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CASE REPORT
Congenital heart disease

A case report: mechanical tricuspid valve thrombosis necessitating cardiac surgery during pregnancy

Gnalini Sathananthan *, Niall Johal , and Jasmine Grewal

Department of Cardiology, St. Paul's Hospital, 1081 Burrard St., Vancouver, British Columbia V6Z 1Y6, Canada

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Background Pregnant women with mechanical valves are considered a high-risk pregnancy. They carry an increased risk of both maternal and foetal complications. This includes maternal valve thrombosis, foetal embryopathy, and haemorrhage. Cardiac surgery is generally avoided during pregnancy, and is used when there are no other alternative options. Cardiopulmonary bypass (CPB) during pregnancy is associated with high foetal mortality. Maternal mortality in the setting of CPB however, is not dissimilar to a non-pregnant woman.

Case summary We present the case of a 29-year-old woman with Ebstein's anomaly who developed thrombosis of her mechanical tricuspid valve at 4 weeks' gestation. This was suspected to be likely due to sub-therapeutic anticoagulation at the time of presentation. She underwent a tricuspid valve replacement during the first trimester of pregnancy after failing medical therapy, with overall favourable maternal and foetal outcomes.

Discussion Valve thrombosis during pregnancy is a devastating complication. There is limited data surrounding the best management strategy of valve thrombosis in pregnancy. Cardiac surgery with CPB is reserved for cases refractory to appropriate medical therapy. Though maternal mortality is largely unaffected, foetal mortality with CPB remains high. The management of pregnant women undergoing CPB is unique and extremely challenging. It requires a meticulous, multidisciplinary approach to improve overall outcomes.

Keywords Pregnancy • Valve thrombosis • Cardiac surgery • Case report

Learning points

- Mechanical right-sided valves are more prone to thrombosis compared with left-sided valves, and this risk increases with pregnancy.
- The anticoagulation strategy used during pregnancy can be challenging. The benefits of low molecular weight heparin and Coumadin therapy needs to be weighed up against the potential risks of each option.
- Cardiac surgery during pregnancy is associated with high foetal mortality and should only be reserved for women who are critically ill or who fail appropriate medical therapy.

* Corresponding author. Tel: +1 604 806 9090, Email: gsathananthan@providencehealth.bc.ca
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Introduction

Mechanical valve thrombosis is associated with significant morbidity and mortality. The incidence of right-sided valve thrombosis is significantly higher than on the left side, and is reported in up to 20% of mechanical tricuspid valves.[1,2] Consequently, higher international normalized ratio (INR) targets are recommended for right-sided mechanical valves.[3,4] Pregnancy in a woman with a mechanical valve is associated with a high risk of complications. In the ROPAC registry, only 58% of women with a mechanical valve had an event-free pregnancy resulting in a live birth.[5] The major risk is related to valve thrombosis and haemorrhagic complications. Valvular and/or ventricular dysfunction accentuates this risk.

In a haemodynamically stable patient with valve thrombosis in pregnancy, initial management includes therapeutic anticoagulation with IV unfractionated heparin (UFH). If this fails in the stable patient, thrombolysis may be considered. Thrombolysis has shown favourable results in right-sided valve thrombosis, though the data in pregnant women remains limited.[6] A small series of 25 pregnancies with mitral valve thrombosis demonstrated safety and success of thrombolysis.[7] Cardiac surgery is reserved for critically ill mothers with obstructive thrombosis. Cardiopulmonary bypass (CPB) during pregnancy is associated with high foetal mortality, up to 33%.[8]

Timeline

Time	Events
11 years before presentation	Mechanical tricuspid valve replacement and valve thrombosis 1 month post-operatively
4 weeks gestation	Switched from warfarin to low molecular weight heparin
6 weeks gestation	Mechanical tricuspid valve thrombosis necessitating hospital admission
8 weeks gestation	Bioprosthetic tricuspid valve replacement
39 weeks gestation	Gestational hypertension and oligohydramnios necessitating induction of labour

Case presentation

A 29-year-old, G2 A1 L0 woman with Ebstein's anomaly underwent a mechanical tricuspid valve replacement (31-mm Carbomedics) at age 18 years. The details surrounding this were not available. She had no other relevant medical history. She was on warfarin, with a target INR of 3–3.5. She presented with mechanical tricuspid valve thrombosis 1 month following surgery with sub-therapeutic INR levels. She received successful thrombolysis and was subsequently followed annually at our Adult Congenital Heart Clinic. Her transthoracic echocardiogram findings remained stable during follow-up, with a mean gradient 6 mmHg across the prosthesis, trivial tricuspid regurgitation (TR), mild right ventricle (RV) dilation, and dysfunction.

She became pregnant at age 29 years. She was switched from warfarin to LMWH (weight-based dose dalteparin 12 500 units daily) at 4 weeks' gestation, in the community. She was transferred to our institution with right-sided heart failure and syncope at 6 weeks' gestation. Physical examination revealed clear lung fields, an elevated jugular venous pressure and mild pedal oedema. She had a Grade 2/4 diastolic murmur and a Grade 2/6 holosystolic murmur, best heard at the left lower sternal edge. She was in sinus rhythm and haemodynamically stable. Her blood work showed mildly abnormal liver enzymes: AST 52 U/L (*N* 10–35), ALT 85 U/L (*N* 5–45), GGT 70 U/L (*N* < 50), ALP 33 U/L (*N* 30–105), bilirubin 8 µmol/L (*N* < 20), and a normal renal profile. She had one anti-Xa level performed 8 days prior which was low (0.13 IU/mL), measured 8 h post-dose. Transthoracic echocardiogram confirmed tricuspid valve thrombosis with restricted occluder motion, mean gradient 13 mmHg, with mild RV dilation and dysfunction. Tricuspid regurgitation was difficult to quantify (*Figure 1*).

Intravenous UFH and low-dose aspirin was commenced with no symptomatic improvement. A transoesophageal echo confirmed restriction of both occluders, with severe TR (*Figure 2*).

Both thrombolysis and cardiac surgery were discussed with the patient considering her history of valve thrombosis, risk of recurrent thrombosis in pregnancy, her significant symptoms and prosthesis dysfunction, limited data on thrombolysis in pregnancy, and the foetal risks associated with cardiac surgery. She opted for a surgical bioprosthetic valve replacement and underwent surgery at 8 weeks' gestation (33-mm St. Jude Epic). The surgery was performed by a senior cardiac surgeon and cardiac anaesthesiologist, with close maternal and uterine monitoring throughout. Foetal monitoring was challenging due to the early gestational age. Total duration of pulsatile CPB was 96 min, her temperature was between 36°C and 37°C, pump flow rate between 2.6 and 3.0 L/min/m^2, and haematocrit between 29% and 31%. The foetus remained viable following surgery. She was placed on dalteparin 15 000 units daily and low-dose aspirin for 3 months post-operatively. Her anti-Xa levels were closely monitored and remained in the desired range of 1–1.5 IU/mL. She remained well throughout the remainder of her pregnancy though developed gestational hypertension and oligohydramnios at 39 weeks' gestation. She was induced and had a normal vaginal delivery. Her postpartum course was uncomplicated. The baby had an Apgar score of 9 and 9 at 1 and 5 min, respectively, with a birthweight of 3.2 kg. At 5-year follow-up, the patient continues to do well.

Discussion

This report illustrates the case of a pregnant woman who developed mechanical tricuspid valve thrombosis at 6 weeks gestation. She was at high risk for valve thrombosis during pregnancy given the right-sided prosthesis, prior valve thrombosis, and questionable compliance with anticoagulation. She had received pre-pregnancy counselling and was aware of the high-risk nature of the pregnancy as well as the complexities of anticoagulation during pregnancy.

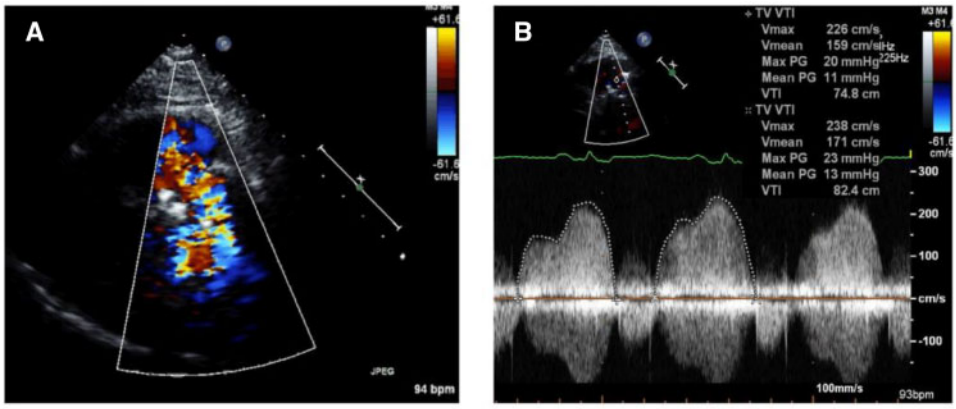

Figure 1 Transthoracic echo showing tricuspid stenosis, with a mean gradient of 13 mmHg.

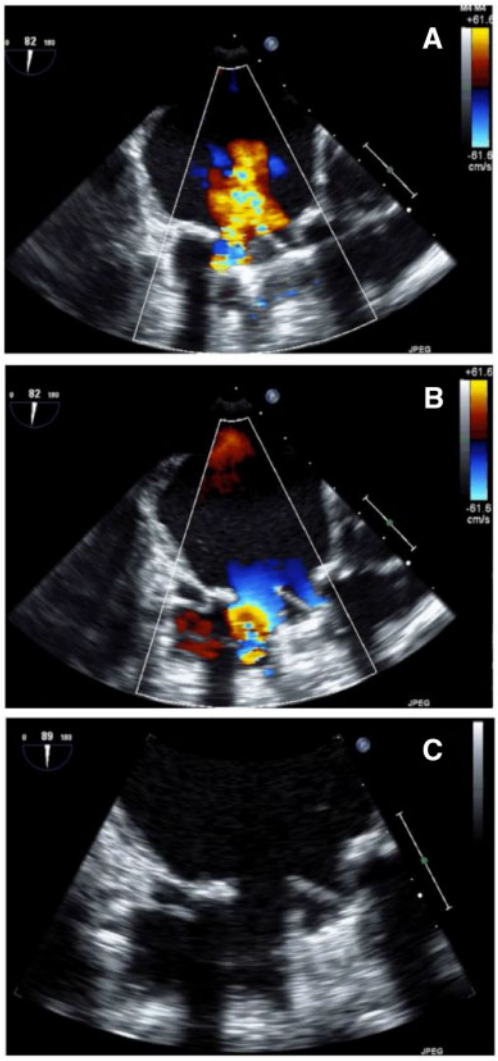

Figure 2 Transoesophageal echo showing restricted occluders and severe tricuspid regurgitation.

Pregnancy and mechanical prosthesis

Choice of anticoagulation strategy during pregnancy requires an extensive discussion with the mother regarding the risks and benefits of both warfarin and heparin. Low molecular weight heparin (LMWH) and UFH are safely used in pregnancy as they do not cross the placenta though there is a substantial risk of valve thrombosis. Valve thrombosis has been reported in 5.8–7.4% of cases when LMWH is used in the first trimester only, which is similar to when LMWH is used throughout pregnancy. Valve thrombosis with UFH is substantially higher, and is reported as high as 33%. However, right-sided prostheses are under-represented in these reports, suggesting that the rates of right-sided valve thrombosis may be even higher.[5,9,10] There are reports of valve thrombosis in the setting of adequate peak anti-Xa levels (target anti-Xa 1.0–1.2 IU/mL measured 4-6 h post-dose, for mitral or right-sided valves) highlighting the need for caution when using this strategy.[3,11] Sub-therapeutic trough levels may play a role and should likely be measured in women at particularly high risk of thrombosis.[12] Warfarin use throughout pregnancy carries the lowest risk for thrombosis (0–4%). However, this needs to be weighed against the risk of embryopathy, foetopathy, foetal loss, and foetal haemorrhage.[13,14] The 2018 ESC guidelines suggest low-dose warfarin can be continued throughout the pregnancy as the risk of foetopathy (<2%) and foetal loss (<20%) is low. If the mother finds this risk unacceptable or a higher dose is required, warfarin can be replaced with LMWH between 6 and 12 weeks of gestation. If delivery is expected at term, the recommendation is to switch back to LMWH at 36 weeks. A planned induction is necessary to co-ordinate cessation of anticoagulation, insertion of epidural anaesthesia and delivery, ensuring that the period without anticoagulation is minimized. Intravenous UFH can be started 36–48 h prior to a planned delivery, stopped 4–6 h before delivery, and restarted 4–6 h following delivery. A normal vaginal delivery is preferred though a planned caesarian section may be required for ease of co-ordination.[15]

Pregnancy and cardiac surgery

Cardiac surgery should only be considered when other interventions have failed in an unwell mother. Maternal mortality with CPB is low

and comparable to non-pregnant women.[8] Foetal mortality is high. If surgery is required, the best period is between 13 and 28 weeks' gestation. Surgery in the first trimester is associated with a higher risk of foetal malformations, while surgery in the third trimester is associated with premature delivery and maternal complications. If the foetus is of advanced gestational age (>28 weeks), delivery prior to the CPB should be considered.[16]

The risk of CPB can be minimized with continuous monitoring of the mother, foetus and uterine tone. Sustained uterine contractions during CPB are the leading cause of foetal death, and are observed in the cooling and rewarming phases of surgery. Uterine muscle excitability is increased by hormonal dilution. Tocolytic therapy to prevent early labour or post-operative hormonal administration can be considered.[17,18] CPB time should be minimized. Non-pulsatile flow during CPB triggers an abnormal fetoplacental response with an increase in placental vascular resistance and placental dysfunction, and therefore, pulsatile flow is preferred. Hypothermia during CPB can affect placental perfusion by acid–base imbalances, coagulation pathway alterations and can cause sustained uterine contractions.[1] Normothermia or mild hypothermia (T >35°C) has been shown to improve foetal outcomes.[18] Adequate pump flow (>2.5 L/min/m^2), perfusion pressure (>70 mmHg), and haematocrit levels >28% during CPB are recommended for optimal utero-placental perfusion.[16] Our patient had a favourable result following surgery with a healthy live birth and no further cardiac complications. The development of gestational hypertension and oligohydramnios may have been the result of placental dysfunction precipitated by the CPB. The long-term impact of CPB on the child is unknown.

Conclusion

Mechanical valve thrombosis is a serious complication during pregnancy. The risk can be decreased with close attention to anticoagulation strategies, taking into consideration maternal risk factors and opposing foetal risk. Anticoagulation with warfarin throughout pregnancy is most effective and should be considered in high-risk women such as our patient. This discussion is easier if the patient is on low-dose warfarin, thus minimizing the associated foetal risk. If LMWH is going to be used for any period of time, close attention should be given to peak and possibly trough anti-Xa levels. If valve thrombosis occurs in pregnancy, the foetal risk with cardiac surgery should be weighed against the maternal need for surgery. Cardiac surgery should generally be avoided during pregnancy, but if required a multidisciplinary approach is key with close maternal and foetal monitoring while ensuring peri-operative/surgical factors are optimized.

Patient perspective

Although the patient had undergone pre-pregnancy counselling and was aware of the potential risk of valve thrombosis, she felt unprepared for it when it did occur and especially so early on in pregnancy. The patient's choice to have surgery rather than thrombolysis was in her mind a fairly straight forward one, as she was told failed thrombolysis may also ultimately culminate in surgery. She had also had significant bleeding when she had been thrombolysed in the past.

There was a great deal of physical recovery required following the surgery but it was perhaps the emotional and psychological recovery that was the most challenging for her. The remainder of the pregnancy was filled with anxiety and worry that it would happen again. Not unsurprisingly, it also raised a lot of uncertainty about whether she wanted to have more children. She did however fall unexpectedly pregnant again 9 months later. Her second pregnancy was uncomplicated from a cardiac standpoint, though her anxiety persisted throughout this pregnancy as well. She ultimately developed postpartum depression after her second pregnancy. She is being slowly weaned off medications for this now, 4 years later.

Lead author biography

Dr Gnalini Sathananthan is currently completing her final year as an adult congenital cardiology fellow at St Paul's Hospital in Vancouver, Canada. She completed her cardiology training in Australia and New Zealand, and has subsequently undertaken fellowship training in both echocardiography and adult congenital cardiology. She has a particular interest in medical teaching.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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