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RESEARCH CORRESPONDENCE

Heart transplantation after donor circulatory death in patients bridged to transplant with implantable left ventricular assist devices

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It has recently been shown that donor hearts can be retrieved from a donor after cardiac death (DCD), resuscitated, assessed ex situ using normothermic perfusion, and successfully transplanted into low-risk recipients.[1] However, the utility of DCD transplantation in high-risk recipients remains undetermined. Here, we report 2 patients with long-term left ventricular assist device (LVAD) support who were successfully bridged to heart transplantation (HTx) using DCD hearts despite an adverse donor/recipient risk profile.

Methods

After a protocol review by the UK Donation Ethics Committee, National Health Service Blood and Transplant, and by our hospital Clinical Practice Committee, requisite approvals were gained by April 2015. Recipients meeting eligibility criteria (Table 1) provided informed consent to DCD HTx (in addition to donation after brain death [DBD]) by signing a supplementary form. Specialist nurses in organ donation were trained to obtain consent from the next of kin of potential Maastricht category III controlled DCD individuals. The retrieval protocol is detailed in Figure 1.

Results

Recipient and donor characteristics, withdrawal of life-supporting therapies (WOLST), and ex situ perfusion parameters are detailed in Tables 2, 3, 4, 5, and 6, respectively. Organ Care System (OCS; TransMedics Inc., Andover, MA) hemodynamic profiles and metabolic and perfusion trends are shown in Figure 2.

For the first donor, aortic pressure remained below the desired range for the first hour of OCS support, presumably due to the glyceryl trinitrate (GTN) administered in the cardioplegia in conjunction with the donor's vasopressor requirement before WOLST. As a result, coronary flow was supranormal; therefore, no maintenance adenosine was administered. The pump flow was lowered and synchronized to the electrocardiogram as soon as stable rhythm was achieved. This strategy permitted an acceptable aortic pressure with a satisfactory coronary flow with the aim of minimizing the development of performance-limiting myocardial edema. Coronary artery vasodilatation diminished progressively after 2 hours of support, and the adenosine infusion was subsequently uptitrated to maintain a mean aortic pressure of 65 mm Hg.

For the second donor, in the light of experience from the first, the GTN dose in the cardioplegia was reduced to 20 mg/liter. This dose was sufficient to achieve the desired perfusion pressure. Donor hemoglobin concentration was 8 g/dl before WOLST, and the baseline perfusate hematocrit on the OCS was 16%, necessitating the addition 100 ml of washed packed red blood cells.

Recipient surgical parameters are summarized in Table 5. In both patients, after completion of left atrial, pulmonary artery, aortic, and inferior vena cava anastomoses, the cross clamp was removed, and cardiac reperfusion was started. The superior vena cava anastomosis was performed with the heart beating on cardiopulmonary bypass. The postoperative outcomes for the recipients are detailed in Table 6.

Discussion

Procurement of DCD hearts has the potential to increase transplant activity substantially by providing a new pool of transplantable organs.[2] This may be particularly important in countries, such as the United Kingdom, where donor availability has remained static in recent years.[3] However

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DCD HTx remains a relatively new concept that has only been implemented in a small number of patients in a few transplant centers in the world,[1,4] and there is a reluctance to use such organs, particularly in high-risk recipients. In situ resuscitation of the heart within the body of the DCD donor is one approach to donor heart resuscitation and hemodynamic assessment, although this continues to raise ethical concerns.[5] To avoid this controversy, our protocol is based on ex situ resuscitation and assessment of the donor heart.

The Heart OCS is the only commercially available device[6] for the resuscitation and transportation of donor hearts. It allows continuous warm perfusion from soon after retrieval until implantation in the recipient hospital, thereby minimizing the detrimental effects of ischemic cold storage and allowing continuous assessment of function. The ability to assess graft viability is of particular importance in DCD HTx, where, in contrast to the DBD setting, the donor organ has invariably been subjected to a sustained ischemic insult before procurement. We deliberately prolonged OCS support duration to allow comprehensive graft assessment and to achieve surgical preparedness in technically demanding recipients with LVADs in situ. Before initiating DCD HTx, we demonstrated[7,8] the clinical utility of the OCS; that is, gaining the ability to assess marginal donor organs and rejecting organs during OCS support that unexpectedly showed adverse characteristics. This allowed for greater recipient surgical preparedness and favorable outcomes, despite an adverse donor risk profile. Combining this experience with our pre-clinical feasibility studies in a porcine DCD model[9] and the pioneering work of the

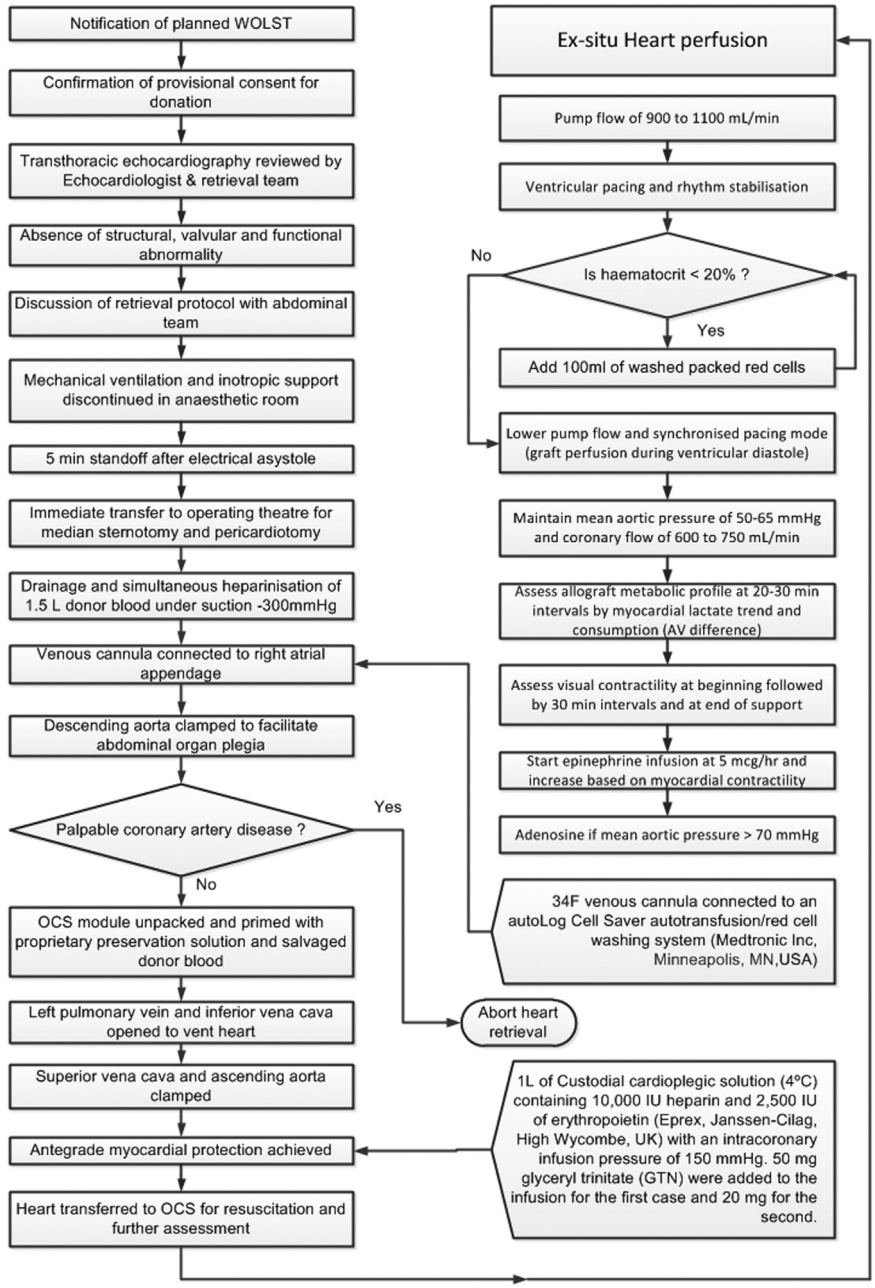

Figure 1 Donation after circulatory death (DCD) heart retrieval protocol. AV, arterial-venous; OCS, Organ Care System (TransMedics Inc.); WOLST, withdrawal of life-supporting therapies.