CASE REPORT

Multiple pregnancy in a primigravida with uncorrected Pentalogy of Fallot

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SUMMARY

Pentalogy of Fallot is a cyanotic congenital heart disease that has guarded prognosis without surgical intervention in infancy. Women with uncorrected defects rarely survive into childbearing age and pregnancy in this group is associated with a high rate of perinatal loss. Physiological cardiovascular changes in pregnancy can lead to maternal haemodynamic instability with subsequent adverse cardiac sequelae with or without fetal decompensation. Optimum management and pregnancy outcomes in mother with uncorrected Pentalogy of Fallot and twin pregnancy have not been described in the literature. We describe a successful case of monochorionic diamniotic twin pregnancy in an affected woman who has not undergone surgical repair. Her pregnancy progressed without any adverse cardiopulmonary complications. Her caesarean delivery and postpartum recovery were favourable, with successful birth of two healthy babies at 35.7 weeks. This case emphasises the importance of a multidisciplinary team, especially of obstetricians with expertise in high-risk pregnancies, adult congenital heart disease cardiologists and anaesthesiologists.

BACKGROUND

Tetralogy of Fallot (ToF) is the most common form of cyanotic congenital heart disease contributing to 10% of all congenital heart malformations.¹ It was a clinical entity first described by the French physician Etienne-Louis Arthur Fallot in 1888, which comprises an over-riding aorta, obstruction of the right ventricular outflow tract (RVOT), right ventricular hypertrophy (RVH) and a ventricular septal defect (VSD).² When an atrial septal defect (ASD) coexists with the presence of ToF, it is often referred to as Pentalogy of Fallot (PoF). Despite this additional anatomical defect, the underlying pathophysiology of PoF and ToF remains similar, with their severity being primarily determined by the degree of RVOT obstruction. The variation in systemic vascular resistance (SVR) and severity of the RVOT obstruction construct a pressure gradient, potentiating a resultant sequelae of right-to-left cardiac shunting.

Normal pregnancy is associated with marked changes in maternal cardiovascular and haemodynamic status, which include increased blood volume and heart rate with a parallel rise in cardiac output and decrease in peripheral and pulmonary vascular resistance.³ Women with surgically uncorrected ToF often have limited cardiac reserve with reduced ability to tolerate the cardiovascular demands of pregnancy.⁴ A fall in SVR due to

systemic vasodilatation during pregnancy increases the degree of right-to-left shunting leading to maternal cyanosis and subsequent fetal hypoxia. In the presence of significant RVOT obstruction, the increased volume load of pregnancy may trigger arrhythmia and right heart failure.^{5 6}

Most patients with cyanotic heart defect are diagnosed immediately after birth and will have undergone either palliative procedures or definitive surgical repair at the time of diagnosis. Without surgical intervention, prognosis is extremely guarded with survival rate of 11% at 20 years dropping to only 6% at 30 years.² Good pregnancy outcomes have been reported in ToF patients who have undergone reparative surgery in childhood without subsequent significant residual lesion,⁷ albeit with higher rate of obstetric complications being reported in literatures than that of the normal population.⁸ Unsurprisingly, pregnancy in unoperated women with this disorder is associated with severe maternal cardiac, obstetric and fetal complications with significantly increased risk of maternal mortality or severe morbidity (Modified WHO Classification of Pregnancy Risk Class III) and an even higher rate of perinatal loss.⁹

There is paucity of literature on the management of pregnancy in uncorrected PoF owing to the high mortality rate in the absence of corrective surgery early in life and the rarity of ongoing pregnancy in such cases. We present the rare case of a woman with uncorrected PoF who survived an almost full course of pregnancy leading to successful delivery of monochorionic twins.

CASE PRESENTATION

A 31-year-old primigravida presented to a regional maternity hospital with a spontaneous pregnancy at 9 weeks gestation for her first antenatal visit. First trimester ultrasound at 11 weeks revealed a single intrauterine gestational sac with two viable fetal poles and absence of the 'twin peak' sign at the membrane-placenta interface, consistent with that of a monochorionic diamniotic (MCDA) twin pregnancy. Routine physical examination revealed a harsh grade 4 systolic ejection murmur at the left upper sternal border. The patient had a history of congenital heart disease that was diagnosed at age 8, for which she declined further work up, treatment and follow-up. In her childhood, she reported multiple episodes of fainting spells and history of blue discolouration of the periphery with squatting episodes. She, however, remained free of cyanotic spells during the current pregnancy.

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At her initial antenatal visit, the patient was well with no cardiopulmonary symptoms. Her oxygen saturation was at 98% on pulse oximetry on room air. ECG showed sinus rhythm, right bundle branch block with right axis deviation, and evidence of RVH (figure 1). Mean haemoglobin concentration was 13.1 g/dL. ECG performed at 21 weeks gestation revealed a large VSD (1.8 cm) with bi-directional shunting across the defect (left-to-right shunting at systolic phase and right-to-left shunting at diastolic phase), over-riding aorta, moderately dilated right ventricular cavity with moderate RVH, severe pulmonary valve (PV) and fundibular stenosis (peak velocity (PV Vmax)) of 5 m/s, peak pressure gradient (PPG) of 101 with mild pulmonary regurgitation (PR) and moderate-sized secundum ASD with predominant left-to-right shunt. Her echo findings were consistent with the diagnosis of PoF. The biventricular functions were normal, with an left ventricular (LV) ejection fraction of 71%.

In view of her high risk pregnancy, her care was subsequently transferred to our hospital at 26 weeks gestation to allow for multidisciplinary team (MDT) involving dedicated specialists with specific expertise to be involved in her care throughout pregnancy, labour, delivery and puerperium. During her initial consultation at our hospital, she was a New York Heart Association Class 1. Patient was subsequently followed up at 2-week intervals for the remainder of her pregnancy at the high-risk obstetric clinic and reviewed at the monthly joint cardiac-obstetric unit, a special clinic involving collaborative management of skilled cardiologist and obstetricians in our maternal-fetal medicine unit. Regular fortnightly ultrasound scans, taking place after 16 weeks gestation, showed no significant discrepancy in amniotic fluid volume between the two sacs to suggest the presence of twin-twin transfusion syndrome (TTTS). Her 20-week screening scan showed concordant male gender with no apparent structural malformations in both fetus, apart from a single umbilical artery for twin 1. Subsequent assessment of fetal growth and well-being with ultrasound scan and Doppler velocimetry after 24 weeks gestation showed satisfactory growth in twin 2, with no evidence of growth restriction. Small-for-gestation (SGA) was noted in twin 1 from 28 weeks of gestation, however, Doppler Index remained normal throughout until 36 weeks gestation. ECG at 31 weeks gestation showed no increased in right-to-left shunting through both the interseptal defects. A detailed written delivery plan was created at 34 weeks gestation following discussion at the multidisciplinary meeting attended by two senior obstetricians, an adult congenital heart disease (ACHD) senior consultant cardiologist, a cardiothoracic surgeon and two senior consultant anaesthesiologists.

Figure 1 The ECG at 9 weeks gestation showing right bundle branch block with right axis deviation and evidence of right ventricular hypertrophy.

TREATMENT

Patient underwent elective lower segment caesarean section (LSCS) at 35.7 weeks. She was admitted 1 day before her scheduled caesarean section date and underwent continuous oxygen saturation monitoring overnight. Two senior consultant obstetricians, one senior consultant anaesthesiologist, one cardiologist, one cardiothoracic surgeon, and two neonatologists attended the delivery. Patient was initially planned for a slow controlled regional anaesthesia via a combined spinal and epidural, however, this was abandoned due to unsuccessful attempts at obtaining cerebrospinal fluid during spinal needle insertion and decision made for conversion to general anaesthesia.

Patient was connected to standard monitors, such as non-invasive blood pressure, pulse oximetry and ECG in the operating theatre. Two 16G Angiocath intravenous catheters were secured. Central venous pressure (CVP) catheter and intra-arterial (IA) line were inserted after induction of anaesthesia to monitor CVP and arterial blood pressure, respectively. Extracorporeal Membrane Oxygenation (ECMO) was placed on standby in anticipation for potential complications such as heart failure and arrhythmia peri-operatively. The patient received phenylephrine infusion (maximum rate of 75 mg/hour) to maintain her SVR. Cefazolin 2 g intravenous was administered 1 hour prior to surgery as prophylaxis against infective endocarditis (IE).

OUTCOME AND FOLLOW-UP

The LSCS performed was uneventful and both babies were born with Apgar score of 8 and 9 at 1 and 5 min of life, respectively. Carbetocin (100 µg), administered as a single intravenous bolus together with a slow intravenous infusion of oxytocin (30 IU in 1000 mL, 150mL/hour) were the uterotonic agents of choice after placental delivery to prevent maternal haemorrhage in the third stage of labour.

Postoperatively, patient was shifted to Surgical Intensive Care Unit for observation and transferred to the ward 48 hours later. Thromboprophylaxis was in place with thromboembolic deterrent stockings (TEDS) and daily subcutaneous enoxaparin (40 mg). Intravenous patient controlled analgesia (PCA) morphine was given as analgesia during the early postoperative period. Daily ECG was performed and patient was reviewed by the cardiology team regularly during her recovery period. Her subsequent postoperative stay in hospital was uneventful. Information on contraceptive measures and future pregnancies were discussed prior to discharge. A follow-up clinical assessment and echocardiography with ACHD cardiologist was arranged at 2 weeks post partum; however, patient defaulted her appointment and was subsequently lost to follow-up.

The birth weight of twin 1 and 2 were 1800 and 1960 g, respectively. There were no congenital anomalies, including congenital cardiac malformations reported in both infants and they were discharged well at day 7 of life.

DISCUSSION

Normal pregnancy and delivery is associated with dramatic cardiovascular changes, most notably an increase in plasma volume and cardiac output and a reduction in systemic and pulmonary vascular resistance. In women with structural heart defect, these alterations can result in functional deterioration leading to decompensation or death of the mother or fetus. There is very limited data on pregnancy outcome in patients with uncorrected cyanotic heart disease as only a small proportion survives to childbearing age and pregnancy is often not advised.⁹ Data on patients who have undergone surgical repair for ToF but with

haemodynamically significant residual lesions such as RVOT obstruction, VSD and aortic regurgitation showed increased risk of maternal and fetal complications. Miscarriages and fetal growth retardation occur at a higher rate in this group compared with the general population with arrhythmia and heart failure being the main cardiac complications reported during pregnancy.

In unrepaired ToF, maternal and fetal outcomes are largely dependent on the degree of maternal cyanosis.^{10 11} In our patient, her underlying cardiac lesions are such that there was minimal right-to-left shunting and patient remained relatively acyanotic throughout her pregnancy and during labour, this is the likely explanation for her good outcome in an uncorrected PoF. Twin pregnancy places this patient at an even higher obstetric risk as it is associated with significantly greater increase in cardiac output than that recorded in singleton pregnancy, because of a greater increase in heart rate which in turn increases the risk of heart failure.¹² A retrospective study on 76 pregnancies complicated by congenital heart disease and residual haemodynamic RVOT obstruction showed twin pregnancy was one of the main predictors of right heart failure in this group.⁷ In spite of this and the severity of PV stenosis in this case, the patient did not develop symptoms of right heart failure at any stage during the pregnancy. Pregnancies with an isolated PV stenosis in the absence of right ventricular dysfunction are usually well tolerated, even with severe stenosis.¹³ Severe PR and/or right ventricular dysfunction were reported in several studies as the main independent risk factors for adverse cardiovascular events in patients with ToF during pregnancy, rendering them at some risk for symptoms of right heart failure.^{14 15} Absence of severe PR with preserved right ventricular function puts the patient at low risk for adverse cardiac event and can potentially explain the lack of maternal complications observed in this case.

Fetal growth restriction was a common occurrence in pregnancy in mothers with unrepaired ToF. In a retrospective study, involving 147 women with ToF, uncorrected defects at the time of pregnancy was found to be an independent risk factor of low birth weight. Eighty-six per cent of infants who were small for gestational age in this study were born to women with unrepaired ToF.⁶

Ideally, women with congenital heart disease should receive preconceptual counselling and undergo detailed assessment of their condition at an ACHD centre. Risk imposed by haemodynamic changes of pregnancy on the existing heart defects should be informed to the patient, ideally before pregnancy. Pregnancy should then be followed-up at joint obstetric and ACHD clinic, follow-up intervals should be individualised to each case.

A planned caesarean delivery was performed in this case for obstetric indication and perceived maternal cardiac risk. Labour in monochorionic twins carries a 10% risk of acute transfusion. There is also concern about maternal deterioration during labour in view of severe right ventricular hypertension and the possibility of increasing right-to-left shunting that was already present at diastolic phase in this case. Following joint discussion between the MDT and the patient, caesarean delivery was preferred as the mode of delivery in this case.

Anaesthesia management of women with uncorrected PoF during labour and delivery poses several challenges to the anaesthesiologist and warrant a meticulous and cautious anaesthetic plan. Regardless of mode of delivery, there is a large increase in cardiac output immediately after delivery arising from relief of caval compression and autotransfusion associated with uterine

involution.¹⁴ This rapid fluid shift can lead to haemodynamic instability and decompensation, such as heart failure due to the addition of extra blood volume on an already volume-loaded right ventricle.

The European Society Guidelines on the management of cardiovascular disease in pregnancy recommends the use of continuous lumbar epidural analgesia or spinal anaesthesia during labour and delivery.¹⁴ Maintenance of left-sided filling pressure is a critical component in the peripartum management of this patient to avoid reversal of left-to-right flow or further worsening of a pre-existing right-to-left shunting through the VSD. Regional anaesthesia can occasionally cause excessive systemic vasodilatation with risk of exacerbating right-to-left shunting leading to maternal hypoxaemia and perioperative cyanotic spells.¹⁶ Right-to-left shunting also increases the risk of paradoxical air embolism and adequate measures to prevent such phenomenon such as ensuring all intravenous devices being equipped with air bubbles filter is crucial.¹⁷ In this case, where regional anaesthesia was not successfully placed, general anaesthesia was implemented. General anaesthesia is associated with several challenges in these patients; many of the agents used for induction and maintenance of general anaesthesia decreases the SVR with a potential of causing more right-to-left shunting through the VSD and there is risk of adverse haemodynamic responses associated with laryngoscopy and intubation that may lead to decompensation in these patients with reduced cardiac reserve.¹⁸ Phenylephrine was used as vasopressor in this case in anticipation of the drop in SVR caused by general anaesthesia. Its use in patients with ToF has also been linked to increase in pulmonary blood flow with subsequent improvement in arterial oxygen saturation.¹⁹

Recommendations from the American Heart Association currently do not support the use of antibiotics prophylaxis against IE in uncomplicated caesarean deliveries.²⁰ However, the decision was made to give IE prophylaxis in this case, as its administration is simple with little adverse outcome and uncorrected cyanotic heart disease has a high risk of adverse complications from endocarditis.

Close monitoring and follow-up in the postpartum period is crucial as cardiac complications may occur up to 6 weeks after delivery.²¹ Long-term follow-up with an ACHD cardiologist is strongly recommended as interventions may be required. With respect to the current case of severe RVOT obstruction with normal biventricular functions and absence of other comorbidities, a complete intracardiac repair should be considered, as overall survival is excellent with an acceptable operative risk.⁵ Should future pregnancies be considered, mothers who undergo corrective surgery prior to conception are able to better accommodate the increased haemodynamic load associated with pregnancy and has lesser risk in compromising the growth of the fetus, resulting in a much reduced rate of infants born with low birth weight.²²

Contraception is another important component to be discussed in the postnatal follow-up. Oestrogen-containing oral contraceptives are associated with increased risk of thrombosis and are therefore best avoided in patients who are already at high risk of thrombosis, such as those with atrial and/or ventricular dilation with risk of atrial fibrillation or intracardiac right-to-left intracardiac shunt where there is risk of paradoxical embolism.²³ Progesterone-only pills and dermal implant are suitable contraceptive method for complex congenital heart disease; however, the latter is preferred due to its efficacy and lack of potential complications associated with its insertion. Intrauterine device is a suitable contraceptive method in the

absence of severe cyanosis; however, its insertion may be associated with bacteraemia.¹⁴

Pregnancy may have long-term implications on mothers with cyanotic congenital heart disease by causing significant deterioration in functional cardiac status that persists after completion of pregnancy.²⁴ Maternal cardiac decompensation occurs frequently during pregnancies in patients with uncorrected defects.^{25 26} Patients who had surgical correction of PoF are also at risk, particularly if they have moderate-to-severe PR, albeit at a much lesser rate than those with unrepaired lesions.^{6 8 27} The majority of patients who had significant cardiac progression during pregnancy return to their prepregnancy functional status following prompt treatment. However, in a small proportion, deterioration of ventricular function persists even after resolution of pregnancy.²⁸ Uebing and colleagues in 2010 reported the effect of pregnancy in patients with heart disease, including women with surgically corrected ToF. Although their study found no change in clinical status and ventricular function in pregnant and non-pregnant group, a persistent right ventricular dilation after pregnancy was reported in mothers with repaired ToF, a phenomenon that was not observed in the non-pregnant control group.²⁹ Increase in right ventricular dimension predisposes these individuals to the development of arrhythmia and sudden cardiac death.³⁰ It is therefore essential to counsel patients with PoF on the likelihood of pregnancy resulting in long-term deterioration in cardiac function.

Learning points

- Pregnancy in women with uncorrected Pentalogy of Fallot falls into class III of the modified WHO classification of maternal cardiovascular risk, where there is a high risk of maternal cardiac complications.
- Obstetric and fetal complications also occur more frequently in this group and are closely related to the degree of maternal cyanosis.
- Intensive cardiac and obstetric monitoring throughout pregnancy, childbirth and the postpartum period are fundamental in achieving successful outcome for mother and baby.
- Multidisciplinary team care involving obstetricians with expertise in maternal fetal medicine, adult congenital heart disease cardiologists and senior anaesthesiologists is crucial in the management of this high-risk pregnancy.

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