. We present the literature surrounding these concerns and the options available to anesthesiologists to provide safe anesthesia for both mother and fetus.

Keywords: High-risk obstetrics; Cardiomyopathy; General anesthesia; Drug-eluting stent; Regional anesthesia; Anticoagulation

Objectives

The purpose of this manuscript is to discuss the proper evaluation of the parturient with cardiac disease, to provide an overview of the literature, and to properly formulate a safe obstetric and labor plan in women with confirmed cardiomyopathy.

Case Report

The patient is a 28 year-old female gravida 7, para 0, well known to the Maternal Fetal Medicine (MFM) and Cardiology Division who presented at 31w 5d for a prenatal visit, during which they found absent end diastolic flow in the umbilical artery dopplers, raising concern for restricted fetal intrauterine development. She was, thus, admitted to the MFM team for optimization of her numerous comorbidities as well as steroids for fetal maturation prior to definitive management of cesarean delivery.

The patient initially presented to Obstetrics Department for antenatal care after having experience six spontaneous abortions, at which time she was referred to the high-risk MFM group for management of her newly diagnosed essential hypertension and poorly

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controlled Type-I diabetes mellitus from which she suffered retinopathy and blindness in the right eye. Consultation to ophthalmology was made and the patient underwent evaluation of both eyes, and was noted to have retinal detachment of the left eye, which was urgently repaired.

Due to persistent elevated blood pressures and complaints of dyspnea during routine antenatal visits, the patient was admitted to Labor and Delivery and a cardiology consult was obtained. An echochardiogram was performed revealing global hypokinesis, with moderate left ventricular concentric hypertrophy and an ejection fraction of 35%, consistent with Grade III diastolic heart failure and ischemia of the Left Anterior Descending (LAD) artery, as evidenced by the hypokinesia of the distal anterior wall and inferior septum. The patient was only 22 weeks pregnant at this time, so the recommended cardiac catheterization was deferred, given fetal risk to radiation exposure.

However, she was readmitted to the Cardiac Care Unit (CCU) within 1 month of her discharge, at 26 weeks gestational age, for an acute or chronic congestive heart failure (CHF) exacerbation with volume overload. Repeat echocardiography revealed an improved EF of 50% compared to her prior echo, with grade III diastolic dysfunction, basal and mid anteroseptal wall segment hypokinesis and a kinetic inferoseptal, apical septal and lateral wall segments. Because this was her second CHF exacerbation within the month, it was determined that angiography would be appropriate, and that necessary precautions would be performed with lead shielding of the uterus. The catheterization revealed a 95% stenosis of the mid-segment of the LAD, which was corrected with angioplasty followed by placement of a drug-eluting stent. The distal segment remained occluded. She was also found to have a 95% occlusion of the non-dominant Right Coronary Artery (RCA) and 30% stenosis of her Left Circumflex (LCx). She was placed on dual antiplatelet therapy, with acetylsalicylic acid (ASA) and clopidogrel. Her outpatient regimen consisted of Metoprolol and Lasix, but a statin and ACE Inhibitor was withheld given contraindications during pregnancy.

The anesthesia department was immediately consulted for re-evaluation for a Cesarean section. Upon evaluation, considerations were made regarding the optimal anesthetic to use for this patient to both conserve her cardiovascular function, while minimizing the amount of fetal exposure to intravenous agents that may exacerbate pulmonary complications of a preterm neonate and the need for pulmonary resuscitation.

The first determinant that general endotracheal anesthesia would be the mode of choice depended on the fact that the patient had taken her prescribed ASA and clopidogrel the morning of admission, and within 36 hours of surgery. Prior to the taking the patient to the operating room (OR), a type and cross for four units was obtained and the blood products were made readily available and were brought to the surgical suite. A central venous catheter (CVC) and ultrasound were also brought into the room in the event that we could not obtain adequate access, given her numerous unsuccessful attempts at venipuncture and intravenous (IV) catheter placement. She was brought to the OR from the floor with a 20G peripheral IV placed by the anesthesia department the day prior. Numerous vasopressors were also prepared in the event she would need cardiovascular support.

Upon entering the OR and placing the standard monitors on the patient, a right radial arterial line was placed pre-induction. Her invasive blood pressure reading was around 190/110 and HR around 89, despite being on B-blockers during and prior to her admission. She was anxious but cooperative, and thus anxiolysis was avoided. The patient was given 10mg Labetalol and pre-oxygenated for five minutes while the obstetric team prepped and draped her.

Once all team members were prepared and an appropriate surgical time out was performed, the patient was induced in a rapid sequence fashion using cricoid pressure and 12 milligrams of Etomidate, 70 milligrams of Propofol to blunt the hemodynamic response to intubation without administering opioids, and 140 milligrams of succinylcholine. She was easily intubated using video laryngoscopy, and the section was immediately begun. Her vitals remained stable without any increase in heart rate of blood pressure. Because we were able to obtain a second 20 gauge peripheral IV, and due to the efficiency of the obstetrician in delivering the fetus, the hemodynamic stability, and lack of excessive blood loss and use of vasopressors, the CVC was not placed. She received 50 milligrams of Rocuronium and was placed on 1 MAC of Sevoflurane for adequate relaxation of the myometrium. The fetus was delivered within 7 minutes of incision and Apgar scores were 8 and 8 at one and five minutes, respectively. Once the fetus was delivered, the patient was placed on an oxytocin 20units/hour infusion and received a total of 300 micrograms of Fentanyl throughout the case. One gram of IV Acetaminophen was administered 45 minutes prior to the end of the case for post-operative analgesia, as we decided to avoid any non-steroidal anti-inflammatory drugs (NSAIDs) given the risk of post-operative bleeding while on ASA and clopidogrel. An ABG was sent and compared to one drawn at the beginning of the case, which was to be use for baseline reference. Her hemoglobin remained stable around 12 g/dL and her fluid status, oxygenation, and ventilation were adequate. Her uterus had adequately contracted, her total estimated blood loss was 600 milliliters, she received 1,600 milliters of crystalloid, and her urine output was measured to be 275 milliliters. She did not require any colloid solution or blood products. She had four twitches at the end of the case, was reversed with Sugammadex 200milligramss to mitigate hemodynamic changes associated with other reversal agents, and was extubated successfully. Her blood pressure remained between 140-175 systolic and 75-100 diastolic throughout the case, with a HR consistently in sinus around 80 beats per minute. The patient was taken directly to the CCU for post-operative management.

Post-operatively, EKG and labs revealed no changes in her EKG from baseline, negative troponins, and adequate hemoglobin, remaining greater than 10g/dL at all times. Her pain also seemed to be adequately controlled, which helped minimize any added stress of the heart. She remained in the CCU for close monitoring, and was restarted on her ASA and clopidogrel on post-operative day 1, in addition to subcutaneous heparin for deep vein thrombosis prophylaxis. She did not suffer from post-partum hemorrhage nor require any blood transfusions. She remained hemodynamically stable with BP ranging from 140-150/90 while on metoprolol and lisinopril. She was discharged home on post-operative day 5.

Discussion

Although women of child bearing age are considered to comprise a generally healthy population, 0.4-4.5% of pregnant women in developed countries are diagnosed with cardiovascular disease[3]. Pregnancy, in of itself is an independent risk factor for the development of antenatal myocardial infarction with a fourfold increase risk compared to non-pregnant women[4]; this is becoming of increasing prevalence as women are more frequently becoming pregnant at more advanced ages [4,5]. Eleven percent of maternal deaths that occur in the developed world are due to complications of cardiomyopathy[1].

Adequate control of the underlying cardiac disease in addition to other comorbidities helps to prevent complications associated with the normal physiologic and hemodynamic changes that occur with pregnancy[5,6]. Furthermore, invasive interventions, such as angioplasty may be indicated, and are favorable to the potentially unfavorable outcomes of emergent cardiac surgery or cardiopulmonary resuscitation during acute cardiac events[6,7]. Implementing a multidisciplinary team that consists of an obstetrician who specializes in high risk maternal fetal care, a medical cardiac team with an available interventionist and surgeon, and neonatologist, in addition to an anesthesia care team proficient in both cardiac and obstetric anesthesia is vital for the optimal management of such patients[1].

As plasma volume increases during pregnancy up through the third trimester, challenges in fluid management can arise when treating a parturient with a weak myocardium and the propensity for the myocardium to fail[2]. Optimizing cardiac perfusion is also imperative, and can be necessary prior to labor as the sympathetic tone and myocardial demand increases with the stress of delivery[2].

Percutaneous coronary interventions (PCI) during pregnancy have been shown to be safe for the fetus, with no increase risk in fetal teratogenicity when less than 10 millisievert (mSV) radiation doses are used at any given stage of the pregnancy[6]. In addition, PCI will confer protective effects on maternal well-being, particularly during a time of increased cardiac stress[4]. Occurrences of antenatal PCI with drug-eluting stents and dual anti-platelet therapy with successful subsequent deliveries have been well documented, although increased incidence of post-operative bleeding has been observed[5,8]. However, due to risk of re-thrombosis, some form of anticoagulation is usually continued through the peripartum period, and the risks and benefits are each patient are weighed on an individual basis depending on the risk of re-occlusion and the risk of post-operative bleeding[8-10]. The most recent American Cardiology College/American Heart Association (ACC/AHA) Guidelines published in 2016 have indicated that patients who undergo revascularization with drug-eluting stent (DES) must remain on a P2Y12 inhibitor, such as clopidogrel, for at least 6 months post-intervention and avoid elective non-cardiac surgery for at least 6 months, to allow for proper endothelialization of the stent and adequate dual anti-platelet therapy during this process [9,11]. Inhibition of the P2Y12 receptor on the platelet surface minimizes platelet degranulation and aggregation This general consensus has been created due the high incidence of a major coronary adverse event after PCI (4-5%, 20% of which result in death)[10]. This has been noted to be a result of discontinuation of dual-antiplatelet therapy, particularly in patients who received the DES greater than 30 days prior, a phenomenon known as late stent thrombosis[11]. Discontinuation conferred a five-to-ten time increase rate of perioperative cardiac death[11]. Adverse clinical events have been noted as early as 3 days after discontinuation of both ASA and clopidogrel, and thus urgent cases should be performed while on anticoagulation[11,12]. If the surgery is deemed too high risk for post-operative bleeding to restart clopidogrel in the immediate post-operative period, bridging therapies using short-acting GP IIB/IIIa inhibitors (i.e. tirofiban) can be instituted to mitigate complete cessation of fibrinolytic therapy[11,13,14]. Due to urgent nature of delivery, surgical intervention could not be delayed, and the fetus was to be delivered within 36 hours of admission, the delay was due to administration of perinatal corticosteroid for fetal lung maturation. Given her cardiac catheterization with stenting of the mid-LAD and persistent distal occlusion, in addition to near total occlusion of the RCA, which was not intervened on, the patient was considered high risk for rethrombosis and was taken to the OR despite having taken her ASA and clopidogrel the prior morning. And although there remains controversy surrounding the timing and length of interruption of antiplatelet therapy, the risk of fatal bleeding remains low at 0.1%, with some studies suggesting that perioperative bleeding is not increased with the continuation of only ASA perioperatively[10,11,15]. As indicated in the case, bleeding was not an issue we faced during this case, in spite of proceeding with surgery while being on therapeutic doses of ASA and clopidogrel, which were withheld for only one day for surgery. However, blood products were made readily available in the event of hemorrhage, and isotropic and inotropic agents in the event of hemodynamic instability or shock. However, the patient remained extremely stable and was extubated in the operating room after the procedure was over. The patient was taken to the CCU for close monitoring post-operatively, particularly for continued evaluation of uterine tone given the potential for bleeding and possible adverse cardiac event in the immediate post-operative period. However, the patient did well and was restarted on her ASA and clopidogrel on post-operative day 1, supporting that perioperative bleeding poses an extremely small risk.

However, this precluded any neuraxial interventions and limited the anesthetic technique to general anesthesia, per ASRA guidelines, which suggest that neuraxial methods be withheld for at least several days for patients on ASA and clopidogrel, to minimize risk of epidural hematoma formation[16,17].

Cardiac optimization with strict blood pressure and heart rate control was achieved with beta blockade the day before surgery. ACE Inhibitors were withheld throughout the pregnancy due to teratogenicity. The patient remained on B-blocker therapy preoperatively, and was given an additional dose of labetalol in the OR prior to induction due to elevated BP on arterial monitoring. Although the patient would be able to tolerate a decrease in her elevated blood pressure, a relatively small amount of Propofol was used to induce the patient in addition to Etomidate to mitigate the sympathetic effects of direct laryngoscopy. Fentanyl was avoided to prevent further pulmonary compromise in the premature fetus, and since other options were available and deemed safe for both the mother and fetus, those were utilized, rather than performing a cardiac induction with high dose opioids. However, another option that has been shown

to be efficacious and safe for both a cardiac parturient and her fetus is the use of Remifentanil, which has been used as a low dose patient-controlled analgesia (PCA) infusion for many laboring women who cannot have neuraxial analgesia during labor[18-23]. Short-acting opioid infusions have been proven to be safe for the patient, with minimal effects on the fetus, supposing the parturient can tolerate the hemodynamic effects of such an anesthetic approach[3]. This may serve as an alternative to fentanyl for induction so that adequate analgesia may be achieved so as to minimize the sympathetic response of intubation. However, there is no consensus regarding a single specific manner to induce and maintain general anesthesia, and each patient will need to be managed based on their specific disease process and on the risks and benefits associated with each modality.

Safe practice in the management of the pregnant cardiac patient is paramount, although there remains controversy on the ideal modality. Practice guidelines based on literature of published cases have tried to discern safety margins of neuraxial techniques in anticoagulated individuals, which may require reevaluation and potentially movement toward less rigid time standards. Operative and anesthetic management of individuals with compromised cardiac states still remains controversial, but optimal planning requires a multidisciplinary approach. Thus, having the various proficient care teams available is crucial, particularly for the management of patients with significant and unstable cardiac disease.

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