Case report - Cardiopulmonary bypass
 Successful surgical management of massive pulmonary embolism during the second trimester in a parturient with heparin-induced thrombocytopenia

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Abstract

Cardiopulmonary bypass during pregnancy is associated with a high fetal and maternal mortality. We report a successful pulmonary embolectomy in a woman at the 27th week of pregnancy; we performed surgical pulmonary embolectomy under cardiopulmonary bypass to restore adequate hemodynamic stability and to relieve right ventricle strain. We discuss the decision made for the preferred anticoagulation drug in the setting of heparin-induced thrombocytopenia in the gravida. The pregnancy was carried to term and she delivered a healthy boy at 38 weeks of gestation.

Keywords: Pregnancy; Pulmonary thromboembolism; Cardiopulmonary bypass; Heparin-induced thrombocytopenia

1. Introduction

Treatment of massive pulmonary embolism in patients with hemodynamic compromise remains controversial: thrombolytic agents, catheter-based thrombus aspiration, or surgical embolectomy [1].

Management of massive pulmonary thromboembolism during pregnancy could be laden with problems, and in the setting of severe thrombocytopenia the use of thrombolytic agents is contraindicated [1].

We report a successful pulmonary embolectomy in a woman at the 27th week of pregnancy; we performed surgical pulmonary embolectomy under cardiopulmonary bypass. We discuss the decision made for the preferred anticoagulation drug in the setting of heparin-induced thrombocytopenia (HIT) in the gravida. The pregnancy was carried to term and she delivered a healthy boy at 38 weeks of gestation.

2. Case report

A 39-year-old pregnant woman G1P0 was hospitalized at 25 weeks of pregnancy because of threatened premature labor. Her past medical history revealed bilateral pulmonary embolism secondary to a deep venous thrombosis at the age of 29 years, laboratory investigations for thrombophilia were negative at that time. On admission, the platelet count was in normal range.

Enoxaparin was given as a subcutaneous injection 40 mg a day. At day 7, the platelet count dropped to 50 × 10^9/L. The low-molecular-weight heparin was replaced by subcutaneous fondaparinux 7.5 mg daily. Antibodies to PF4 were detected by ELISA test optic density (OD) = 1.5 [results considered as negative if (OD < 0.40)] as per the manufacturer’s instructions and HIT diagnosis was confirmed by standard light-transmission platelet aggregometry.

At day 9, the patient complained of severe acute dyspnea, a transesophageal echocardiography (TEE) (Fig. 1) showed massive pulmonary embolism, thrombus in the right atrium, a right ventricle (RV) dilatation, a moderate tricuspid regurgitation and pulmonary hypertension. She rapidly progressed to acute respiratory distress syndrome and therefore she was intubated.

An emergency pulmonary embolectomy under cardiopulmonary bypass (CPB) using tirofiban and heparin was performed because of HIT. The fetal heartbeat was monitored continuously by an obstetric-gynecologist during the whole procedure.

An intravenous bolus of tirofiban (10 µg/kg) and heparin (3 mg/kg) was given at incision, CPB was instituted by aortic and bicaval cannulation, tirofiban was infused continuously (0.15 µg/kg/min) and the platelet blockage was assessed by a photometric platelet aggregometry and heparin infusion was adjusted to maintain an activated clotting time of over 400 seconds.

The heart was arrested using an antegrade cold blood cardioplegia. The main pulmonary artery was opened with a longitudinal incision; the thrombotic material was...
extracted by means of forceps and assisting suction thus allowing complete clot removal. A right transverse atriotomy was done to explore the right cavities, and no thrombus was found.

After declamping the aorta, tirofiban infusion was stopped and the patient was easily weaned from CPB. Adequate heparin neutralization with protamin was sufficient to control the bleeding. The CPB time was 57 min and the aortic cross-clamp time was 35 min.

After the intervention she was transferred to the intensive care unit of cardio-thoracic surgery. TEE revealed improved RV dilatation and absence of residual thrombi into the pulmonary artery. The postoperative course was uneventful and she was weaned from mechanical ventilation at H6.

Twenty-four hours after the operation and throughout the remainder of her pregnancy, she received subcutaneous fondaparinux 7.5 mg daily.

On postoperative day (POD) 5, she was moved to the obstetrical department. A magnetic resonance imaging (MRI) fetal scan was performed two weeks later, which excluded any ischemic intracranial complication. She was discharged at POD 15.

At week 38 of pregnancy, she was admitted as scheduled for induction of labor, fondaparinux had been discontinued 24 hours previously. She gave birth to a healthy boy. Six hours after delivery, the patient received fondaparinux and on the next day oral warfarin was initiated. Daily injection of fondaparinux was discontinued after three days of oral warfarin intake, blood assay revealed an international normalized ratio at 2.6. The patient was kept on lifelong anticoagulation and the newborn was discharged in good condition.

3. Discussion

Pregnancy is a hypercoagulable state with a high-risk of thromboembolic complications, the incidence varies from 0.5 to 3.0 per 1000 pregnant women and the risk is higher when there is a history of a previous thrombotic event [2, 3].

Right ventricular dysfunction secondary to an acute pulmonary embolism with hemodynamic compromise is associated with a poor prognosis; rapid removal of the emboli is considered the best solution to improve the patient’s survival [1]. Even though thrombolytic therapy can be used during pregnancy with minimal fetal complications, it is considered as a major contraindication in the setting of severe thrombocytopenia. Catheter-based pulmonary embolectomy is a minimal invasive option. However, this procedure is difficult to perform within a short time and should be undertaken by highly qualified and competent staff. In this case, we choose to perform a surgical thromboembolotomy because we are familiar with performing this procedure when the fibrinolytic therapy is not an option in the setting of hemodynamic compromise.

Usually, an open cardiac surgery in the third trimester is managed by a cesarean section [4] followed immediately by a cardiac operation using usual techniques. Thrombectomy during pregnancy results in a high maternal morbidity (44%) and mortality (22%) [5, 6]. CPB during pregnancy may be accompanied by a high-risk of miscarriage [6]. However, in this case of a parturient in the second trimester we preferred not to induce abortion, the fetus heart rhythm was closely monitored during CPB which was conducted without hypothermia to avoid fetal suffering. Using this strategy the pregnancy was carried to term.

We decided, in the setting of HIT, to use heparin and tirofiban as anticoagulant agents during CPB. In our department, tirofiban a platelet glycoprotein IIb/IIIa reversible inhibitor is routinely used in association with unfractionated heparin in cases of HIT. Tirofiban has a short half-life and is not contraindicated during pregnancy [7, 8]. By strongly inhibiting fibrinogen binding to GPIIb/IIIa, tirofiban effectively blocks platelet aggregation by HIT antibodies. Direct thrombin inhibitors like lepirudin, bivalirudin and argatroban can be proposed as an alternative to heparin/tirofiban in the setting of HIT during CPB. In the Restore trial severe thrombocytopenia (50 × 10⁹/µL) was only observed in 0.2% of the patients treated with tirofiban. Anticoagulation was stopped during the 24 hours before labor was induced in order to decrease the risk of bleeding and warfarin was continued thereafter for a lifelong anticoagulation.

In conclusion, pulmonary embolectomy with CPB using tirofiban and heparin, and carrying pregnancy to term proved to be a good and safe strategy for both the mother and her fetus.

References

I read with great interest the report by Hajj-Chahine et al. regarding successful surgical pulmonary embolectomy in a second trimester parturient with heparin-induced thrombocytopenia (HIT) [1]. The outcome was excellent as pulmonary embolism (PE) is the leading cause of pregnancy-related maternal death in the developed world [2].

I was surprised however, that the authors used unfractionated heparin to achieve systemic anticoagulation for cardiopulmonary bypass (CPB) given the definitive laboratory diagnosis of HIT 48 h earlier and subsequent clinical picture in keeping with type-II heparin-induced thrombocytopenia and thrombosis (HITT).

Cessation of all forms of heparin therapy is fundamental in treating patients with suspected or proven HIT. Thrombin specific inhibitors (e.g. lepirudin, bivalirudin or synthetic argatroban) can provide adequate safe anticoagulation in HIT positive patients requiring CPB although local drug availability can be an issue [3]. This patient had a history of bilateral pulmonary emboli ten years previously and I wonder if consideration was given to placement of a caval filter at the time of the embolectomy, especially as the right atrium was also opened and explored. The exact risk/benefit ratio of inferior vena cava filters however, is difficult to ascertain due to incomplete follow-up in most series and the not infrequent associated local complications such as recurrent deep vein thrombosis or post-thrombotic syndrome [4].

The authors’ use of CPB and cardioplegic arrest, however, reflects a contemporary approach to pulmonary embolectomy that allows for good visualization of the pulmonary vasculature, thus facilitating thrombus extraction in a controlled manner. This is in contrast to the historical ‘smash and grab’ approach with caval inflow occlusion. We have successfully used this approach (six cases to date – Sachithanandan and Satur, Stoke-on-Trent, UK) and similarly routinely used a longitudinal incision in the main pulmonary artery (PA) that can be easily extended in a curvilinear fashion into either proximal branch PA. Furthermore, exposure of the retro-aortic proximal right branch PA is enhanced with retraction on a depressurized aorta following application of the cross-clamp.

**References**


