Anesthetic Management of a Pregnant Patient With an Automatic Implantable Cardioverter-Defibrillator: A Case Report

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There is little data currently available for the obstetric anesthetist to use as a reference for the anesthetic management of laboring women with automatic implantable cardioverter-defibrillators (AICDs). This case report involves a parturient with an AICD and a history of serious cardiac events. The information contained in this case report may be used by anesthesia providers in the obstetric suite confronted with this unique subset of patients that require in-depth anesthetic management.

The parturient presented to our labor suite in active labor. The choice of anesthetics used to provide her with analgesia for labor is described, including the rationale for this anesthetic plan. A review of the literature that contains information on safe and effective anesthesia used for laboring women with AICDs is described.

Keywords: Arrhythmia, automatic implantable cardioverter-defibrillator (AICD), epidural, pregnancy.

Automatic implantable cardioverter-defibrillators (AICDs) are being used more frequently in the general population to treat life-threatening cardiac arrhythmias. Hence, pregnant patients with lethal cardiac arrhythmias requiring an AICD will be seen with increased regularity in the labor and delivery suite. Currently, there is a limited amount of data available to the anesthesia care provider, which is not only a concern to the mother but to the fetus as well.

The purpose of this case report is to identify and discuss the controversies that exist regarding AICD management and the treatment of the pregnant patient with an AICD. These controversies include the preferred regional anesthetic technique, the use of an epidural test dose containing epinephrine, and the decision to suspend the AICD while in labor or during a cesarean section.

Case Study
A 33 year-old woman (178 cm, 77 kg, gravida 3, para 2 at 37.5 weeks gestation) presented to the labor and delivery suite for elective induction. The patient’s medical history was significant for tetralogy of Fallot repair when she was 10 months old. Subsequently as a result of the surgery, the patient developed a first-degree atroventricular block, trifascicular block, and episodes of nonsustained ventricular tachycardia.

An AICD was placed when she was 29 years old because of multiple episodes of syncope (Figure 1). Electrophysiology studies revealed she was prone to frequent inducible malignant ventricular arrhythmias. A Medtronic (Minneapolis, Minnesota) dual chamber automatic implantable cardioverter-defibrillator (Marquis DR model 7274) was placed in the left pectoralis muscle under monitored anesthesia care with intravenous sedation without complications. She remained asymptomatic for 18 months until the AICD then fired 31 times secondary to ventricular fibrillation.

Because of the potential for arrhythmias with an AICD during labor, a preoperative consultation with the
patient’s obstetrician, maternal fetal medicine, cardiology, and anesthesiology was obtained. A forceps-assisted vaginal delivery under epidural anesthesia was planned to avoid possible malignant tachycardia resulting from the Valsalva maneuver attributable to the patient pushing during active labor. The Valsalva maneuver involves a rise in intrathoracic pressure due to the patient exhaling against a closed glottis, which creates a decrease in preload, a decrease in cardiac output, a drop in blood pressure, and a reflexive tachycardia.2

Upon presentation to the labor and delivery suite in active labor, a history and physical performed in the labor and delivery suite revealed that she was taking oral atenolol, 25 mg daily, and smoked a half pack of cigarettes per day. Cardiology was consulted and it was decided to suspend the function of the AICD detection algorithm in order to prevent discharge in the event of an inappropriately detected malignant tachycardia during labor. Cardiology determined that this particular AICD could be suspended by placing a magnet over the device. Therefore, a magnet was placed over the AICD, and it was taped in place in order to ensure AICD inactivation throughout the delivery. Additionally, external defibrillator pads with pacing capability were applied on the patient’s back and front torso for treatment of potential arrhythmias.

Initial vital signs were: heart rate, 84/min; blood pressure, 111/66 mm Hg; respiratory rate, 18/min; fetal heart rate, 140/min with a reassuring pattern; and temperature, 35.9°C. Continuous electrocardiogram monitoring revealed intermittent ventricular pacer spikes with a heart rate between 70 and 90/min. The patient requested an epidural for treatment of labor pain at 2 cm cervical dilatation.

Under sterile technique in the left lateral position, an epidural catheter was inserted into the L3-4 interspace on the second attempt with no complications. The standard 3 mL of 0.5% lidocaine with epinephrine 1:200,000 test dose was not given to prevent potential tachycardia as a result of intravascular placement of the epidural catheter. Intravenous injection of a test dose containing epinephrine (15 µg) will cause an increase in heart rate of approximately 30/min at 20 to 40 seconds after injection.2 After negative aspiration to blood and/or cerebral spinal fluid, a test dose containing only 3 mL of 0.1% ropivacaine was administered to rule out intrathecal epidural placement. A bolus of fentanyl, 100 µg, and 0.1% ropivacaine, 8 mL, was then administered over 30 minutes without hemodynamic instability. For maintenance of labor analgesia, the patient was placed on a continuous infusion of 0.1% ropivacaine and 2 µg/mL fentanyl at 12 mL/h.

The patient remained comfortable throughout labor and subsequently delivered by forceps delivery requiring no additional bolus through the epidural catheter. A healthy female was born weighing 2,360 g with Apgar scores of 8 at 1 minute and 9 at 5 minutes. After delivery, the magnet was removed to allow full operation of the AICD and the external defibrillators were removed. The Medtronic representative interrogated the AICD and the pacer function. The patient’s native rhythm was assessed (Figure 2). Her vital signs remained stable postdelivery, and she was discharged home 2 days postpartum.

**Discussion**

Cardiac disease complicates approximately 1% of all pregnancies.1 In the past, therapies for patients with ventricular arrhythmias included emergency management, antiarrhythmic drugs, and ablation of aberrant foci. However, these interventions resulted in numerous side effects. Since the development of the AICD, therapeutic strategies have developed into a combination of overdrive pacing sequences or shocks delivered from the device. These treatments are often combined with antiarrhythmic medications in select patients in order to minimize the frequency of episodes requiring painful shock therapy.

There are many concerns that surround the use of the AICD in pregnancy. One of these concerns is that the leads may become dislodged, fractured, or create a malignant arrhythmia due to migration related to the expanding gravid abdomen.3 Another concern is pressure necrosis of the tissue surrounding the pulse generator as the gravid uterus expands in the abdomen.3 Little data exists regarding complications of pectorally implanted devices.

External cardioversion has been used during pregnancy without incidence of adverse fetal outcomes.4 However, it remains controversial as to the effects that the AICD discharge may have on the fetus. Eleven reports of AICD discharge during pregnancy without fetal harm have been documented. The amount of energy transferred to the uterus is very small and the fibrillatory threshold of the fetal heart is high.3 The primary danger
to the fetus during cardioversion is decreased placental perfusion due to maternal hypotension.³

Arrhythmias are common during pregnancy and delivery.⁶ It has been questioned if these arrhythmias actually occur more often during pregnancy or simply are more commonly detected because of more frequent monitoring.⁶ Most arrhythmias during pregnancy and delivery are benign in that they are atrial in origin and have no adverse hemodynamic sequelae.⁷ However, an increased incidence of supraventricular tachycardia due either to accessory pathway-mediated (50%) or atrioventricular nodal reentrant mechanisms (46%) may be seen in pregnant women who are otherwise healthy.¹,⁵ Because of the hemodynamic and autonomic nervous system changes that occur during pregnancy, women with cardiac disease can elicit ventricular tachycardia.⁴ Criteria for temporary pacing include atropine-resistant bradycardia, first-degree and second-degree atrioventricular block, and atrial fibrillation with low ventricular rate.⁷

Congenital heart disease and surgery with resultant scar tissue formation and conduction disruption present in this patient increases the risk of developing these arrhythmias. The patient discussed in this study was diagnosed with tetralogy of Fallot at birth. There are several surgical treatment options for patients with this pathology, including right ventriculotomy procedure repair. It is not uncommon for these patients to develop a right bundle branch block after this procedure as a result of the surgery.⁸

The anesthetic plan for this patient population should include measures to avoid maternal sinus tachycardia (heart rate > 100/min), which may decrease placental blood flow leading to fetal acidosis and may inappropriately trigger a discharge from the AICD.³ Epidural anesthesia during the intrapartum period may be helpful to reduce the catecholamine release from pain; however, one must be careful to avoid reflex tachycardia due to maternal hypotension.³

Natale and colleagues⁵ performed a multicenter retrospective analysis on 44 pregnant patients with an AICD. The researchers evaluated complications reported in patients who had their AICD turned off during labor (n = 16) and those with AICDs that remained functional during labor (n = 28). The authors found that the rate and severity of complications between both groups was no different.⁵ Natale and colleagues⁵ concluded that pregnancy does not increase the incidence of AICD-related complications, including AICD discharge.

In our case, the AICD device was suspended with a magnet based on the recommendations of the cardiology service to prevent inappropriate firing. We applied external defibrillator pads on the patient in case of emergency. Although the AICD can be left active, suspended, or turned off during labor, the AICD must be turned off during cesarean delivery when electrocautery is used. Epidural anesthesia offers the distinct advantage in-cluding easy conversion from labor analgesia to surgical anesthesia, preservation of fetal-maternal hemodynamics, prevention of increases in plasma catecholamines due to labor or operative pain, and the potential for local anesthetic suppression of arrhythmias.³ It is important to realize that the test dose containing epinephrine can elicit malignant tachyarrhythmias and should be avoided in this particular patient population.³ In our case, we did not give a test dose. There are only a few case reports of neuraxial anesthesia administered to pregnant women with AICDs for delivery. Isacs et al³ published a case report safely documenting the use of epidural anesthesia for a parturient with an AICD. Frost and Dolak¹ reported the safe use of epidural anesthesia for a cesarean delivery after failed vacuum-assisted delivery in a parturient with an AICD. Maternal and fetal outcomes were described as being “excellent.” Al-Refai et al⁹ published a report on the first use of spinal anesthesia in a pregnant patient with an AICD and established that this is a safe method of anesthesia for cesarean delivery in this patient population.

It is important to avoid hypotension, as it can elicit tachycardia. However, in this patient with a previous history of surgical tetrology of Fallot repair, tachycardia can potentially lead to fatal arrhythmias, placental hypoperfusion, and ultimately cardiac arrest, as a result of residual scar tissue formation and disruption of the conduction pathway.¹,⁹ Hemodynamic instability that occurs because of neuraxial analgesia may be treated with sympathomimetics, such as ephedrine, which can lead to tachycardia and atrial fibrillation, reducing atrial filling time and reducing cardiac output. Phenylephrine, which is a pure direct α-agonist, may be a better choice as it causes reflex bradycardia.

Conclusion

Because of improved medical care, pregnant patients with AICDs will be seen more often in the labor and delivery suite. The severity of underlying cardiac disease is the determining factor in the management of these patients, not the fact that they have an AICD. Controversy exists concerning whether or not it is appropriate to leave the device on or turn it off and use an external defibrillator if the need should arise. This decision requires collaboration with the obstetric and cardiology services. Current literature supports leaving the AICD on unless a cesarean delivery is planned because of the use of electrocautery. Case reports have been published that show both epidural and spinal anesthesia are safe and effective forms of anesthesia for parturients with AICDs.

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