Case report - Cardiopulmonary bypass

Mechanical prosthetic mitral valve thrombosis in a first trimester pregnant woman

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Abstract

Pregnant women with a mechanical heart prosthesis are at a higher risk of thromboembolic complications. The optimal anticoagulation strategy in this setting remains unclear. When prosthesis thrombosis happens and cardiac surgery must be performed, the risk of fetal mortality is high. Special attention must be paid to improve the placental perfusion during cardiopulmonary bypass (CPB) to improve fetal outcomes. A 31-year-old woman, nine weeks pregnant, was admitted to our institution due to a mitral mechanical prosthesis replacement with CPB at 34 °C and a short cardiac arrest time. Both mother and fetus survived. We briefly review the different anticoagulation options during pregnancy and perfusion strategies on CPB to improve fetal outcomes.

Keywords: Pregnancy; Mechanical heart valve

1. Introduction

Pregnant women with mechanical prosthetic heart valves (MPHV) have a hypercoagulability state [1] which significantly increases the risk of thromboembolic complications. To avoid them, an optimal anticoagulation regime is essential, taking into account the side effects of the anticoagulants on the fetus. When a prosthetic thrombosis occurs and cardiac surgery is performed, it is necessary to optimize the hemodynamic support during cardiopulmonary bypass (CPB) to improve survival chances on both mother and fetus [2, 3].

2. Case report

A 31-year-old woman, who was nine weeks pregnant, was admitted to our center because of respiratory failure. She had undergone a mitral valve replacement by a 25-mm Carbomedics mechanical prosthesis when she was 16 years old in Morocco. When pregnancy was confirmed, previous treatment with acenocumarol was discontinued and replaced by low molecular weight heparin (LMWH) (tinzaparin 0.6–0.8 ml/day (12,250–16,000 IU/day)). During the previous two weeks she had anti Xa levels within the range of anticoagulation (0.6–1.2 U/ml).

On her arrival to our center, she had congestive cardiac failure, oligoanuria and acidosis. The transthoracic echocardiography showed a prosthetic thrombosis, pannus proliferation causing a blockage of both disks and severe stenosis and moderate regurgitation (Fig. 1). Under these circumstances, an emergent surgery was performed.

We performed a median re-sternotomy. CPB was established under full (3 mg/kg) systemic heparinization, ascending aorta and bicaval cannulation. The ascending aorta was cross-clamped and a diastolic cardiac arrest was induced with antegrade cardioplegia. A nasopharyngeal temperature above 34 °C and perfusion pressures over 70 mmHg were maintained during CPB. We conducted a transseptal approach to the left atrium. The mitral prosthesis was blocked by a thrombus (Fig. 2). Thick pannus tissue had proliferated on both sides of the prosthetic ring. The prosthesis was removed, a St Jude mechanical prosthesis of 25 mm was implanted and the left atrial appendage was excluded.

The patient had a full uneventful recovery. She received non-fractioned heparin (NFH) and aspirin for four more weeks in the hospital and was discharged on the 13th week of gestation treated with aspirin and acenocumarol. When this case was reported, the mother was on her 20th week of gestation and the fetus remained alive. No anomalies were detected in the follow-up gestational echography.

3. Discussion

Pregnancy increases the risk of thrombosis of MPHV [1–3]. Oral anticoagulants (OA) are the most effective drugs for the prevention of prosthetic thrombosis, but they are also the ones with highest risk to the fetus [4]. LMWH

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The ACC/AHA [7], recommend prosthetic replacement for left prosthetic thrombosis, while thrombolysis is indicated when surgical risk is high or surgery is not possible. There is not much information on the outcomes of cardiac surgery with CPB on the mother and fetus. Mahli et al. [2] reported a mortality of 1.5–5% for the mother and 16–33% for the fetus, in pregnant women undergoing cardiac surgery with CPB. Gestational age of <25 weeks was a predictor of fetal mortality. Therefore, the surgical risk to the patient does not seem higher than in any other patient. However, in this setting, fetal outcomes are poor, especially at early gestational ages.

The results of fibrinolytic treatment in pregnancy are poorly studied. Leonhardt et al. [8] published, in 2006, a review of the results of fibrinolysis with recombinant tissue plasminogen activator on 28 pregnant patients, 7 of them with prosthetic thrombosis, with a 7% maternal mortality, 11% therapeutic failure and 24% fetal and peripartum mortality. Besides, fibrinolysis is associated with an elevated mortality (6.1–9.3%) [9] and a high incidence of intracranial bleeding (up to 19.8%) [9]. Based on these data, surgery seems preferable over fibrinolysis in the management of left prosthetic thrombosis in pregnancy.

Cardiac surgery with CPB may have deleterious effects on both the pregnant woman and the fetus. Pulsus circulation, activation of the cascades of coagulation and complement, hypotension, hypothermia and the inflammatory response may result in alterations of the placental circulation [10]. CPB under normothermia or mild hypothermia (>32 °C), high perfusion pressures (>70 mmHg) and a short CPB run seem to decrease fetal damages. In fact, Mahli et al. reported a fetal mortality of 24% in hypothermia vs. 0% in normothermia. Placental hypoperfusion leads to acidosis and subsequent fetal bradycardia that may be monitored, allowing us to modify the perfusion parameters. Fetal monitoring, which is helpful in this setting [2, 10], is only feasible in the late stages of pregnancy, therefore impossible to perform in our case.

Most of the patients reported in the literature had a gestational age >20 weeks. In our case, surgery outcomes in terms of fetal survival were uncertain prior to surgery due to the short gestational age of the mother. We maintained a CPB of 34 °C of hypothermia, perfusion pressures around 80 mmHg and a cardiac arrest time <50 min. With these precautions, the postoperative period was uneventful for the mother and the embryo survived.

References

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Comment: Cardiac operation during pregnancy: what is the cardiopulmonary bypass (CPB) used on pregnant women at various stages of pregnancy? The risks are inevitably increased and substantial efforts must be made to reduce the risk. There are several cases reported in the literature of fetal mortality is found that highly increased under hypothermic conditions. The two percent of all pregnant women suffer from some kind of cardiac disease is the leading cause of death in pregnancy [6]. Many factors are associated with pregnancy in cardiopathic patient such as social, ethical and maternal desire for decision whether the pregnancy will be terminated or maintained. When a cardiac problem requires an operation during pregnancy the risks are inevitably increased and substantial efforts must be made to reduce the risk. There are several cases reported in the literature of cardiopulmonary bypass (CPB) used on pregnant women at various stages of pregnancy [2–4]. Many factors associated with cardiac operations requiring CPB can adversely affect both the mother and the fetus, but the embryofetal mortality is found that highly increased under hypothermic conditions than the normothermic conditions although maternal mortality did not differ at different temperatures [2]. Younger gestational age and a greater degree of hypothermia are known to increase fetal morbidity during CPB [3]. Cardiopathic pregnant patients can be separated into two groups. One of them is pregnant women who have cardiac pathologies and the other is pregnant women who require emergent surgical interventions. The cardiopathic patient, even if well compensated, can easily sustain acute heart failure caused by the increase of cardiopulmonary bypass requirements during pregnancy. Ideally, valve disease should be evaluated before pregnancy and treated if necessary. However, pregnancy is often already present when the patient presents. In such cases, if possible, it is always preferable to delay surgery until the time the fetus is viable and a caesarean section can be performed as part of a concomitant procedure [4]. On the other hand, medical therapy is not always sufficient to drive a heart with a reduced functional reserve and acute complications, such as the thrombosis of a valvular prosthesis, endocarditis or acute aortic dissection, which can seriously compromise the heart functions of the pregnant woman. When the open heart operation is necessary to save the patient’s life in such situations, the fetus could be seriously compromised after exposure to cardiopulmonary bypass. High-flow, high-pressure, normothermic bypass offers the least risk to both the fetus. Fetal heart and uterine monitoring is essential to allow adjustments to the flow to ensure adequate placental perfusion and early control of contractions as they are associated with significant fetal loss [4].

Pregnancy is associated with a hypercoagulable state due to relative decreases in protein S activity, plasminogen, and venous hypertension and predisposition to dissection with or without an underlying connective tissue disorder due to decrease in collagen synthesis. Hence, the appropriate anticoagulation management is important in pregnancy. Fetal mortality due to operation is considerably <100% mortality incurred by therapeutic abortion. This case report has shown once again that open heart operation is not a contraindication to pregnancy prolongation and it has been reported to be undertaken at any gestational age but it should be kept in mind that is best between 24 and 28 weeks’ gestation, after the completion of organogenesis. Pump flow and mean arterial pressure during cardiopulmonary bypass seem to be the most important parameters that influence fetal oxygenation.

References

Comment: Are low molecular weight heparin effective in cardiopathic pregnant patients? Both mechanical valve prosthesis anticoagulation during pregnancy? 

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We read with great interest the report by Carnero-Alcazar and co-workers regarding the successful mechanical mitral valve replacement due to prosthetic valve thrombosis in a first trimester pregnant woman [1]. Two percent of all pregnant women suffer from some kind of cardiac pathology. Although this incidence varies in different countries, cardiac disease is the leading cause of death in pregnancy [2]. Many factors are associated with pregnancy in cardiopathic patient such as social, ethical and maternal desire for decision whether the pregnancy will be terminated or maintained. When a cardiac problem requires an operation during pregnancy the risks are inevitably increased and substantial efforts must be made to reduce the risk. There are several cases reported in the literature of cardiopulmonary bypass (CPB) used on pregnant women at various stages of pregnancy [2–4]. Many factors associated with cardiac operations requiring CPB can adversely affect both the mother and the fetus, but the embryofetal mortality is found that highly increased under hypothermic conditions than the normothermic conditions although maternal mortality did not differ at different temperatures [2]. Younger gestational age and a greater degree of hypothermia are known to increase fetal morbidity during CPB [3]. Cardiopathic pregnant patients can be separated into two groups. One of them is pregnant women who have cardiac pathologies and the other is pregnant women who require emergent surgical interventions. The cardiopathic patient, even if well compensated, can easily sustain acute heart failure caused by the increase of cardiopulmonary bypass requirements during pregnancy. Ideally, valve disease should be evaluated before pregnancy and treated if necessary. However, pregnancy is often already present when the patient presents. In such cases, if possible, it is always preferable to delay surgery until the time the fetus is viable and a caesarean section can be performed as part of a concomitant procedure [4]. On the other hand, medical therapy is not always sufficient to drive a heart with a reduced functional reserve and acute complications, such as the thrombosis of a valvular prosthesis, endocarditis or acute aortic dissection, which can seriously compromise the heart functions of the pregnant woman. When the open heart operation is necessary to save the patient’s life in such situations, the fetus could be seriously compromised after exposure to cardiopulmonary bypass. High-flow, high-pressure, normothermic bypass offers the least risk to both the fetus. Fetal heart and uterine monitoring is essential to allow adjustments to the flow to ensure adequate placental perfusion and early control of contractions as they are associated with significant fetal loss [4]. Pregnancy is associated with a hypercoagulable state due to relative decreases in protein S activity, plasminogen, and venous hypertension and predisposition to dissection with or without an underlying connective tissue disorder due to decrease in collagen synthesis. Hence, the appropriate anticoagulation management is important in pregnancy. Fetal mortality due to operation is considerably <100% mortality incurred by therapeutic abortion. This case report has shown once again that open heart operation is not a contraindication to pregnancy prolongation and it has been reported to be undertaken at any gestational age but it should be kept in mind that is best between 24 and 28 weeks’ gestation, after the completion of organogenesis. Pump flow and mean arterial pressure during cardiopulmonary bypass seem to be the most important parameters that influence fetal oxygenation.

References
Mechanical prosthetic mitral valve thrombosis in a first trimester pregnant woman

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Pregnancy in women with mechanical prosthetic valves is associated with a high risk of maternal mortality as the outcome of prosthetic-valve thrombosis. One of the actual goals of modern cardiology is an adequate anticoagulation therapy for such category of patients. It is well known that clinical recommendations concerning valvular heart disease during pregnancy are dependent on the period of gestation.

In this report [1], Carnero-Alcazar and colleagues describe their experience of the mitral valve replacement due to mechanical prosthetic valve thrombosis which occurred during first trimester of pregnancy. Cardiopulmonary bypass has many potential adverse effects that can compromise uteroplacental perfusion and fetal development. The authors have performed the surgical procedure using high perfusion pressure and mild hypothermia during cardiopulmonary bypass. The maintenance of acid-base balance during open heart, the use of high flow rate, high perfusion pressure and normothermia or mild hypothermia during cardiopulmonary bypass, minimization of the duration of the aortic cross-clamp time have a significant importance in successful outcomes of operation.

Administration of warfarin during pregnancy in women with mechanical valves [2] diminishes the risk of development of prosthetic valve thrombosis. But it is associated with a high level of fetal loss (—30% including spontaneous abortions, stillbirths, and neonatal deaths). The rate of adverse events during warfarin therapy is considered to be 6%. Administration of warfarin is associated with ‘fetal warfarin syndrome’ characterized by nasal hypoplasia, stippled epiphyses, limb deformities, and respiratory distress. Warfarin therapy in period between 6 and 12 weeks of gestation doubles in fetal mortality compared to administration of heparin. Injection of heparin during the first trimester reduces by half the risk of maternal thromboembolism and death (9.2% and 4.2%, respectively) [3]. Nevertheless, long-term heparin administration is associated with a higher risk of heparin-induced thrombocytopenia and osteopenia in women [1]. A strategy of substituting warfarin for low molecular weight heparin during the period of organogenesis (6—12 weeks of gestation) reduces the risk of warfarin embryopathy but increases twice the maternal thromboembolism (9%).

In the Bakoulev Center for Cardiovascular Surgery, the management of pregnant women with mechanical valves has been investigated. Only preliminary data have been accumulated.

According to the data presented in overviews and case reports, usually the caesarian section is applied in most of the cases before radical correction of cardiac pathology. Based on cited data it is recommended to administer warfarin with target level of INR 2.0—3.0. It is inadmissible to use warfarin therapy during two periods: between 6 and 12 weeks of pregnancy and after 36 weeks of pregnancy [2]. Within these periods an unfractionated heparin should be applied under monitoring of coagulation. In spite of the existence of well-tested cardiopulmonary bypass protocol, complications are still observed. The problem is insufficiently known because of limited quantity of studies. Further investigation should be carried out.

References