Case Report

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Urgent Extracorporeal Membrane Oxygenation Support Immediately after Cesarean Section Delivery in a Witnessed Cardiopulmonary Collapse Eclamptic Parturient

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The incidence of acute pulmonary edema is relatively low during pregnancy and in the postpartum period. In this report, we discuss a highly urgent case of a severely hypertensive parturient who collapsed in the emergency room (ER) before the diagnosis of acute medical problems. A 36-year-old patient initially presented with dyspnea when arriving at the ER and eventually developed a productive cough with pink frothy sputum, tonic-clonic seizure, and circulatory collapse. The infant was delivered via cesarean section by the perioperative team after a few cycles of cardiopulmonary resuscitation. The mother was supported by postpartum venovenous extracorporeal membrane oxygenation (VV-ECMO) owing to acute pulmonary edema and impaired gas exchange. The newborn and mother were discharged without any sequelae after two weeks of hospital care. Early activation of the perioperative care team is essential to enhance maternal and neonatal survival in pregnant women with acute cardiopulmonary collapse.

Key words: pregnancy, acute pulmonary edema, extracorporeal membrane oxygenation, acute cardiopulmonary collapse, cesarean section

Introduction

Extracorporeal membrane oxygenation (ECMO) is used as an urgent rescue therapy for pregnant and postpartum women in several peripartum conditions including cardiopulmonary arrest, acute respiratory distress syndrome (ARDS), status asthmaticus, massive amniotic fluid embolism, peripartum cardiomyopathy, eclampsia, and postpartum hemorrhage.[1] Peripartum ECMO is most commonly used in the antepartum period to manage ARDS and cardiomyopathy.[1-3] However, in pregnant women with acute circulatory collapse, deciding whether ECMO support should precede the delivery of the infant can be very difficult. In this report, we

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present the case of an eclamptic parturient who developed acute cardiopulmonary collapse in the emergency room (ER) and was on ECMO support immediately after an emergency cesarean section delivery. Effective communication and collaboration in the perioperative care team are essential to enhance maternal and neonatal survival in parturients with acute cardiopulmonary collapse.

Case Report

The present case involved a 36-year-old multiparous woman who was generally healthy but was diagnosed with persistent hypertension at 32 weeks of pregnancy. The patient was started on regular antihypertensives to control blood pressure. However, she complained of new-onset chest discomfort associated with a significantly elevated blood pressure (174/121 mmHg) at 35 weeks of gestation. The patient was then transferred from a regional hospital to the ER. On arrival, her blood pressure persisted at 176/120 mmHg, and grade III pitting edema was noted bilaterally in the lower limbs. An obstetric examination revealed no signs of imminent labor. The patient suddenly became restless and dyspneic after the obstetrician's review, and she developed a vigorous productive cough with pink frothy sputum, followed by a grand mal seizure. The patient was unconscious and pulseless, and advanced cardiac life support (ACLS) was started immediately in the ER. The patient was transferred to the delivery room while receiving cardiopulmonary resuscitation (CPR). Meanwhile, several clinical service teams were consulted for the urgent management of this patient, including obstetricians, anesthesiologists, neonatologists, cardiovascular surgeons, and intensivists.

After a few cycles of CPR in the delivery room, the patient regained spontaneous circulation, and weak pulses were palpated in the peripheral arteries. The resuscitation team quickly decided to perform an emergency cesarean section delivery of the fetus and place the mother on ECMO support after delivery. Nasal endotracheal intubation was successfully established by the anesthetic team under the guidance of fiberoptic bronchoscopy because of severe trismus after a grand mal seizure. Hemodynamics were stabilized after mechanical ventilatory support. However, her peripheral oxygen saturation (SpO_2) and arterial partial pressure of oxygen (PaO_2) remained low (48% and 64 mmHg, respectively) despite 100% inspired oxygen supplementation and applying high positive end-expiratory pressure (12 cm H_2O). Sevoflurane (1 – 1.5% v/v in mixed gases) was administered via the endotracheal tube to maintain general anesthesia, and the fetus was delivered by cesarean section within 7 minutes following transverse incision. The newborn's Appearance/Pulse/Grimace/Activity/Respiration (APGAR) scores assessed at 1, 5, and 10 minutes after delivery were 2, 6, and 7, respectively. The neonatology team immediately took care of the newborn in the incubator. Meanwhile, an anesthesiologist performed a fast transesophageal echocardiography scan to assess cardiac function and noted preserved left ventricular systolic function with mild dilatation of the right ventricle. The cardiovascular surgeon and ECMO team decided to set up venovenous (VV)-ECMO via the right internal jugular vein (Fig. 1A) and femoral vein to facilitate gas exchange. The patient's SpO_2 level dramatically improved after VV-ECMO support.

The patient was started on labetalol and $MgSO_4$ infusions for blood pressure management and seizure prophylaxis after admission to the intensive care unit (ICU). A chest X-ray taken in the ICU showed bilateral perihilar lung shadowing that was comparable with acute pulmonary edema (Fig. 1A). The patient was successfully weaned off VV-ECMO support on the second postoperative day, and pulmonary edema and gas exchange significantly improved after anti-hypertensives and diuretic

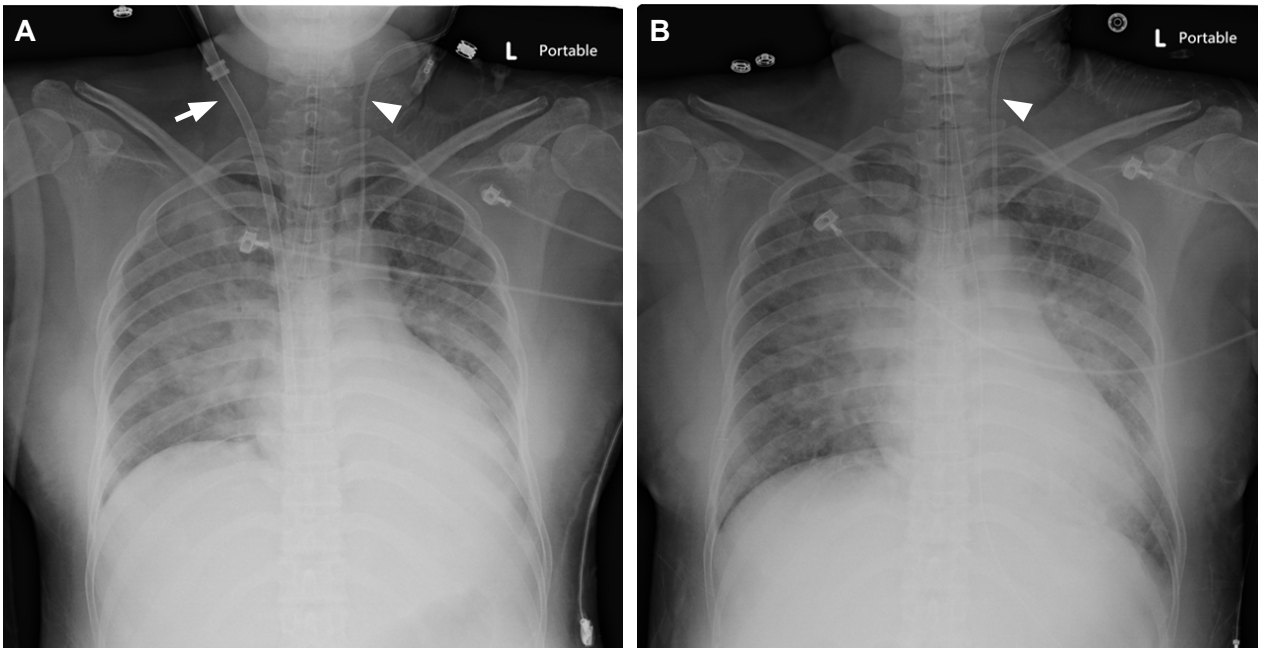

Fig. 1 (A) Postoperative chest X-ray taken in ICU. The cannulation catheter of the venovenous (VV)-ECMO was inserted in the right internal jugular vein (white arrow), and a central venous catheter was placed in the left internal jugular vein (arrowhead). (B) Chest X-ray was taken after weaning off ECMO on the second day after the operation.

therapy in the ICU (Fig. 1B).

A transthoracic echocardiogram performed in the ICU showed generalized hypokinesia in the left ventricle (LV), but there was no left displacement of the septum, suggesting that the preload in the right ventricle (RV) was not significantly increased (Fig. 2). The estimated ejection fraction of LV was about 46% (Fig. 3), and the peak transvalvular pressure gradient in the tricuspid valve was 45 mmHg. No other obvious structural abnormalities were observed in the heart valves. The patient was supported

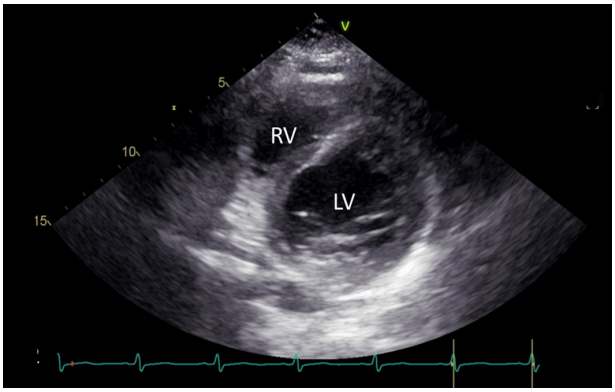

Fig. 2 Transthoracic echocardiographic image measured on the parasternal left ventricular short-axis view. RV: right ventricle; LV: left ventricle.

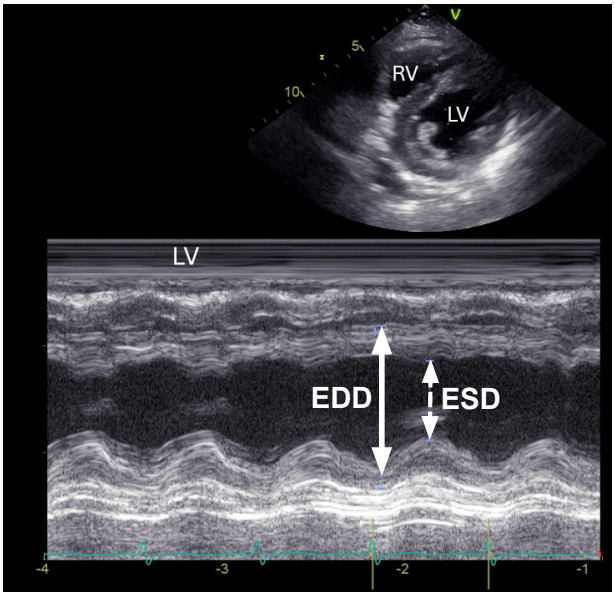

Fig. 3 Calculation of the left ventricular fractional shortening using the M mode echocardiography. RV: right ventricle; LV: left ventricle; EDD: left ventricle end-diastolic diameter; ESD: left ventricle end-systolic diameter.

by mechanical ventilation for a week until adequate spontaneous ventilation was achieved, and the endotracheal tube was removed. One week later, the patient and her baby were discharged from the hospital without any sequelae.

Discussion

Pregnancy-induced hypertension (PIH) is one of the most common gestational disorders, affecting 6 – 10% of pregnancies. PIH is associated with increased maternal morbidity and mortality.[4] PIH typically develops after 20 weeks of gestation, and in about 25% of these pregnant women, PIH may progress to preeclampsia or eclampsia that might lead to significantly worse outcomes.[5] Several risk factors are associated with the development of PIH, including collagen vascular disease, obesity, black race, insulin resistance, gestational diabetes, increased serum testosterone concentrations, and thrombophilia.[4] In the present case, PIH became poorly controlled at 36 weeks of gestation, and the parturient presented with new-onset chest discomfort, which is an important predictive sign for major adverse maternal outcomes.[6] The presence of chest discomfort or dyspnea in pregnant women with poorly controlled PIH indicates the development of acute myocardial stress and pulmonary congestion. Elevated sympathetic tone and release of catecholamine into the systemic circulation may abruptly increase peripheral vascular resistance and excessive pulmonary capillary permeability, eventually leading to flash pulmonary edema in the peripartum period.[7] In addition, a rapid rise in systolic blood pressure may disrupt normal cerebral autoregulation and integrity of the blood-brain barrier, resulting in hypertensive encephalopathy, vasogenic cerebral edema, and seizures.[8]

After arriving at the ER, the patient's condition rapidly deteriorated with symptoms of eclamptic seizures and flash pulmonary edema before cardiopulmonary collapse. In pregnant women with cardiopulmonary collapse, early fetal delivery by labor induction or cesarean section before maternal ECMO support is associated with favorable clinical outcomes when signs of colporrhagia and uterine contractions are present.[9] Because imminent signs of labor were absent in the present case, deciding on whether maternal ECMO support should precede fetal delivery was challenging. The optimal timing of delivery of a fetus in a pregnant woman with acute cardiopulmonary insufficiency is debatable because improvement in maternal hypoxemia after ECMO support may not always result in improved fetal outcomes, but anticoagulation therapy during ECMO support may increase the risk of postpartum hemorrhage and surgical wound bleeding after cesarean section.[10] In the present case, the resuscitation team decided to deliver the fetus before ECMO support because the patient had regained spontaneous circulation after successful ACLS. In addition, the cardiovascular team required more time to prepare the ECMO apparatus.

Although we tentatively diagnosed sympathetic crashing acute pulmonary edema based on the clinical presentation of this patient, other etiologies, such as acute decompensated cardiomyopathy and acute pulmonary embolism, should also be considered because ECMO support modes and treatment strategies would differ in these situations.[1,3] The anesthesiologist performed transesophageal echocardiography (TEE) that showed preserved global ventricular function without obvious signs of massive pulmonary embolism, supporting the clinical diagnosis of acute pulmonary edema secondary to PIH. Owing to a technical failure of storage during operation, images of TEE were not available in this report. Therefore, VV-ECMO was placed in the femoral veins to facilitate gas exchange and rest the lungs. After overnight ECMO support and diuretic therapy, oxygenation levels significantly improved. The patient was weaned off ECMO support within

24 hours and discharged without any sequelae.

Conclusion

Although the incidence of acute pulmonary edema is very low during pregnancy and in the postpartum period, a pregnant woman can present with poorly controlled PIH and signs of cardiopulmonary insufficiency as the early signs of acute pulmonary edema. Early activation of the perioperative care team (including members of the ER, obstetrics, anesthesiology, neonatology, cardiovascular surgery, and ICU teams) is essential to enhance maternal and neonatal survival in pregnant women with acute cardiopulmonary collapse. This report highlighted the effectiveness of VV-ECMO in restoring oxygenation and facilitating pulmonary gas exchange in cases of peripartum cardiopulmonary collapse secondary to acute pulmonary edema.

Author Contributions

Wei-Chin Chen, Conceptualization, Writing-original draft, Investigation; Kuang-Yao Li, Writing-review and editing, Supervision; Hsuan-Yin Wu, Yun-Hsiang Hung, Validation.

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Conflicts of Interest

The authors declare no conflict of interest.

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