Case Report

Transcatheter Closure of a Large Patent Ductus Arteriosus in three Pregnant Women

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Abstract

Background: Hemodynamically significant PDA during pregnancy requires closure to reduce risk of maternal and fetal mortality and morbidity. But PDA device closure during pregnancy is complex in light of elevated maternal and fetal risk as well as radiation exposure to the fetus.

Case presentation:

Case 1: A 22-year-old female referred for PDA device closure. She was 26 weeks pregnant. She presented with the complaint of shortness of breath and palpitation before pregnancy, and an increase in the above symptoms for a month. A 14x16 ADO device was used to close the PDA. An echocardiogram was used to confirm closure of the duct. The total fluoroscopy time for this procedure was 0.7 min with radiation exposure of 9.5 mGy.

Case 2: A 28-year-old female referred for PDA device closure by the cardiac surgeon. She was 28 weeks pregnant. She presented with the complaint of shortness of breath for 3 weeks. A 16x18life tech PDA device ADO device, was used to close the PDA. An echocardiogram was used to confirm closure of the duct. The total fluoroscopy time for this procedure was 1.3 min with radiation exposure of 28 mGy. An echocardiogram performed the next day following device implantation demonstrated no evidence of obstruction to either branch pulmonary artery or across the aorta, and no residual shunting across the duct.

Case 3: A 31 years old female referred for PDA device closure. She was G2P1 with 26 weeks pregnant. She presented with the complain of shortness of breath of 4 weeks. A 16x18life tech PDA device was used to close the PDA. Echocardiogram was used to confirmed closure of the duct. The total fluoroscopy time for this procedure was 1.5 min with radiation exposure of 28mGy. An echocardiogram performed next day following device implantation, demonstrated no evidence of obstruction to either branch pulmonary artery or across the aorta and, no residual shunting across the duct.

Conclusions: Unrepaired PDA discovered late in pregnancy poses management challenges. With our experience of doing adult PDA, we could do the procedure with very short exposure to radiation of the fetus.

Introduction

Congenital heart disease poses a great risk to both mother and baby during pregnancy.[1] In a study with over 26,000 births, maternal mortality was 18-fold higher in those with congenital heart disease compared with those without.[2] During an uncomplicated pregnancy, maternal cardiac output will typically increase by a variety of mechanisms. Heart rate and stroke volume increase during the first trimester and peak at 6 months of gestation, while plasma volume peaks at 7–8 months.[3] In addition, both systemic and pulmonary vascular resistance will fall significantly during pregnancy.[4] Finally, there can be quite dramatic shifts in volume during labor, including maternal autotransfusion due to uterine contractions as well as marked blood loss after delivery. These changes will ultimately result in increased cardiac output leading to improved placental perfusion for the growing fetus.[5] However, Physiologic changes in pregnancy impose further stress on the maternal heart, particularly in the setting of preexistent congenital heart disease; for example, the decreased systemic vascular resistance that occurs during pregnancy increases right-to-left shunting, leading to reduced pulmonary perfusion and subsequent hypoxemia.[6] This will lead to further decompensation and an increase in maternal and fetal morbidity and mortality.[1]

In the setting of a large patent ductus arteriosus (PDA), there is, at least initially, a large left-to-right shunt, increased pulmonary blood flow, and resultant increase in the pulmonary artery pressure. Over time with a large enough ductus, this may result in irreversible pulmonary vascular obstructive disease and ultimately Eisenmenger's syndrome,[7] which carries a 50%-65% mortality rate

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during pregnancy.[8] However, in the absence of pulmonary vascular obstruction, the large left-to-right shunt that is typically seen with a large ductus arteriosus may lead to congestive heart failure. This may be exacerbated by the increases in vascular volume and cardiac output that are typical of the pregnant patient. Additionally, as already noted, pulmonary pressure will also rise in the setting of a large ductus and any degree of pulmonary hypertension may pose a significant risk during pregnancy, resulting in increased maternal morbidity and mortality as well as increased incidence of fetal wastage.[9] Additionally, there have been many cases of pregnant women presenting late in their pregnancy with complications such as preeclampsia, HELLP (hemolysis, elevated liver enzymes, low platelet) syndrome due to previously undiagnosed PDA.[8] Other Potential adverse effects of untreated PDAs during pregnancy include LV failure, Eisenmenger syndrome, and infective endocarditis.[1] The rationale for closure of the large PDA was to prevent the development of congestive heart failure as well as to decrease her risk of developing irreversible pulmonary vascular obstructive disease.[5]

Fetal radiation exposure is a concern when considering interventional procedures during pregnancy. Radiation can have a deterministic effect, where damage is induced above a dose threshold; this can produce congenital malformations of the fetus, mental and growth retardation or embryonic death.[10] Radiation can also have a stochastic effect where even the smallest exposure increases the probability of an effect in an individual, for example, malignancy. Due to these concerns, many radiological procedures are avoided in pregnancy.[11] When intervention are required, Every effort is needed to reduce radiation exposure. These measures include collimation, fluorosave, abdominal shielding, ultrasound guided puncture.[12]

We report two cases of successful transcatheter closure of a very large PDA in pregnancy in shahid Gangalal National Heart Centre, Kathmandu, Nepal.Every effort was made to reduce the radiation exposure to the patients and fetus.

Case report

Case 1. 22 years old female referred for PDA device closure. She was 26 weeks pregnant. She presented with the complain of shortness of breath and palpitation before pregnancy and increased in above symptoms for last one months. ECG showed sinus rhythm as in Fig 1. An echocardiogram was performed demonstrated dilated LA and LV, large PDA 9 mm in size with left-to-right flow across the duct on color Doppler interrogation as shown in Fig 2. To reduce the radiation dose during catheterization to we shield the patient's abdomen and pelvis with lead shields. We used low frame rates (7.5/second), small collimated beamsizes, just fluoro was used cine was not taken. Only femoral vein was cannulated and JR and straight tip standard was used to cross the PDA. Amplatzer super stiff was introduced through the JR catheter into the descending aorta. A nine French delivery sheath was introduced. Device size was selected as per the echo sizing so aortogram was not done. A 14x16 ADO device was used to close the PDA. Echocardiogram was used to confirmed closure of the duct. The total fluoroscopy time for this procedure was 0.7 min with radiation exposure of 9.5mGv. An echocardiogram performed next day following device implantation, demonstrated no evidence of obstruction to either branch pulmonary artery or across the aorta and, no residual shunting across the duct.

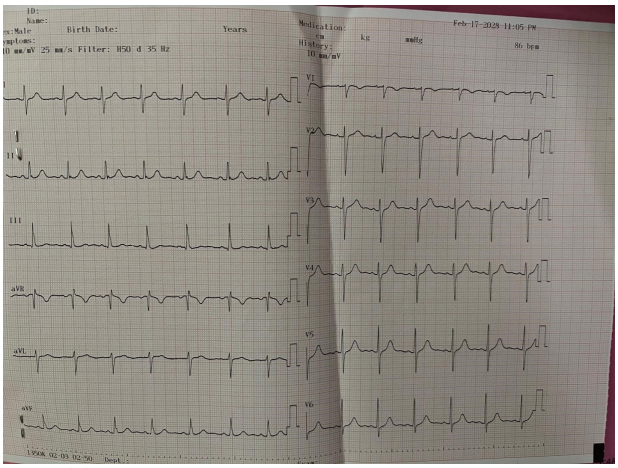

Fig 1 ECG

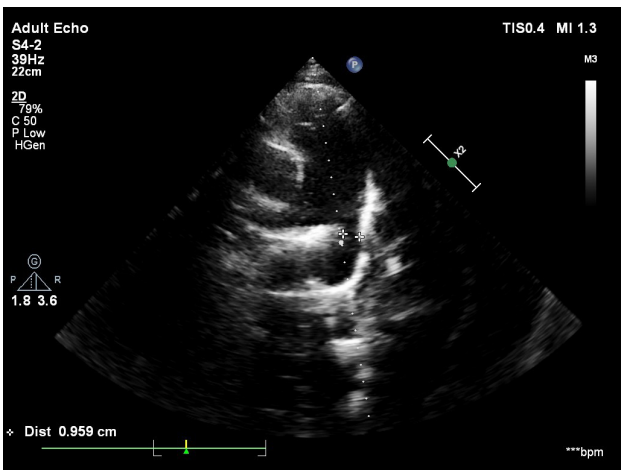

Fig.2 ECHO

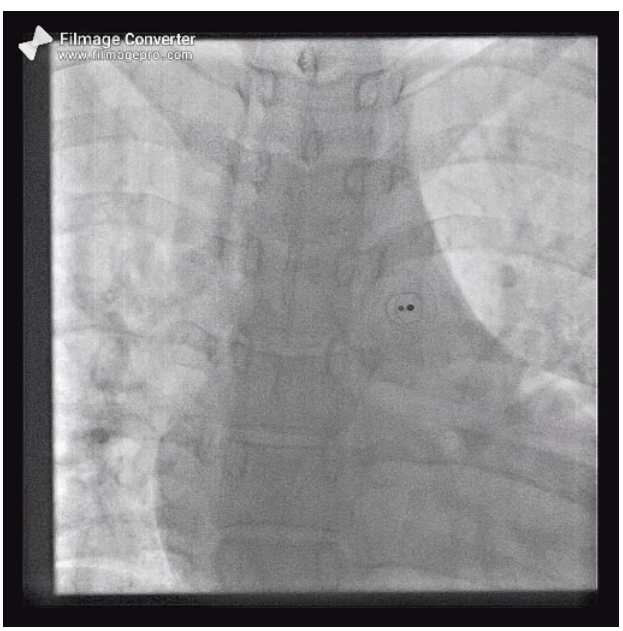

Fig 3.A 14x16 Amplazter Duct Occluder

Case 2. A 28 years old female referred for PDA device closure by the cardiac surgeon. She was 28 weeks pregnant. She presented with the complain of shortness of breath of 3 weeks. ECG showed sinus rhythm as shown in Fig 4. An echocardiogram was performed demonstrated dilated LA and LV, large PDA 12 mm in size with left-to-right flow across the duct on color Doppler interrogation Fig 5. To reduce the radiation dose during catheterization we shield the patient's abdomen and pelvis with lead shields. We used low frame rates (7.5/second), small collimated beamsizes, just fluoro was used cine was not taken. Only femoral vein was cannulated and JR and straight tip standard was used to cross the PDA. Amplatzer superstiff was introduced through the JR catheter into the descending aorta. A nine French delivery sheath was introduced. Device size was selected as per the echo sizing so aortogram was not done. A 16x18life tech PDA device device was used to close the PDA as shown in Fig 6. Echocardiogram was used to confirmed closure of the duct. The total fluoroscopy time for this procedure was 1.3 min with radiation exposure of 28mGy.

An echocardiogram performed next day following device implantation, demonstrated no evidence of obstruction to either branch pulmonary artery or across the aorta and, no residual shunting across the duct shown in Fig 7.

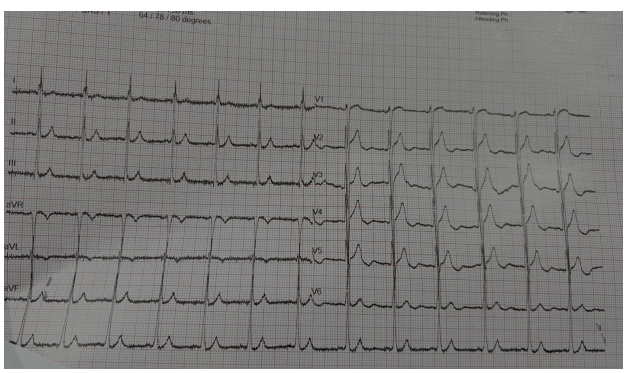

Fig. 4 ECG

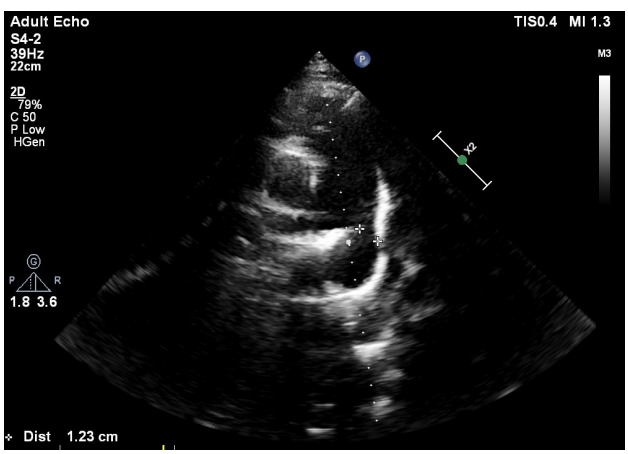

Fig 5. Echocardiogram.

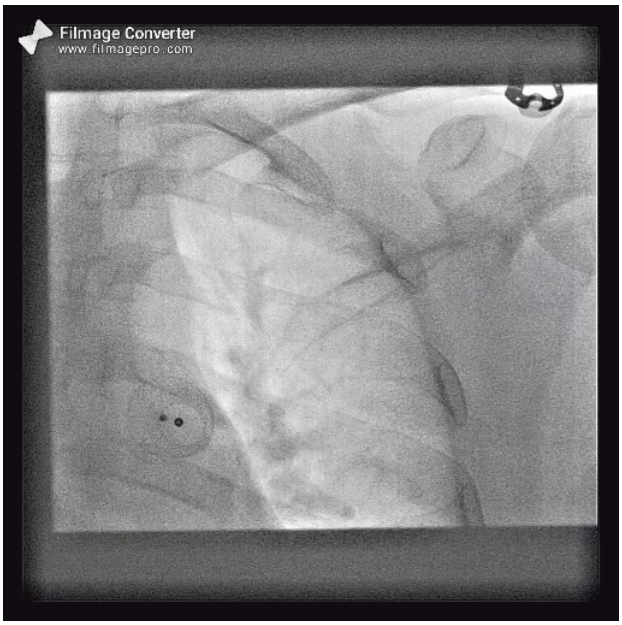

Fig 6. PDA device

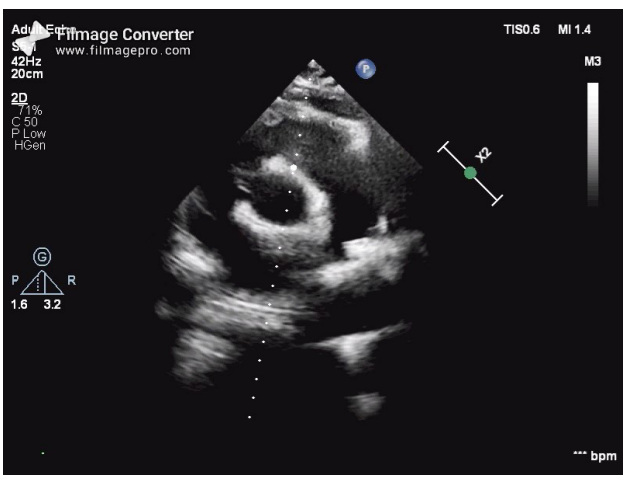

Fig.7 Echocardiogram After device closure

Case 3. A 31 years old female referred for PDA device closure. She was G2P1 with 26 weeks pregnant. She presented with the complain of shortness of breath of 3 weeks. ECG showed sinus rhythm as shown in Fig 8. An echocardiogram was performed demonstrated dilated LA and LV, large PDA 11 mm in size with left-to-right flow across the duct on color Doppler interrogation as shown in Fig 9. To reduce the radiation dose during catheterization we shield the patient's abdomen and pelvis with lead shields. We used low frame rates (7.5/second), small collimated beamsizes, just fluoro was used cine was not taken. Only femoral vein was cannulated and JR and straight tip standard was used to cross the PDA. Amplatzer superstiff was introduced through the JR catheter into the descending aorta. A nine French delivery sheath was introduced. Device size was selected as per the echo sizing so aortogram was not done. A 16x18life tech PDA device was used to close the PDA shown in Fig. 10.Echocardiogram was used to confirmed closure of the duct. The total fluoroscopy time for this procedure was 1.5 min with radiation exposure of 28mGy.

An echocardiogram performed next day following device implantation, demonstrated no evidence of obstruction to either branch pulmonary artery or across the aorta and, no residual shunting across the duct.

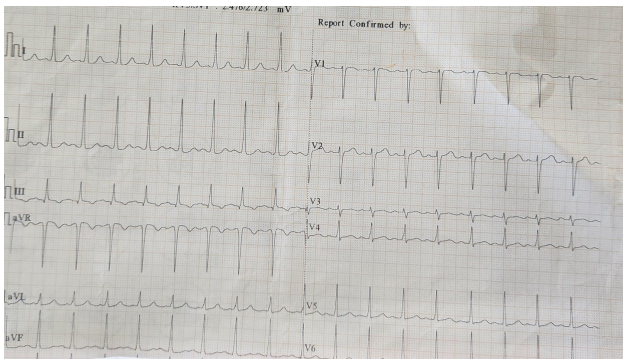

Fig 8. ECG

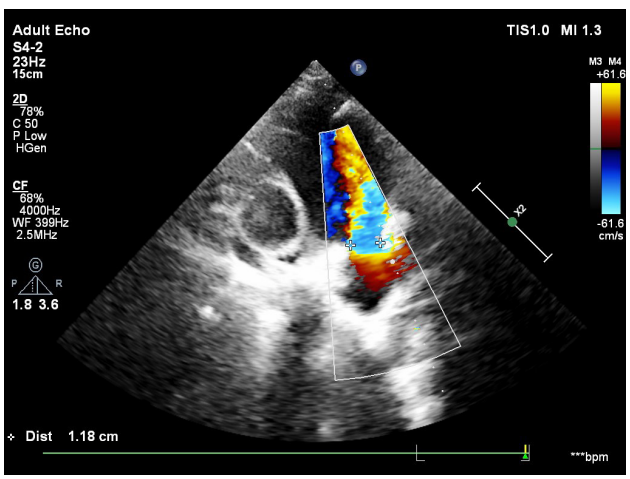

Fig 9 ECHO: PDA of 1.1cm

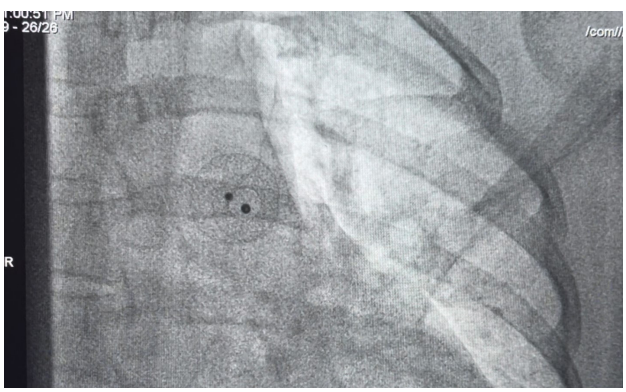

Fig 10. PDA Device in AP view

Discussion

Pregnancy is well tolerated in women with silent and small PDA or in patients who were asymptomatic before pregnancy. In woman with

a hemodynamically significant PDA,Potential adverse effects of untreated PDAs during pregnancy include LV failure, Eisenmenger syndrome, and infective endocarditis.[1] Large PDA with low-normal LVEF along with severely dilated LA and LV placed at high risk for peripartum decompensation. Ideally, PDA should be closed prior to attempted pregnancy. If pregnant patients present with a notably dilated LV in the first or second trimester, it is likely would not be able to wait for postdelivery PDA closure. But if they present late during the pregnancy when patient is at the maximal volume expansion the risks of PDA closure outweighed the benefits.[1] Both of our cases patients were symptomatic; PDA was hemodynamically significant so require PDA device closure.

In our case the PDA was successfully closed with the major advantage of avoiding the surgery, thus potentially reducing risk to both mother and fetus. A review of 394 cases of cardiac surgery performed during pregnancy by Harken and Taylor[7] demonstrated a 2% maternal mortality rate and 9% fetal mortality. Most complications to the fetus were attributed to fetal hypoxia and acidosis, which were brought on by sudden maternal anemia, alkalosis, hypotension, hypocarbia, and premature uterine contractions. Often these complications may be a consequence of anesthesia. Surgical closure of a large PDA has been associated with significant complications, including recurrent laryngeal nerve injury, aortic dissection, and left pulmonary artery ligation.[13,14,15] Additionally, the repair of such a lesion in an adult is often complicated by calcification of the ductus requiring the use of cardiopulmonary bypass because of concerns of ductal rupture during simple ligature or attempts at division.[5] All these risks are clearly compounded in the pregnant patient where any surgery of any nature, is generally of greater risk.

Fetal radiation exposure is a concern when considering interventional procedures. Every effort should be made to reduce the radiation exposure. In our cases total fluoroscopy time was 0.7 min and 1.3 min with radiation exposure of 9.5mGy and 28mGy. The American College of Obstetricians and Gynecologists supports the NCRP recommendation, that exposure to a radiation dose ≤50 mGy has not been associated with an increase in fetal anomalies or pregnancy losses.[16] Most interventions can be performed with exposure of<50 mGy; at this threshold, no reported fetal anomalies have been noted.[16,17] other studies have reported that fetal risk of malformation increases at a threshold of >150 mGy.32 In our cases we did collimation, fluorosave, abdominal shielding, swift procedure to reduce radiation exposure to the patients and the fetus. We did the femoral vein cannulation without fluoro.

The potential for fetal malformation correlates with gestational age, such that exposure during the first trimester, the period of organogenesis, is associated with the highest risk, with declining risk as gestational age advances. If possible, consideration for intervention should take into account gestational age and be deferred until after the first trimester.[12] In our cases we performed after the second trimester to reduce the exposure to the patient.

The usual problem encountered in PDA closure in adults is difficulty crossing the duct from the pulmonary end.[18] If crossing PDA from the pulmonary end take time or cannot crossed from the pulmonary end and have to go through retrograde approach longer radiation is required. This may cause the risk to the fetus. In our case due to our experience on doing many adults PDA we easily crossed the PDA; reducing the duration of radiation exposure.

Conclusion

We present three cases of a large, unrepaired PDA discovered late in pregnancy, which poses management challenges. With our experience of doing adults PDA, we could do the procedure with very short exposure of radiation to the fetus.

We obtained a written consent from the patients.

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