Introduction

Heart surgery is relatively rare in women of child bearing age and estimated to occur in only 2%–4%. Congenital heart disease accounts for majority of cases in the western World and rheumatic valvular heart disease in the developing World. Ischemic heart disease with acute coronary syndrome (ACS) is rare with most patients treated medically and by percutaneous coronary intervention (PCI). Surgical revascularization in pregnancy is infrequent and has traditionally been performed with the aid of cardiopulmonary bypass (CPB). We report a case of a pregnant patient presenting with ACS and severe triple vessel coronary artery disease (CAD). She successfully underwent off pump coronary bypass surgery (OPCAB) during the first trimester, with subsequent delivery of a full term healthy baby.

Case Report

A 31 year old female with known history of coronary artery disease and percutaneous coronary intervention presented with acute coronary syndrome. Unknown that patient was pregnant she had inadvertent radiation exposure to the fetus during cardiac catheterization which showed triple vessel disease and severe left ventricular dysfunction. Patient subsequently underwent multivessel off pump coronary artery bypass surgery with intraaortic balloon pump support after declining the recommendation for abortion. Postoperative course was uneventful and patient subsequently delivered a full term healthy baby several months later.

Off pump revascularization with its ability to maintain pulsatile perfusion to the fetus should be considered if technically feasible for severe coronary artery disease requiring surgery during pregnancy.

Keywords: coronary artery bypass surgery, off pump surgery, pregnancy

Off Pump Coronary Artery Bypass Surgery for Multivessel Disease in Pregnancy

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31 year old morbidly obese African American female smoker, gravida 4 para 3, body mass index (BMI) 36.8 presented to the emergency room with ACS. Unknown that patient was pregnant she had inadvertent radiation exposure to the fetus during cardiac catheterization which showed triple vessel disease and severe left ventricular dysfunction. Patient subsequently underwent multivessel off pump coronary artery bypass surgery with intraaortic balloon pump support after declining the recommendation for abortion. Postoperative course was uneventful and patient subsequently delivered a full term healthy baby several months later.

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and high density lipoprotein (HDL) 39. Because of her prior cardiac history, patient underwent immediate cardiac catheterization which revealed severe triple vessel CAD with estimated ejection fraction (EF) 25%–30% (Figs. 2 and 3). She was deemed unsuitable for PCI and was therefore referred for surgical revascularization. Patient was unaware of being pregnant until the urine pregnancy test returned positive after being exposed to radiation from cardiac catheterization. Gynecology consultation was then obtained and an ultrasound confirmed a viable fetus of 9 weeks gestation with beta human chorionic gonadotropin (B-HCG) of 67498. Estimated calculated radiation dose from cardiac catheterization and fluoroscopy was 20 millisievert (20 mSV). Patient had stopped Plavix 2 weeks before and Lisinopril and Crestor (both contraindicated in pregnancy) about three months earlier when they ran out. High risk perinatal gynecologic evaluation was also obtained and patient counseled on potential risks of radiation and drug exposure in early pregnancy. She refused recommended abortion and elected to undergo surgical revascularization. Formal genetic counseling and further additional counseling on pregnancy risk was therefore recommended after discharge. Patient subsequently underwent OPCAB with left internal mammary artery (LIMA) to the LAD and reversed saphenous vein grafts to the obtuse marginal and posterior descending coronary arteries. Intraoperative intraaortic balloon pump (IABP) was utilized to help stabilize hemodynamics during manipulation of the heart. Mean arterial pressure was maintained at 80–90 mmHg with pressors throughout the surgery. Bedside ultrasound was performed preoperatively just before surgery, postoperative day one and before discharge to reconfirm fetal viability. Hospital stay was uneventful and patient discharged home on day seven. Remaining duration of her pregnancy was uneventful and she delivered a full term baby without any obvious abnormalities detected at birth. Patient 9 months after her coronary artery bypass surgery (CABG) underwent single lead automatic implantable cardioverter defibrillator (AICD) implantation for primary prevention due to ischemic cardiomyopathy with EF 25% on echocardiogram.

**Discussion**

The first reported use of CPB in pregnancy was for atrial septal defect closure during first trimester in 1959, with subsequent spontaneous abortion of the fetus occurring 3 months later. Majdan JF et al.1 reported in 1983 the first case of CABG with CPB at 12 weeks gestation with delivery of a normal full term baby. A 1983 survey of Society of Thoracic Surgeons members on intracardiac surgery in pregnancy by Becker2 found more than 80% fetal survival amongst 68 procedures performed, and reported literature fetal mortality with CPB ranging from 16%–33%. Most
cases of heart surgery reported during pregnancy are associated with rheumatic valvular disease with very few involving CABG. Atherosclerotic heart disease is rare with myocardial infarction estimated to occur 1 in 10,000 pregnancies.\(^3\) Spontaneous coronary artery dissection accounts for majority of ACS and most cases of CABG reported during pregnancy. To the best of our knowledge there has been only one reported case in the literature of atherosclerotic heart disease requiring CABG during pregnancy,\(^4\) with our patient representing the second with CAD undergoing CABG. CABG has traditionally been performed with aid of CPB until the advent of OPCAB in the mid-90s which now accounts for about 15%–20% of CABGs performed in the US and Europe\(^5\) and over 60% in Japan.\(^6\) CPB with its attendant consequences of hemodilution, hypothermia, complement activation, nonpulsatile perfusion has some deleterious effects on the uterus that could result in fetal loss.\(^7\) Parry and Westaby\(^8\) in a current literature review of CPB during pregnancy concluded that maternal mortality was comparable to that of nonpregnant women undergoing the same surgical procedures, but that fetal mortality however remains high. They suggested avoiding open heart surgery during the first trimester if feasible, and to utilize high flow, high pressure normothermic bypass to reduce risk to the fetus. Also in a more recent best evidence literature review in Medline from 1948–2011, Sepehripour et al.\(^9\) concluded that although CPB is high risk during pregnancy, utilizing high flow, high pressure, pulsatile, normothermic bypass, fetal and uterine monitoring during surgery provides the best chance of reducing associated risks. OPCAB in patients with CAD by avoiding some of these deleterious effects associated with CPB presents an alternative approach when feasible. There is however significant hemodynamic changes with manipulation of the heart during OPCAB especially with retractions and mechanical stabilizations required for exposure of the posterior surface of the heart during multivessel revascularization. These hemodynamics impairments are likely less during early pregnancy with the smaller uterine size. OPCAB at normothermia with a beating heart and maintaining mean arterial pressure at 80–90 mmHg with pressors and IABP in our patient achieved this goal of maintaining adequate perfusion to the uterus and fetus recommended for surgeries utilizing CPB. However, if patient is unable to tolerate the retractions required for multivessel OPCAB, utilizing on pump beating heart CABG with high flows at normothermia would be another alternative technique. Because our patient had severe left ventricular dysfunction we elected to perform OPCAB with the possibility of conversion to on pump beating heart CABG should significant hemodynamic instability occur during manipulations of the heart. The insertion of IABP we believe helped maintain hemodynamic stability during the various retractions and manipulations of the heart.

**Conclusion**

Abu-Omar and Taggart\(^5\) after an extensive critical review of several randomized trials, meta-analysis and observational studies concluded that OPCAB was at least as safe as on pump surgery in experienced hands and that both techniques are acceptable for revascularization. OPCAB was especially beneficial in high risk elderly patients with atherosclerotic aorta posing a higher risk for stroke with manipulation. CAD in pregnancy requiring surgical revascularization may be another high risk category where consideration should be given for OPCAB when technically feasible to reduce fetal mortality associated with cardiopulmonary bypass.

**Disclosure Statement**

The authors have no financial or other interests in the manufacture or distribution of any of the implanted valves. The authors have no conflict of interest.

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