

Case Report

## Organ Donation after Extracorporeal Cardiopulmonary Resuscitation and Brain Death

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A 38-year-old primipara Japanese woman suffered cardiac arrest due to a pulmonary thromboembolism 1 day after undergoing a cesarean section. Extracorporeal cardiopulmonary resuscitation was initiated and extracorporeal membrane oxygenation support was needed for 24 h. Despite intensive care, the patient was diagnosed with brain death on day 6. With the family's consent, comprehensive end-of-life care including organ donation was discussed based on our hospital's policy. The family decided to donate her organs. Specific training and education are required for emergency physicians to optimize the process of incorporating organ donation into end-of-life care while respecting the patient's and family's wishes.

**Key words:** brain death, end-of-life, extracorporeal cardiopulmonary resuscitation, organ donation, potential organ donor

Due to improvements in surgical techniques, immunosuppressive agents, and patient care, organ transplantation has substantially improved the quality of life and survival of patients with end-stage organ failure. Although the donation of organs after a patient's brain death is a standard practice in many countries, in Japan the organ donation rate from cadaveric donors is still low, and a shortage of organs has recently become more evident due to increased demand [1]. A study of Japanese clinicians' perspectives suggested that this shortage can be attributed in part to the clinicians' unfamiliarity with approaching the family of a potential organ donor [1].

An increase in the use of extracorporeal cardiopulmonary resuscitation (ECPR), which is characterized by the use of veno-arterial extracorporeal membrane oxygenation (ECMO) during CPR, contributes to opti-

mized outcomes for patients who have experienced cardiac arrest [2]. However, the use of ECPR may also lead to a greater number of patients with a hopeless neurological prognosis or with brain death. Emergency physicians thus struggle with a profound gap between resuscitation efforts for patients' recovery and the issues concerning end-of-life (EOL) care, including organ donation [3]. Nonetheless, clinicians are obligated to provide personalized and compassionate EOL care while considering patient- and family-centered goals.

We present the case of a patient who experienced cardiac arrest due to a pulmonary thromboembolism (PTE) that occurred ~24 h after she had undergone a cesarean section. ECPR was required for her resuscitation. Although she was successfully weaned from ECMO, she was subsequently diagnosed with brain death. We initiated a conversation with her family about potential organ donation as part of the patient's

EOL care in a timely manner. The family agreed to donate her organs, presuming her willingness to donate. Although this case may not represent an uncommon clinical scenario, our experience could provide a good opportunity to expand the discussion on respectful EOL care, including organ donation and relevant surrounding issues.

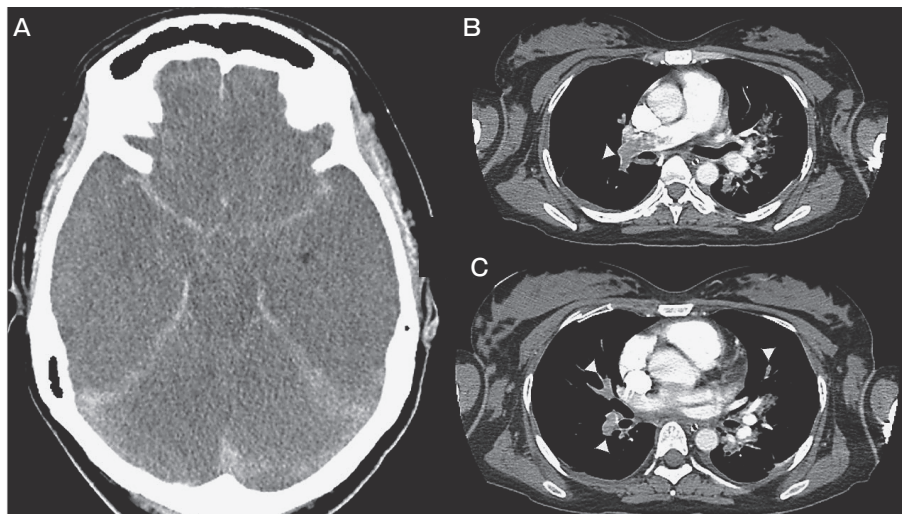
### Case

A 38-year-old primipara Japanese woman who had delivered a healthy infant by caesarean section at another hospital on the prior day lost consciousness and went into cardiac arrest. She was transferred to our emergency department 27 min later, receiving CPR. On arrival, pulseless electrical activity was noted. A return of spontaneous circulation was achieved after the administration of another 1 mg of epinephrine. Based on the patient's history of present illness and right ventricular dilatation determined by echocardiography, PTE was highly suspected as the cause of the cardiac arrest.

As the patient developed serious hemodynamic instability by refractory cardiac arrest, ECPR was implemented 33 min after her arrival for obstructive cardiogenic shock with right ventricular failure and respiratory compromise. Her initial lactate level was 14.3 mmol/L. The patient was in a deep coma and her

pupils were 6 mm in dia. without light reflex. Head computed tomography (CT) revealed diffuse brain swelling consistent with anoxic brain injury (Fig. 1A). Subsequent contrast-enhanced CT showed massive thromboses in the right main pulmonary artery and the left pulmonary artery (Fig. 1B, C).

The patient was moved to the intensive care unit and treated with targeted temperature management. The PTE was conservatively treated with anticoagulants without intervention for thrombus removal. The patient was successfully weaned from ECMO 24 h after its initiation. She remained in a deep coma with fixed, unreactive pupils. Amplitude-integrated electroencephalography showed a flat trace pattern. The family, including the patient's husband, was informed that the patient's recovery would be regarded as hopeless due to catastrophic brain damage. Her daily medical condition was explained to her family. On day 6, she was diagnosed with brain death based on serial neurological examinations, including electroencephalography. Since the family appeared to understand and accept the clinical situation, we approached them to discuss options for EOL care including organ donation that same day. The patient had not expressed any prior explicit decision and did not have a documented willingness to donate. On day 9, further details and information on organ donation were provided by a transplant coordinator. The family members thereafter decided to donate the



**Fig. 1** Computed tomography findings of the patient, a 38-year-old primipara Japanese woman. **A**, Diffuse brain swelling and pseudo-subarachnoid hemorrhage signs were seen on head CT; **B, C**, Contrast-enhanced CT showing multiple thromboses in the right main pulmonary artery and left pulmonary artery.

patient's organs, presuming what she would have desired. Brain death was legally declared on day 10. Multiple organs (liver, pancreas, and kidneys) were procured for transplantation on day 12.

## Discussion

ECPR has increasingly emerged as a feasible and promising strategy to treat refractory cardiac arrest [2]. Subsequently, emergency physicians have been challenged by the need to treat many patients with resulting devastating neurological injuries. Our primary responsibility as clinicians is to focus on patients' survival. In these scenarios, there is an ethical dilemma between the motivation to save the patient's life and facilitating the opportunity to donate organs, the latter of which particularly matters in the middle of active resuscitation. Another study demonstrated that although Japan has an extensive practice of ECPR, deceased donor organ donation is not acceptable "culturally" [4].

Due to our patient's massive pulmonary embolism leading to obstructive cardiogenic shock with right ventricular failure, respiratory/circulatory assistance by ECMO was required for resuscitation. However, the ECMO and therapeutic anticoagulation resulted in hemodynamic restoration compatible with the weaning of ECMO within 24 h. ECMO provides extended respiratory and cardiac support by creating an external heart-lung bypass. Because of the need for heparin and the loss of Von Willebrand factor multimers that are crucial for hemostasis, clinicians must remain aware of the potential for increased bleeding during the use of ECMO. However, ECMO effectively maintains systemic circulation for organs including the liver, pancreas, and kidneys which may be donated. It was reported that compared to the use of conventional CPR in emergency rooms, the use of ECPR led to more multi-organ donations [5]. Nevertheless, careful assessment is required to evaluate organ functions when a patient on ECMO support is being considered as an organ donor candidate. No data are available to date concerning the number of donors who experienced cardiac arrest and required ECMO support in Japan. In addition, we do not have any data regarding the precise number of brain-dead patients with normal organ function after ECMO support for an acute massive pulmonary embolism. These patients represent a source of donors that may have not been previously considered.

These dilemmas have led to the proposed possibility of not identifying potential donors and maintaining these patients on meaningless life-sustaining treatments [6]. Once the futility of treatment due to a devastating brain injury is determined, the patient's care team should consider the possibility of that patient serving as a potential donor in order to deliver comprehensive EOL care. Otherwise, these patients and their families may miss the opportunity to save and transform the lives of others if the patient or their family members are willing to donate the patient's organs. In our patient's case, we believe that the multidisciplinary team of attending physicians, psychiatrists, nurses, and social workers spent sufficient time discussing emotional aspects with the family members before the patient's brain death was declared on day 6 [7].

Based on our hospital's policy and current guidelines (available from: [http://www.mhlw.go.jp/bunya/kenkou/zouki\\_ishoku/dl/hourei\\_01.pdf](http://www.mhlw.go.jp/bunya/kenkou/zouki_ishoku/dl/hourei_01.pdf) and <https://www.jotnw.or.jp/files/page/medical/manual/doc/situgi.pdf>, 1-43.), the family was given information regarding organ donation options as part of the patient's EOL care. According to a survey of attitudes about organ donation among emergency physicians in Japan, only 20% of junior emergency physicians who do not wish to donate their own organs were willing to have a conversation with the family of a potential donor regarding organ donation options, but this willingness increased to 67% when the junior emergency physicians did express their willingness to donate their own organs [8]. Unless emergency physicians mention organ donation, patients and their families may lose the chance to potentially help others. Although approaching the family of a potential donor can be challenging, healthcare providers should appropriately support and guide the family in making the right decision to provide the patient with respectful EOL care. Emergency physicians must be educated and adept in communicating during pivotal situations to emotionally support families during a patient's EOL care, including making decisions about organ donation [1, 8].

Currently, there is no standardized and internationally accepted EOL care and donation process education program in Japan; however, a theoretical knowledge section combined with scenario-based interactive online learning would help physicians gain insight into the provision of optimal EOL care [9]. In addition, understanding both the reasons for refusing organ

donation and a family's experience during and after the donation process may help to minimize families' distress and fulfill the patient's wishes.

### Conclusion

Given the increasing use of ECPR, clinicians will encounter more potential organ donors in emergency and critical care settings. Organ donation should be part of the interactive discussion on EOL care to respect both the patient's and family's wishes, maximizing the opportunity for organ donation. Both specific training on how to approach the family of a potential organ donor during the EOL period and further debate are warranted to deliver optimal patient- and family-centered care.

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