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Extracorporeal life support and multiorgan donation in a severe polytrauma patient: A case report



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ABSTRACT

INTRODUCTION: Organ availability represents a key factor in transplants due to an almost universal shortage of deceased donors.

PRESENTATION OF CASE: We present the case of a 41-year-old patients with severe polytrauma, where extracorporeal life support (ECLS) allowed brain death (BD) declaration and multiorgan retrieval and transplantation.

DISCUSSION: Organ procurement is of utmost importance for transplant procedures. The presented case could rise ethical doubts as ECLS could be viewed as a tool for organ preservation instead of patient support. Nonetheless, it is obvious how organ preservation represents the necessary condition for patient preservation.

CONCLUSION: Besides its role in non heart beating donors, ECLS is emerging as an adjunctive tool for brain dead donors management when standard treatment fails, potentially allowing a substantial increase in organ availability.

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1. Introduction

Organ availability represents a key factor in transplant procedures. Transplant rates vary widely across the globe, but there remains an almost universal shortage of deceased donors [1]. Nowadays, the largest number of potential organ donors are brain-dead individuals and maximization of the support represents a suitable approach to optimize donor pool [2,3]. Complex physiologic disturbances follow brain death, leading to hemodynamic instability, and in a consistent percentage of cases to cardiac arrest and failure of organ procurement [4,5]. Besides its role in non heart beating donors, ECLS proved to be an adjunctive tool for brain dead donors management when standard treatment failed, potentially allowing a substantial increase in organ availability [6–8].

2. Presentation of case

A 41 year-old M was admitted to our ICU following a motorcycle accident. Past medical history was consistent with HCV-positivity ten years before, reversed after therapy with ribavirin and interferon. On the accident scene, the emergency team found a state of cardiac arrest and cardiopulmonary resuscitation was for 20 min before return of spontaneous circulation. During resuscitation maneuvers cricothyroidotomy was performed after a failed attempt of orotracheal intubation. Upon emergency room arrival (ER) the patient was comatose (GCS3), severely hypotensive due to maxillofacial bleeding and impairment of gas exchange resulting from massive bronchopulmonary aspiration of blood. Initial vital parameters were: BP 40/20, HR: 122 bpm, SpO₂: 88% with 100% O₂; arterial blood gas analysis revealed Hb: 6.7 with severe mixed respiratory and metabolic acidosis. A physical examination revealed bilateral dilated pupils with no light reflex, skin laceration over the frontal area and multiple abrasions over the face. In ER aggressive fluid resuscitation and vasoactive support were performed, and airways were secured by means of a surgical tracheostomy. 5U of RBC were transfused together with 2 U of fresh frozen plasma (FFP); initial coagulopathy management required tranexamic acid, prothrombin complex concentrates (PCC) and fibrinogen based on thromboelastometry. After initial hemodynamic stabilization, craniofacial CT-scan revealed diffuse cerebral

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edema, right frontal cerebral contusion, midbrain hemorrhagic petechiae consistent with diffuse axonal injury and multiple cranio-facial fractures; lung CT showed pulmonary contusions without lesions amenable of emergent intervention; the CT of abdomen highlighted contusion of the sixth liver segment and contusion of the left kidney. At ICU admission, hemodynamic instability occurred, nonetheless aggressive fluid infusion, RBC transfusion and vasoactive support, consistently with severe maxillofacial injuries and trauma-induced coagulopathy. Poor neurological status was present (GCS: 3) with bilateral dilated pupils, and absent brainstem reflexes. In the following hour respiratory gas exchange worsened with oxygen refractory hypoxia; furthermore, hemodynamic and metabolic parameters deteriorated due to the severity of maxillofacial injuries, which made nasal and pharyngeal packing difficult and prevented an effective control of the bleeding. In light of the hemodynamic and respiratory failure, ECLS implantation was discussed by a multidisciplinary team and implemented. In addition, treatment options and global prognosis were discussed with patient family who gave acceptance to ECLS implementation, in the perspective of treatment maximization and/or potential organ donation. Using the Seldinger technique, a venous-arterial ECLS was established by cannulation of the right femoral vein and left femoral artery, with distal femoral shunt positioning. Maxillofacial injuries did not allow transesophageal echocardiography and correct cannula position was performed by means of transthoracic echocardiography; in regard of severe coagulopathy, confirmed by thromboelastometry, circuit and patient anticoagulation was not established. After ECLS initiation, there was a substantial improvement in respiratory and hemodynamic parameters, with a mean arterial pressure of 60 and optimal oxygen saturation. In the following 6 h persistent bleeding was present, due to poor source control and coagulopathy, which required administration of fluids, RBC, FFP, Platelets, fibrinogen and tranexamic acid as appropriate according to laboratory and thromboelastometry. Over a 36-h period, a total of 26U of RBC, 8 l of FFP, 2 l of Plt 3 g of fibrinogen and 2 g of tranexamic acid were transfused.

In the following hours, neurologic status was unchanged, with GCS score 3 and absent brain stem reflexes. A preliminary EEG revealed the absence of cortical activity. Commission for BD determination was convened by intensivists together with patient family, who gave the acceptance for a possible organ donation. BD observation was started. After the 6-h observation period, the patient was declared dead and was subsequently conducted in the operating room under ECLS assistance. Liver and kidneys were retrieved and transplanted successfully to HCV-positive patients. Post-operative recoveries were uneventful, and the patients were discharged in good conditions.

3. Discussion

We presented the case of a severe major trauma, where ECLS was started due to failure of medical therapy before brain death determination, and where ECLS allowed organ retrieval and transplantation. In spite of the result which led to organ transplantation in patients on the waiting list, it is necessary to highlight some clinical and ethical aspects that should be taken into account when such an aggressive management of a potential donor is performed.

To our knowledge, this is the first described case where ECLS is performed for BD determination in a patient with ongoing bleeding. In this case the nature of lesion and trauma induced coagulopathy made not possible an adequate source control. Heparin-free extracorporeal membrane oxygenation support in severe trauma patients with coexisting bleeding has been previously described with good results [9]. In our case a surgically manageable source of bleeding which would have prevented ECLS support was excluded,

and ongoing facial bleeding was to an extent amenable of medical treatment, despite requiring massive transfusions over a relatively short period of time. Even if possible, this application could raise doubts about Blood Banks preservation and maximal use of a limited resource.

Secondly, ECLS made BD diagnosis possible in a patient where a poor neurologic and global prognosis could be anticipated, based on the dynamic of the accident, the nature of lesions, the radiological findings and physical examination. This application could rise ethical doubts as ECLS application could be viewed as a tool for organ preservation instead of patient support. In Italy, diagnostic criteria for BD are defined Laws n. 578 of December 29, 1993, and n. 582 of April 11, 2008: coma, absence of reflexes of the brainstem proven by the absence of spontaneous breathing apnea test ($\text{PaCO}_2 \geq 60$ mm Hg, arterial pH, 7.40), no EEG recording of brain electrical activity. The BD certification is issued by a Commission composed of an anesthesiologist, a forensic physician, and a neurologist. In each of the two Commission meetings (time 0 and after 6 h), a clinical examination and 30 min of EEG recording are performed. As a result, BD diagnosis represents a dynamic event and maximal therapy should be afforded during the entire determination time, including ECLS if needed. In spite of this, a gray area between patient support and organ preservation still remains. In this case, resuscitation and organ preservation team was one and the same, allowing a continuity in the decisional process through different phases of patient management. This aspect must be emphasized, in a context where a shift in goals was required. Furthermore, it's obvious how organ preservation represents the necessary condition for patient preservation.

Lastly, it must be highlighted that maximal support has been provided despite the uncertainty of organ suitability for transplantation. The adequacy of organs retrieved in patients under ECMO support has been previously demonstrated [10], but in this case several variables could have compromised organ function, such as persistent hypotension, hypoxia, vasoactive drugs effect, possible venous cannula interference on organ drainage.

4. Conclusion

Besides its consolidated role in non heart beating donors, ECLS can be a valuable option in unstable brain dead donors management, potentially allowing a substantial increase in organ availability [6–8].

Conflict of interest

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Consent

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Author contribution

PB, MC, AP, MB, GC and MLM contributed to the case management and paper draft.

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