



## Research Letter

# Successful application of extracorporeal membrane oxygenation and pulmonary thromboembolism in a patient with a life-threatening pulmonary embolism

Chi-Jou Chuang<sup>a</sup>, Chun-Shuo Hsu<sup>a, b, \*</sup><sup>a</sup> Department of Obstetrics and Gynecology, Dalin Tzu Chi Hospital, Chiayi, Taiwan<sup>b</sup> School of Medicine, Tzu Chi University, Hualien, Taiwan

## ARTICLE INFO

## Article history:

Accepted 25 July 2014

Pulmonary embolism is a leading cause of maternal mortality. It can occur abruptly and progress rapidly. In patients with acute massive pulmonary emboli, right ventricular failure is followed by left ventricular dysfunction and cardiogenic shock. Prompt identification of patients at risk of pulmonary embolism and early resuscitation with cardiopulmonary support are vital for survival.

A 29-year-old gravida 1 para 1 woman arrived to our emergency room because of progressive dyspnea in the morning that began 2 days after a cesarean section. She had no history of diabetes, hypertension, or other chronic diseases. Her antepartum course was uneventful. She underwent a cesarean section because of a non-reassuring fetal heart rate tracing. She remained in bed until the bladder catheter was removed on the 3<sup>rd</sup> day, at which time she felt dizzy and short of breath. Her obstetrician suspected an amniotic fluid embolism. She was then sent to our emergency room for an evaluation of her progressive dyspnea.

On arrival, her blood pressure was 112/64 mmHg and pulse rate was 126 beats per minute. She became drowsy and lost consciousness 5 minutes later. She was intubated, mechanical ventilation was initiated, and vasopressin and dopamine were administered; however, she became pulseless 20 minutes later, despite cardiac massage. Forty minutes later, extracorporeal membrane oxygenation (ECMO) was successfully initiated in the emergency room via the right common femoral artery to the right common femoral vein. Heparin was used for anticoagulation. Her blood pressure returned to 140/60 mmHg, and she was admitted to our intensive care unit.

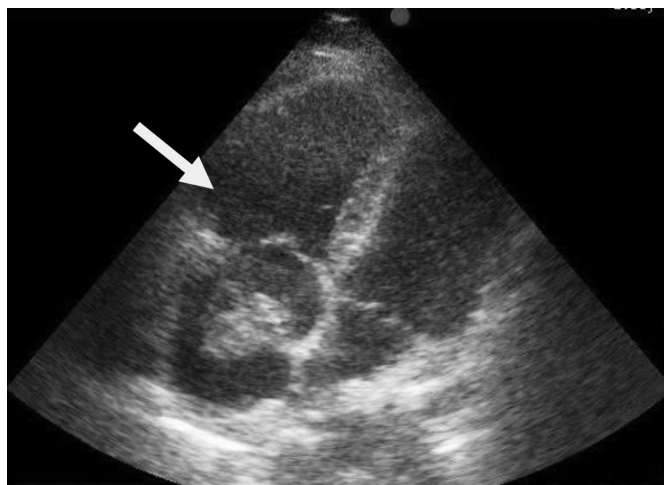
An echocardiogram revealed a 3-cm floating mass within the right atrium that protruded into the right ventricle (Figure 1), and a dilated right atrium and ventricles. Normal left ventricular wall motion with mild mitral valve regurgitation was also present. Computed tomography revealed thrombi in the pulmonary arteries (Figure 2); however, no deep vein thrombosis was visible on Doppler ultrasound. Her uterus contracted well postoperatively without signs of postpartum hemorrhage. Heparin was titrated, based on the activated clotting time. Pulmonary thromboembolism was performed on the second day after admission, during which massive thromboemboli in the pulmonary arteries and right atrium were noted and removed. After the thrombi had been removed, the dilated right atrium and ventricle contracted well, and ECMO was discontinued. She recovered well with the exception of burn injuries on both thighs caused by accidental electrocoagulation during resuscitation in the emergency room. The injury was complicated by *Staphylococcus aureus* and influenza infections during hospitalization. After 43 days, she was discharged in a stable condition.

Venous thromboembolism (VTE) occurs in one in 500–2000 pregnancies, and it is more common postpartum than prepartum [1]. Pulmonary embolism is a leading cause of maternal death in Western countries. Risk factors for pulmonary embolism in gravida and parturient women include immobilization, cesarean section, genetic and acquired thrombophilia, renal disease and liver disease, obesity, and smoking. Pregnant women are at a high risk of VTE because of the presence of all three components of Virchow's triad (i.e., venous stasis, endothelial injury, and a hypercoagulable state) [2]. The risk of VTE is approximately twice as high after cesarean delivery than after a vaginal birth [3]. Prophylactic anticoagulation for high-risk patients and early ambulation after cesarean section is important to prevent VTE.

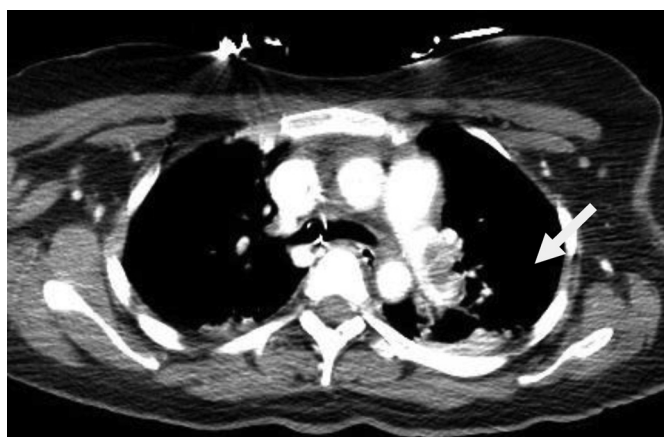
Pulmonary emboli during pregnancy or during the postpartum period are less common in Asian patients, which may be related to ethnicity or under-diagnosis [4]. In two retrospective studies, congenital thrombophilia, factor V Leiden, and prothrombin G20210A were reported in 60% of pregnancy-related VTEs [5,6]. Congenital thrombophilia is rare in Asians [7]. Yang [4] reports a VTE incidence in pregnancy of 1.88 per 1000 deliveries in the

\* Corresponding author. Department of Obstetrics and Gynecology, Dalin Tzu Chi Hospital, Number 2, Min-Sheng Road, Dalin Town, Chia-Yi 62247, Taiwan.

E-mail address: [wufuchuang@tzuchi.com.tw](mailto:wufuchuang@tzuchi.com.tw) (C.-S. Hsu).



**Figure 1.** The echocardiogram shows a floating mass (arrow) within the right atrium that protruded into the right ventricle.



**Figure 2.** Computed tomography shows thrombi (arrow) in the left pulmonary artery.

Chinese population, which is similar to the reported incidence in Western countries. A national register is needed in Taiwan to determine the incidence of pregnancy-related VTE.

Anticoagulant therapy is the primary therapy for acute pulmonary embolism. Surgical embolectomy is a high-risk surgery that is indicated when there is echocardiographic evidence of an embolus trapped within the foramen ovale, right atrium, or right ventricle [8]. Case reports suggest that thrombectomy can be used successfully as a lifesaving measure when other measures have failed [9]. In our patient, large thrombi were trapped in the right atrium and pulmonary arteries. She recovered well after embolectomy.

The pathogenesis of acute massive pulmonary embolism is similar to the initial stages of amniotic fluid embolism in which pulmonary hypertension and right ventricular failure are followed by left ventricular dysfunction and cardiogenic shock [10]. Disseminated intravascular coagulopathy is a major component of amniotic fluid embolism, but not pulmonary embolism. The emergency application of ECMO and cardiopulmonary bypass has

been used successfully in both catastrophic conditions [11–13]. Extracorporeal membrane oxygenation provides cardiopulmonary support. There are two types of ECMO: venoarterial (VA) ECMO and venovenous (VV) ECMO. Both types provide respiratory support, but only VA ECMO provides hemodynamic support. The criteria for initiating ECMO include acute severe cardiac or pulmonary failure that is potentially reversible and unresponsive to conventional management. Our patient did not respond to intubation, mechanical ventilation, or cardiac massage because of massive embolus-induced right heart failure. Extracorporeal membrane oxygenation is vital for life support until appropriate treatment can be instituted.

Cesarean section and immobilization are risk factors for pulmonary embolism. Common symptoms of pulmonary embolism include shortness of breath, chest pain, cough, hemoptysis, and tachycardia. Identifying high-risk patients and facilitating early transfer of highly suspected cases is important. Anticoagulation is the mainstay of treatment for VTE. In patients with a massive pulmonary embolism and shock, cardiopulmonary bypass or ECMO is a lifesaving option. Most obstetric units are not equipped to provide ECMO; therefore, a well-trained nursing staff is important for the early identification and transfer of obstetric patients with suspected pulmonary emboli.

### Conflicts of interest

The authors have no conflicts of interest relevant to this article.

### References

- [1] Marik PE, Plante LA. Venous thromboembolic disease and pregnancy. *N Engl J Med* 2008;359:2025–33.
- [2] Greer IA. Thrombosis in pregnancy: maternal and fetal issues. *Lancet* 1999;353:1258–65.
- [3] Stein PD, Hull RD, Kayali F, Olson RE, Alshab AK, Meyers FA, et al. Venous thromboembolism in pregnancy: 21-year trends. *Am J Med* 2004;117:121–5.
- [4] Yang Y, Liang L, Zhai Z, He H, Xie W, Peng X, et al. Investigators for National Cooperative Project for Prevention and Treatment of PTE-DVT. Pulmonary embolism incidence and fatality trends in Chinese hospitals from 1997 to 2008: a multicenter registration study. *PLoS One* 2011;6:e26861.
- [5] Grandone E, Margaglione M, Colaizzo D, D'Andrea G, Cappucci G, Brancaccio V, et al. Genetic susceptibility to pregnancy-related venous thromboembolism: roles of factor V Leiden, prothrombin G20210A, and methylenetetrahydrofolate reductase C677T mutations. *Am J Obstet Gynecol* 1998;179:1324–8.
- [6] Gerhardt A, Scharf RE, Beckmann MW, Strube S, Bender HG, Pillny M, et al. Prothrombin and factor V mutations in women with a history of thrombosis during pregnancy and the puerperium. *N Engl J Med* 2000;342:374–80.
- [7] White RH, Keenan CR. Effects of race and ethnicity on the incidence of venous thromboembolism. *Thromb Res* 2009;123(Suppl. 4):S11–7.
- [8] Bloomfield P, Boon NA, de Bono DP. Indications for pulmonary embolectomy. *Lancet* 1988;2:329.
- [9] Funakoshi Y, Kato M, Kuratani T, Shigemura N, Kaneko M. Successful treatment of massive pulmonary embolism in the 38th week of pregnancy. *Ann Thorac Surg* 2004;77:694–5.
- [10] Gist RS, Stafford IP, Leibowitz AB, Beilin Y. Amniotic fluid embolism. *Anesth Analg* 2009;108:1599–602.
- [11] Stanten RD, Iverson LI, Daugharty TM, Lovett SM, Terry C, Blumenstock E. Amniotic fluid embolism causing catastrophic pulmonary vasoconstriction: diagnosis by transesophageal echocardiogram and treatment by cardiopulmonary bypass. *Obstet Gynecol* 2003;102:496–8.
- [12] Hsieh YY, Chang CC, Li PC, Tsai HD, Tsai CH. Successful application of extracorporeal membrane oxygenation and intra-aortic balloon counterpulsation as lifesaving therapy for a patient with amniotic fluid embolism. *Am J Obstet Gynecol* 2000;183:496–7.
- [13] Malekan R, Saunders PC, Yu CJ, Brown KA, Gass AL, Spielvogel D, et al. Peripheral extracorporeal membrane oxygenation: comprehensive therapy for high-risk massive pulmonary embolism. *Ann Thorac Surg* 2012;94:104–8.