Case Report

Successful treatment of pulmonary embolism-induced cardiac arrest by thrombolysis and targeted temperature management during pregnancy

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Background: Thrombolysis for pulmonary embolism and targeted temperature management for cardiac arrest are controversial treatments in pregnancy.

Case: A 37-year-old woman at 23 weeks gestation presented with persistent dyspnea. She experienced cardiac arrest soon after arrival at the emergency room. Massive right ventricular dilatation on echocardiography during the transient return of spontaneous circulation suggested pulmonary embolism. We administered recombinant tissue plasminogen activator for suspected pulmonary embolism to successfully resuscitate the patient experiencing refractory cardiac arrest despite heparin infusion. After an additional dose of monteplase for persistent shock with remaining right ventricular dilatation on echocardiography, maternal hemodynamics dramatically improved, but fetal heart rate transiently decreased. Targeted temperature management was initiated for delayed recovery of consciousness. She fully recovered consciousness without neurological deficit. However, the fetus was aborted because of fetal hydrops.

Conclusion: Thrombolysis and targeted temperature management should be considered as treatment options for pulmonary embolism-induced cardiac arrest during pregnancy.

Key words: Cardiopulmonary resuscitation, critical care, monteplase, recombinant tissue plasminogen activator, venous thromboembolism

INTRODUCTION

PREGNANCY IS A known risk factor for pulmonary embolism (PE) reflecting the hypercoagulable state.[1] Although thrombolysis is recommended for massive PE with shock or hypotension,[2,3] it is a controversial treatment for pregnant patients.[4] Moreover, the safety and efficacy of post-resuscitation targeted temperature management (TTM) during pregnancy have not been well described. We encountered a case of PE-induced cardiac arrest in pregnancy successfully treated with thrombolysis and TTM.

CASE

A 37 -year-old woman at 23 weeks gestation in her first pregnancy had complained of dyspnea for 3 days prior to the hospital admission. She had no past medical history and was not taking any medication. Hyperventilation and syncope brought her to the hospital, and she arrived by ambulance. She was in a restlessness state, with blood pressure 142/97 mmHg and respiratory rate 44 breaths/min; oxygen saturation was not detectable because of cold extremities.

Soon after arrival at the emergency department, the patient experienced cardiac arrest (initial electrocardiogram rhythm: pulseless electrical activity). Standard cardiopulmonary resuscitation procedures, including chest compressions, adrenaline administration, and endotracheal intubation, were initiated immediately. Return of spontaneous circulation (ROSC) was achieved 4 min after the initiation of cardiopulmonary resuscitation. Heparin (5,000 units) was given based on the finding of massive right ventricular dilatation, suggesting PE, on echocardiography carried out at the bedside by an emergency physician (Fig. 1A). However, she experienced a second cardiac arrest 22 min after the initial episode. After ROSC following adrenaline injection (1 mg), we administered recombinant tissue plasminogen activator (rtPA; monteplase, 800,000 units) for strongly suspected PE. We added another dose of monteplase (800,000 units) 30 min after the initial rtPA

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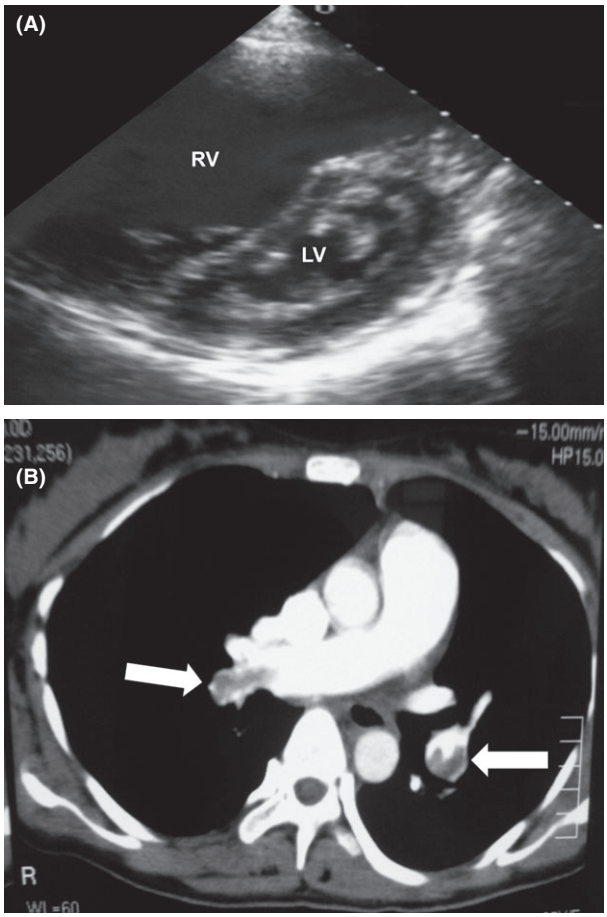

Figure 1. A 37-year-old woman at 23 weeks gestation experienced cardiac arrest soon after arrival at the emergency room. A, Parasternal short axis view on echocardiography at admission demonstrating a "D-shape," left ventricular collapse due to right ventricular dilatation. RV, right ventricle; LV, left ventricle. B, Image of a contrast computed tomography scan indicating massive thrombi in the bilateral pulmonary artery. Arrows indicate thrombi in the pulmonary artery.

administration because of refractory shock with persistent right ventricular dilatation on echocardiography. Maternal hemodynamics dramatically improved approximately 12 min after the second infusion of rtPA, but the fetal heart rate dropped to 60 b.p.m. on a fetal ultrasound. Contrast computed tomography scan revealed massive thrombi remaining after thrombolytic therapy in the bilateral pulmonary arteries and left popliteal vein (Fig. 1B). Meanwhile, the patient remained unconscious without responses to verbal commands or physical stimulus for over 60 min following the second ROSC. After carefully explaining the risks of heparin infusion for PE and TTM for post-cardiac arrest brain injury during pregnancy, we obtained consent from her family to initiate both therapies. She was treated under careful monitoring of fetal heart rate in addition to the standard physiological monitoring in the intensive care unit.

The target body temperature of 34°C was reached approximately 5 h after cardiac arrest. She was rewarmed after being maintained at 34°C for 24 h. During TTM, the patient required dopamine for 48 h to maintain maternal systolic blood pressure over 100 mmHg and fetal heart rate above 100 b.p.m. (Fig. 2). She was extubated after recovery of consciousness on day 3. Right ventricular dilatation had also improved on echocardiography. However, fetal hydrops became evident, and the fetus was aborted on day 10. We diagnosed her with obstetric-related PE after ruling out other coagulation disorders, including protein S deficiency, protein C deficiency, antithrombin deficiency, and antiphospholipid antibody syndrome, according to her laboratory findings. She was discharged from the hospital without any neurological deficit on the day 23.

DISCUSSION

TO THE BEST of our knowledge, this is the first case of PE-induced cardiac arrest during pregnancy treated by both thrombolysis and TTM. We reported the effectiveness of rtPA for massive PE causing cardiac arrest and the feasibility of TTM for post-cardiac arrest brain damage during pregnancy.

Although heparin can be safely used for PE during pregnancy,[1] use of thrombolytic agents for PE complicated by shock or hypotension during pregnancy is highly controversial due to the risk of bleeding complications and miscarriage.[4] According to recent published works, 19 cases of successful maternal treatment using rtPA have been reported,[4–8] with complicating fetal death in one case and a minor bleeding episode in another.[9] Our case required an additional dose of monteplase for refractory shock with persisting right ventricular dilatation 30 min after the initial dose. The risk of hemorrhage supposedly increased with the added dose, but we did not encounter bleeding complications. In addition, 30 min can be considered more than sufficient time to evaluate the treatment effect to decide whether an additional dose is needed.[6] Although the diagnosis was made based on limited observation, the sustained pulse after the first dose of rtPA gave us the impression that rtPA was effective in improving the clinical situation.

Targeted temperature management has not been recognized as a standard therapy for post-cardiac arrest brain injury during pregnancy. It is not contraindicated for pregnant patients after resuscitation,[10] but has been rarely used, with only four cases reported recently.[11–14]

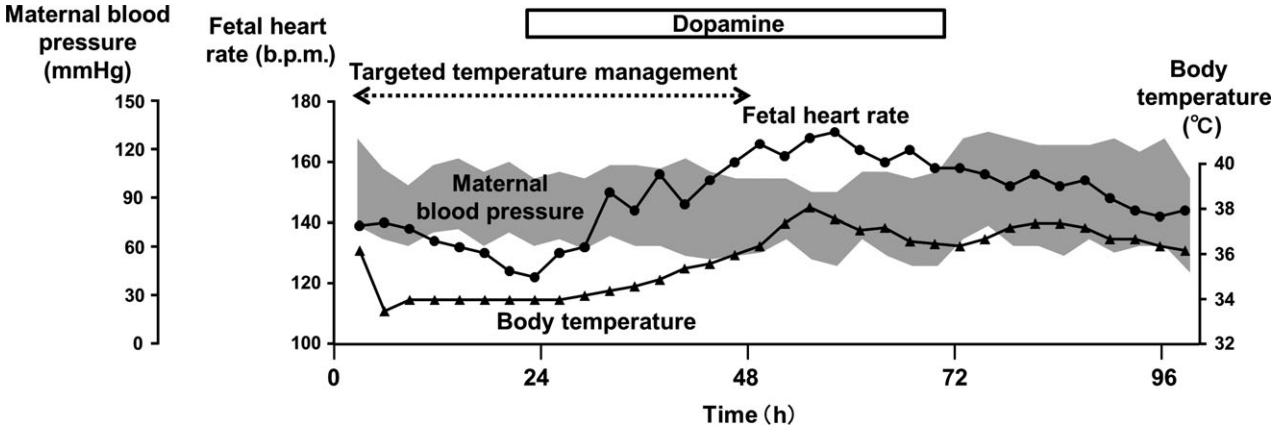

Figure 2. Maternal blood pressure, fetal heart rate, and maternal temperature during targeted temperature management of a 37-year-old woman who experienced cardiac arrest at 23 weeks gestation. Targeted temperature management consists of a maintenance phase at 34°C for 24 h and a rewarming phase. The procedure was completed at 48 h after admission to the intensive care unit. Dopamine was given to maintain maternal blood pressure and fetal heart rate (3–5 μg/kg/min) for 48 h. During the procedure, maternal systolic blood pressure was maintained above 100 mmHg, and fetal heart rate was maintained above 100 b.p.m.

Although TTM was completed without any maternal complications in all of those cases, one fetal death was documented.[12] The causality relationship between fetal demise and TTM was not clarified in that report, and several factors, including hypoperfusion during cardiac arrest and cardiac dysfunction, were implicated to be associated with fetal death. Although we set a targeted temperature of 34°C in our case, Nielsen *et al.*[15] cast doubt on TTM at a targeted temperature of 33°C. Therefore, normothermia therapy should be considered for future cases according to the current trend of TTM.

In the present case, the fetus showed signs of hydrops despite the rigorous monitoring and management to maintain fetal heart rate during TTM, as recommended in previous reports.[10,14] In addition, we did not undertake immediate delivery because of the fetal age and a risk of bleeding complications by the preceding administration of a thrombolytic agent. We could not exclude the possibility that thrombolytic therapy or TTM led to the fetal hydrops. However, in a limited number of reports, thrombolysis has rarely led to fetal complications, and TTM has been safely carried out for neonatal hypoxic–ischemic encephalopathy.[16] Moreover, we did not observe bleeding complications after thrombolysis, nor significant hemodynamic compromise during TTM. Therefore, the detrimental influence of cardiac arrest is more likely to be the primary cause of fetal hydrops in our case; the effect of thrombolytic therapy or TTM remains to be studied in future reports. Despite the risk of these unfavorable effects on the fetus, we believe the mother's survival should be prioritized in the most critical situations.

In conclusion, thrombolysis and TTM should be considered for maternal survival in PE-induced cardiac arrest during pregnancy, despite the risk of associated fetal damage.

DISCLOSURE

Approval of the research protocol: N/A.
Informed Consent: Due to difficulty in contacting the patient to obtain consent for publication at the moment, we have carefully de-identified the patient information. Following the decision of our hospital's ethical committee, we applied an opt-out methodology for the submission without consent based on the low risk of leaking patient information.
Registry and the registration no. of the study/trial: N/A.
Animal Studies: N/A.
Conflict of interest: None.

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