Is it time for the United States to engage in heart transplantation using donation after circulatory death?

Oliver K. Jawitz, MD,1,2 and Carmelo Milano, MD3

Feature Editor's Note—Despite significant advances in medical management and availability of durable mechanical circulatory support devices to treat end-stage heart disease, no therapy to date has provided the survival benefit afforded by heart transplantation. For an adult patient who received a heart transplant worldwide between 2002 and 2008, median survival following heart transplantation now extends to 12.2 years (Lund LH. J Heart Lung Transplant. 2017;36:1037-46). Despite the significant increase in the number of heart transplant procedures performed in the United States over the past 10 years as a result of the expansion of acceptable donor criteria and the opioid epidemic (Durand CM. Ann Intern Med. 2018;168:702-11), heart transplantation has been chronically plagued by donor shortages that have limited the overall epidemiologic benefit of this therapy. Recently, there has been a growing interest in using heart organs obtained from donors following circulatory death (ie, donation after circulatory death [DCD]) to expand the heart donor pool (see the recent report by Chew and colleagues. J Am Coll Cardiol. 2019;73:1447-59). In this issue of the Journal, Jawitz and Milano provide a timely and thoughtful review of the state of DCD heart transplantation and the report by Chew and colleagues. Jawitz and Milano review recent compelling evidence from Australia and the United Kingdom on DCD heart transplantation and present a very cogent argument why such a strategy should be implemented in the United States.

Recently, there has been a growing interest in using heart organs obtained from donors following circulatory death (ie, donation after circulatory death [DCD]) to expand the heart donor pool (see the recent report by Chew and colleagues. J Am Coll Cardiol. 2019;73:1447-59). In this issue of the Journal, Jawitz and Milano provide a timely and thoughtful review of the state of DCD heart transplantation and the report by Chew and colleagues. Jawitz and Milano review recent compelling evidence from Australia and the United Kingdom on DCD heart transplantation and present a very cogent argument why such a strategy should be implemented in the United States.

Despite a robust experience with DCD transplantation of lungs, livers, and kidneys in the United States, DCD heart transplantation carries inherent clinical challenges, including ensuring equivalent clinical outcomes to brain-death donors, ethical issues in management of the donor, and increase in resource use to sustain a DCD heart-transplant program. As put forth by Kawitz and Milano, a significant ethical and clinical framework for DCD heart donation in the United States has been made by groundbreaking efforts in Australia and the United Kingdom. Because of the dire need for donor hearts, it is clinically necessary to resolve these controversies and challenges to expand the current heart donor pool in the United States.

Donation after circulatory death (DCD) donors were used in the early days of human heart transplantation, before the dissemination of formalized brain death criteria.1,2 Since then, the transplant donor pool has shifted to donation after brain-death donors, which have the added benefit of foregoing the warm ischemia time period inherently associated with DCD organs. Due to a universal shortage of donor allografts, there has been renewed interest in DCD heart transplantation, which is not currently performed in the United States.3-5

Recently, in the Journal of the American College of Cardiology, Chew and colleagues6 report on their series of 23 cardiac transplants using DCD donors at St Vincent’s Hospital in Sydney, Australia. The authors provide a detailed description of their clinical protocol and intermediate results. Average donor age was 29 years (range 20-38 years). Their protocol accepted a warm ischemia time (defined as the time from withdrawal of mechanical ventilation until administration of cardioplegia) up to 30 minutes. The average time from withdrawal to asystole was only 10 minutes. After declaration of death,
a 2- to 5-minute stand-off period was employed. All hearts were perfusion stored with the Organ Care System (TransMedics, Inc, Andover, Mass), and therefore, before explantation of the heart, roughly a liter of blood was removed from the donor to serve in the perfusate on the circuit. Notably, the surgeons received permission to administer heparin to the donors before withdrawal. Donor heart viability on the Organ Care System device was gauged with the lactate profile, hemodynamic parameters, and the overall appearance. Although initial lactate levels were high, used hearts displayed a down trending lactate level and evidence for lactate absorption on serial perfusate samples.

Of the 23 transplants, at least 9 displayed significantly reduced initial ventricular function requiring intra-aortic balloon pump support in one instance and venoarterial extracorporeal membrane oxygenation (ECMO) support in the other 8 cases. Venoarterial ECMO support was maintained for an average of 5 days. The majority of the earlier dysfunction resolved, and the authors report only 1 early mortality. Some patients have been followed out to 4 years, and the authors suggest that overall survival is equivalent to their cohort of brain-death donors. This series of highly selected and protocolized DCD donors demonstrates remarkable outcomes and suggest the DCD population may be an untapped resource for additional heart transplants.

In the context of the recent report by Messer and colleagues7 from the United Kingdom, which is the largest published series of DCD heart transplants to date, there is now a growing body of literature supporting the efficacy, safety, and viability of performing DCD heart transplantation in the modern era. In their series of 26 consecutive DCD heart transplants from 2015 to 2017, Messer and colleagues report comparable 30-day, 90-day, and 1-year survival between recipients of brain-death donors and DCD donor hearts. In contrast to the study by Chew and colleagues, in which approximately 35% of recipients required post-transplant ECMO for delayed graft function, only 12% of patients in the series from Messer and colleagues required such support. This may reflect variations in procurement protocols between the 2 groups, particularly since almost one half of the procurements in the study by Messer and colleagues were performed using normothermic regional perfusion instead of direct procurement and perfusion.

The highly favorable outcomes reported by both the Australian and UK groups highlight the need for further investigation to standardize DCD heart procurement protocols and donor selection criteria. These efforts will be instrumental in facilitating a broader adoption of DCD heart transplantation, which has the potential to significantly increase heart transplant volumes worldwide. Although the impact of DCD donors on the overall heart transplant donor pool is difficult to predict, multiple analyses have suggested that an increase of 15% to 30% would be a reasonable expectation and would be associated with a substantial decline in waiting list mortality.8-11 Similarly, in a retrospective analysis of national registry data, our group applied the DCD heart transplant donor selection criteria used by Messer and colleagues from the United Kingdom to the historic pool of DCD donors in the United States. In doing so, we predicted an increase of up to 30% in US heart transplant volumes with maximal use of the DCD donor pool.1,2 Although the barriers to implementing DCD heart transplantation in the United States are substantial and require novel solutions to important ethical, legal, and financial issues, the benefit to our patients is clear and is certainly worthy of our community’s investment.

Conflict of Interest Statement
Authors have nothing to disclose with regard to commercial support.

References