Masters of Cardiothoracic Surgery

Heart and multiple organ transplantation from donation after circulatory death using mobile normothermic regional perfusion and cardiac surgery extra-corporeal membrane oxygenation team out of the hub transplant centre

Sofia Martin-Suarez, Luca Botta, Giuseppe Barberio, Filippo Londi, Costanza Fiaschini, Davide Pacini

Division of Cardiac Surgery, IRCCS Azienda Ospedaliero-Universitaria di Bologna, S. Orsola Hospital, Bologna, Italy

Correspondence to: Sofia Martin-Suarez, MD, PhD. Division of Cardiac Surgery, IRCCS Azienda Ospedaliero-Universitaria di Bologna, S. Orsola Hospital, Via Massarenti 9, 40138 Bologna, Italy. Email: docsofi74@hotmail.com; sofia.martinsuarez@aosp.bo.it.

Submitted Apr 25, 2024. Accepted for publication Jun 10, 2024. Published online Aug 14, 2024.
doi: 10.21037/acs-2024-dcd-22
View this article at: https://dx.doi.org/10.21037/acs-2024-dcd-22

Clinical vignette

Introduction

Heart failure is on the rise due to aging populations and the spread of risk factors. While heart transplantation remains the gold standard treatment for end-stage heart failure unresponsive to optimal medical therapy, a critical challenge exists: the "donor-recipient mismatch" (1). In this framework, cardiac grafts from donors not meeting criteria for brain death but whose circulatory functions have ceased irreversibly can concur to expand the donor pools, alongside with *ex-vivo* perfusion and transport devices. A key hurdle is managing the warm ischemia time (the time the heart is deprived of oxygenated blood) until it is reperfused for transplantation. Italian law mandates a 20-minute documented period of asystole to confirm death. Thoraco-abdominal normothermic regional perfusion (TA-NRP) conducted with extra-corporeal membrane oxygenation (ECMO) after death declaration can be a valid option to preserve heart (and other grafts) viability for transplantation during post-mortem assessment. Several experiences in countries such as Spain, the USA and the UK showed satisfactory results (2,3).

Clinical scenario

In August 2023, a suitable heart was made available for a 60-year-old male on our heart transplant waiting list, to which he had been admitted three years earlier. He had been diagnosed with right ventricle arrhythmogenic cardiomyopathy in 1989, implanted with an implantable cardioverter defibrillator (ICD) in 2013 and underwent right ventricle ablation in the same year. During the following years, symptoms and instrumental status continued worsening despite optimal medical therapy. Latest transthoracic cardiac ultrasonography showed mild mitral regurgitation, massive tricuspid regurgitation, right ventricle severe dilatation and hypokinesia, with mid-apical free wall akinesia. Left ventricular ejection fraction (LVEF) was 40%. Preoperative New York Heart Association (NYHA) score was II.

Donor management

A young patient was admitted to the intensive care unit of a regional hospital without cardiothoracic surgery, with irreversible post-anoxic brain damage. The patient did not fulfil brain death criteria but required maximal care and mechanical ventilation. Considering the irreversible neurological condition, the attending physicians, in consultation with the family, decided to discontinue life-sustaining treatment. Donation consent was afterwards verified. The potential donor was evaluated through a multidisciplinary assessment and referent transplantation center was contacted to allocate organs. Our donation after circulatory death (DCD) heart team reached the donor site, endowed with ECMO team. Standard monitoring was arranged, for temperature and hemodynamic parameters [electrodes for on-paper electrocardiogram (EKG)

recording, invasive arterial pressure monitoring, central venous catheter, and Swan-Ganz catheter], alongside with functional assessment (through transesophageal echocardiography).

Surgical technique

Surgical field preparation and withdrawal of life-sustaining treatment (WLST)

Furthermore, surgical field was prepared as well as ECMO lines. Right femoral artery and vein sheaths were placed for cannulation and in the left side for the intra-aortic occluder balloon. After partial heparinization, guides were positioned for perfusion cannulas in the right side and for the balloon in the left side. The last of which was placed with transesophageal ultrasonographic guidance.

Withdrawal of life support determined a fast beginning of the agonal phase, followed by asystole. Death was declared following 20-minute on-paper recorded asystole, as provided by Italian law. Subsequently, two teams worked simultaneously: one with femoral vessels cannulation (21-French arterial cannula, 25- or 27-French venous cannula) and the other one with sternotomy and epiaortic vessels exposition and clamping. Notably, brain vessels need being clamped before TA-NRP can be established to avoid death diagnosis invalidation through cerebral reperfusion. To achieve reperfusion to abdominal organs sooner, the intra-aortic balloon could have been inflated before epiaortic vessels were clamped. In this case, aortic vessels were closed before perfusion started, avoiding the need for intra-aortic balloon to be inflated (4).

Once TA-NRP was established, the pericardium was opened. The heart started fibrillating: electric shock was applied once, then a left ventricular vent was introduced through the right superior pulmonary vein, close to Waterston's groove, and an efficient second electric shock restored sinus rhythm.

Completion

After reperfusion, the candidacy for procurement of the heart and other organs was thoroughly assessed via instrumental and laboratory parameters for an adequate time frame; subsequently, TA-NRP was terminated, leaving ECMO re-circulating to allow heart function evaluation with an ordinary afterload. Once deemed satisfactory, assessment was concluded and organs were procured in a standard fashion; in particular, as far as the heart is concerned, cardioplegia was delivered, heart harvested and stored for transportation to the recipient hospital.

The recipient had previously been prepared for implantation; after standard orthotopic transplantation according to the bicaval technique, the graft was assessed before proceeding with hemostasis and finishing surgery. Final functional warm ischemic time (fWIT) was 40 minutes, while total graft ischemic time was 181 minutes.

Post-operative outcome

After surgery, the patient was admitted to the cardiac anesthesia intensive care unit for 5 days, with persistent hemodynamic stability; immunosuppressive therapy was started. Heart function was assessed through cardiac transthoracic ultrasonography, with biventricular optimal function and no valvular defects. Postoperative course was uneventful, apart from the need for percutaneous drainage of a severe pericardial effusion and cytomegalovirus (CMV) positivization, due to donor-recipient serologic mismatch. The patient was discharged from hospital on the 26th postoperative day, in good clinical status.

Comments

This case presents the initial and successful experience of TA-NRP with ECMO out of the transplantation hub center to perform heart and other organ transplantation from a donor after controlled circulatory death, despite the prolonged expected fWIT due to Italian legal provisions for declaration of circulatory death (5). Efficacy of this technique facilitates heart and other graft evaluation and allows a predictable expansion of the donor pool.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References

1. Hess NR, Hong Y, Yoon P, et al. Donation after circulatory death improves probability of heart transplantation in waitlisted candidates and results in post-transplant outcomes similar to those achieved with brain-dead donors. J Thorac Cardiovasc Surg 2024;167:1845-1860.e12.
2. Messer S, Rushton S, Simmonds L, et al. A national pilot of donation after circulatory death (DCD) heart transplantation within the United Kingdom. J Heart Lung Transplant 2023;42:1120-30.
3. Hoffman JRH, McMaster WG, Rali AS, et al. Early US experience with cardiac donation after circulatory death (DCD) using normothermic regional perfusion. J Heart Lung Transplant 2021;40:1408-18.
4. Li SS, Funamoto M, Osho AA, et al. Acute rejection in donation after circulatory death (DCD) heart transplants. J Heart Lung Transplant 2024;43:148-57.
5. Joshi Y, Macdonald PS. Heart Transplantation From DCD Donors Enters the Mainstream. Transplantation 2023;107:2449-50.

Cite this article as: Martin-Suarez S, Botta L, Barberio G, Londi F, Fiaschini C, Pacini D. Heart and multiple organ transplantation from donation after circulatory death using mobile normothermic regional perfusion and cardiac surgery extra-corporeal membrane oxygenation team out of the hub transplant centre. Ann Cardiothorac Surg 2024;13(6):534-536. doi: 10.21037/acs-2024-dcd-22