Extracorporeal membrane oxygenation in brain-death organ and tissues donors: a single-centre experience

Editor—Organ donation and transplant rates vary widely across the globe, but there remains an almost universal shortage of deceased donors. Actually, in the Western Hemisphere, the number of potential transplant recipients has increased to almost 140,000 and yet the number of donated organs from all sources is not increasing sufficiently to maintain an acceptable situation. Veno-venous or veno-arterial extracorporeal membrane oxygenation (ECMO) is the treatment of refractory cardiogenic shock and of severe acute respiratory distress syndrome. ECMO can be also used in patients with neurological injury both in the case of cardio-circulatory failure refractory to conventional treatment or in the presence of cardiorespiratory instability during determination of brain death (BD).

We have experienced a case series in which ECMO permitted organ donation in BD patients. The case series here reported were carried out from the intensive care unit of the Emergency Department of the Careggi Teaching Hospital in Florence (Italy). Operations were carried out to diagnose BD and organs and tissues harvesting according to the guidelines of the Organization Tuscany Transplantation and National Transplant Center. 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 brain-stem proven by the absence of spontaneous breathing apnoea test (Paco2 ≥ 60 mm Hg, arterial pH > 7.40), no EEG recording brain electrical activity. The BD certification is issued by a Commission composed of an anaesthesiologist, 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. The proper arterial CO2 can be obtained by reducing and titrating ECMO fresh gas flow. All ECMO devices used were from Maquet (Maquet Rotaflow Centrifugal Pumps with Quadrox-D oxygenators, Maquet, Rastatt, Germany).

Table 1 summarizes the case series. Three of the seven patients treated with V-A ECMO had suffered post-traumatic cardiac arrest. The use of ECMO in these particular conditions allowed adequate organs perfusion in five of the eight patients. Unfortunately, the haemodynamic instability before ECMO support allowed only liver donation in most of cases. In one patient (number 1 in Table 1), clinical conditions worsened irreversibly after the first step of the BD diagnosis due to the hypoxia during the apnoea test. In this case, the immediate application of ECMO allowed us to complete the BD diagnosis and, following patient’s and relative’s wishes, the organs donations. Transplantation of organs had been unsuccessful in three cases, two were not considered suitable donors to

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yr)</th>
<th>Gender</th>
<th>Admission diagnosis</th>
<th>Indication to ECMO</th>
<th>Typology of ECMO</th>
<th>ECMO started before BD</th>
<th>ECMO duration before BD (h)</th>
<th>Paco2 (mm Hg)</th>
<th>Consent to donation</th>
<th>Donation organs donated Before BD</th>
<th>Donation organs donated After BD</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>19</td>
<td>Male</td>
<td>Head and chest trauma</td>
<td>V-A</td>
<td>Yes</td>
<td>N-A</td>
<td>46</td>
<td>67</td>
<td>Yes</td>
<td>Heart, liver, pancreas, kidneys</td>
<td>Liver</td>
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<tr>
<td>2</td>
<td>84</td>
<td>Male</td>
<td>Post-traumatic respiratory failure</td>
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<td>Yes</td>
<td>No</td>
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<td>57</td>
<td>Yes</td>
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<td>Liver</td>
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<tr>
<td>3</td>
<td>69</td>
<td>Male</td>
<td>Head and chest trauma</td>
<td>V-V</td>
<td>Yes</td>
<td>Yes</td>
<td>39</td>
<td>78</td>
<td>Yes</td>
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<tr>
<td>4</td>
<td>67</td>
<td>Female</td>
<td>Cardiac arrest</td>
<td>V-A</td>
<td>No</td>
<td>Yes</td>
<td>35</td>
<td>66</td>
<td>No</td>
<td>Yes</td>
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</tr>
<tr>
<td>5</td>
<td>64</td>
<td>Female</td>
<td>Head injury</td>
<td>V-A</td>
<td>No</td>
<td>Yes</td>
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<td>61</td>
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<tr>
<td>7</td>
<td>62</td>
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<td>Cardiac arrest</td>
<td>V-A</td>
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<td>Yes</td>
<td>30</td>
<td>62</td>
<td>Yes</td>
<td>Liver</td>
<td>Liver</td>
</tr>
</tbody>
</table>

Table 1 Patient’s clinical features: ECMO, extracorporeal membrane oxygenation; V-V, veno-venous; V-A, veno-arterial; BDD, brain death determination; BDD-1, start of brain death determination; BDD-2, end of brain death determination (after 6 h).
surgical exploration after organ harvesting, and in one case, there was no consensus by relatives.

Our experience suggests that ECMO support can allow organ support before BD determination and, consequently, increase the possibility of organs donation. While in seven patients, ECMO was initiated as life-saving procedure in the early phase of hospital admission (haemodynamic and respiratory support), in one patient, ECMO was needed to permit the end of BD determination procedure. We must admit that ECMO support initiated to permit the end of BD diagnosis can be sound as a sort of ethical limit. But, in our opinion, this very particular case must be viewed, considering that the BD diagnosis is made only at the end of the BD procedure, not at the beginning or in the middle: in this contest, reanimation manoeuvre should be afforded during BD determination time, including extracorporeal support where available. To avoid misunderstandings, we do not use ECMO as supportive therapy for organ donation, but as supportive/rescue therapy in emergency clinical situations. The fact that organs will be available for donation is the consequence and not the goal, even if the possibility of ECMO support initiated after the donor was declared dead has been done.2

Declaration of interest
None declared.

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A note from the future
Editor—As advanced technology swarms our intensive care units (ICUs) and patients constantly receive higher quality of care, there seems to be a void when it comes to one of the most basic of principles within medical practise—documentation. Surely, those illegible, disorganized, missing notes should be a thing of the past?

The NHS has been seen to improve IT facilities nationwide with the introduction of the National Programme for IT (NPfIT) delivered by the Department of Health’s NHS Connecting for Health. Started in 2002, this was as a result of an increasing need for more easily accessible, electronic patient records.1 It was envisaged that basic information would be kept about all patients in a central location, which could then be accessed by healthcare providers around the country to provide better care to patients. This, for example, could have helped in out-of-hours emergency department presentations, where patients might not be local to the area and medical notes not stored.2 However, despite generous funding, the programme was never completed.

We have moved into a time where rapid patient diagnosis, investigation, and treatment occur with high patient turnover and an ever-increasing workload. Our documentation system should reflect and facilitate this in these times in our modern NHS.

On a more local scale, most hospitals currently use computerized systems for certain clinical means, such as radiography;3 however, few have warped themselves completely into the technological era. We looked at how ICUs throughout the UK utilized computers clinically by performing a survey on all general adult ICUs in the country. We retrieved data for 94% (n = 219) of units out of a total of 233 general, adult ICUs.

We found that all units used digital systems to view X-rays; moreover, the system used over the country is the picture archiving and communication system (PACS), with some units using software to retrieve or utilize data from PACS such as Impax or Sectra. This was a nationwide transformation made by the NHS’s Connecting for Health programme earlier in the century.3 Ninety-four per cent (n = 205) of units used a digital laboratory service, whereby pathology results are retrieved electronically. Of these, the most popular system is Sunquest’s ICE (Integrated Clinical Environment) occupying ≈18% (n = 37) of all ICUs electronic pathology systems, followed by software designed by iSoft (PatientCenter, iClinical Management) at 18% (n = 36) and Cerner (Millenium) at 5% (n = 11).

Electronic patient notes were utilized in only 21% (n = 46) of ICUs across the country. The majority of which (22%, n = 10) used Philips’ Intellivue system, followed by software by iMDsoft (15%, n = 7) according to our data. Finally, fewer ICUs throughout the country used electronic drug charts at 17% (n = 36) of the total units. The most popular software manufacturers to be used by units were Philips (25%, n = 9) and iMDsoft (19%, n = 7).

In conclusion, the NHS seems to be moving to a more computerized hospital approach, where healthcare providers need rapid access to accurate, up-to-date patient records, which will also allow the running of more efficient hospitals. This comes with various dilemmas, such as security breaches and a ‘big brother’ society. However, overall, we think that these systems would provide better overall care for our patients in the NHS.

Declaration of interest
None declared.

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