



Thoracic Transplant Quarterly Article Review

Tchana-Sato V, Ledoux D, Detry O, Hans G, Ancion A, D'Orio V, Massion PB, Amabili P, Bruls S, Lavigne JP, Monard J, Delbouille MH, Sakalihan N, Defraigne JO. Successful clinical transplantation of hearts donated after circulatory death using normothermic regional perfusion. *J Heart Lung Transplant*. 2019 Jun;38(6):593-598.

[https://www.jhltonline.org/article/S1053-2498\(19\)31409-3/fulltext](https://www.jhltonline.org/article/S1053-2498(19)31409-3/fulltext)

Abstract:

“ **BACKGROUND:** Heart transplantation (HT) from donation after circulatory death (DCD) has yet to achieve wide clinical application despite the encouraging results reported recently. In this study we describe 2 cases of successful adult DCD HT performed at our institution using an original protocol. **METHODS:** Our local abdominal DCD protocol was updated to allow DCD heart procurement and was accepted by the institutional ethics committee. The main features of the protocol include: pre-mortem insertion of peripheral venoarterial extracorporeal membrane oxygenation cannulas; thoracoabdominal normothermic regional perfusion (NRP) by clamping the 3 aortic arch vessels to exclude cerebral circulation; and in-situ heart resuscitation. The retrieved hearts were directly transplanted into recipients located in an adjoining operating room. **RESULTS:** The procurement warm ischemic time was 25 minutes for the first donor, and 26 minutes for the second donor. The cold ischemic time was 16 minutes for the first recipient and 17 minutes for the second recipient. The suture time was 30 minutes for the first recipient, and 53 minutes for the second recipient. Both recipients were easily weaned off cardiopulmonary bypass in sinus rhythm and inotropic support. Post-operative evaluation of cardiac function was excellent and the patients were subsequently discharged home. **CONCLUSIONS:** Transplantation of hearts from DCD donors is now a clinical reality. NRP is a useful tool for resuscitation, reperfusion, and preservation of transplanted hearts. It also offers the opportunity to assess the function and viability of organs before transplantation. However, due to ethical issues, some may object to ante-mortem intervention.”

Commentary by Barbara Wilkey, MD

Our article for this quarter, penned by Tchana- Sato and colleagues, addresses the use of normothermic regional perfusion (NRP) to allow successful heart transplantation with DCD grafts. There are four established procurement methods for DCD hearts, outlined in Table 1 below. In this particular case series, NRP with cold storage (CS) was used for two DCD donor hearts and transplanted into recipients prepared in adjacent operating rooms. The donors were

intubated and administered sevoflurane to a goal end tidal concentration of two percent or greater. The donor was heparinized and femorally cannulated for extracorporeal membranous oxygenation (ECMO). Life support was then withdrawn, and when the femoral arterial line was without pulsatility and the mean arterial pressure (MAP) was below 30 mmHg circulatory arrest was declared. After 5 minutes of circulatory arrest without further intervention, death was declared, sternotomy was performed, the heart was exposed, and the arch vessels were clamped. After vessel clamping ventilation was resumed and ECMO started with a goal cardiac index of 2.5 liters/min/m² or greater and MAP greater than 50 mmHg. Of note, the donor hearts did spontaneously resume electrical activity after reperfusion with ECMO. Other physiologic parameters included temperature greater than 35 degrees Celsius and hematocrit over 30%. After 30 minutes of support, ECMO was discontinued and the heart was evaluated for transplant suitability. Requirements for graft acceptance were 1) left ventricular ejection fraction >50%, 2) normal right ventricular size and function, 3) cardiac index >2.5 liters/min/m², 4) pulmonary artery capillary wedge pressure <12 mmHg 5) MAP >60 mmHg and 6) no arrhythmia ("arrhythmia" not defined). If the graft could maintain these parameters for 30 minutes, it was harvested for transplant. For the two cases published in this series the functional warm ischemic time prior to procurement (MAP less than 50 mmHg until NRP with ECMO) was 7 minutes for donor 1 and 11 minutes for donor 2. The procurement warm ischemic time (withdrawal of life support to initiation of NFP) was 25 minutes for donor 1 and 26 minutes for donor 2. Both recipients required Dobutamine and Norepinephrine infusions postoperatively, with recipient one on the infusions for 179 hours and recipient two on the infusions for 435 hours. Recipient one was discharged postop day 31, and recipient two discharged on postop day 54.¹

The first human heart transplant ever performed was a Donation after Cardiac Death (DCD) event. Approximately one year later, in 1968, brain death criteria were defined and after that event DCD heart donation went by the wayside. It wasn't until the 21st century that attention slowly began to return to DCD heart donors. In 2008 the Children's Hospital in Denver, Colorado published its experience successfully transplanting three infants with DCD grafts using the DP-CS technique. In the ensuing years, interest in DCD heart transplantation and the evolution of medical interventions to support it has blossomed. Despite these gains DCD heart transplantation has not been widely incorporated into practice. Only 105 DCD heart transplants have been performed worldwide with the majority of those being performed by one group.² It is unclear what is driving this lack of utilization; potentially a combination of factors such as cost, perceived utility, physician comfort and ethical issues. Some would consider this unfortunate as it is estimated that use of DCD grafts could increase the heart graft pool by 17-30%. Regardless of opinion, DCD heart grafts are proving to be a viable, cultivable resource.

Table 1. DCD Harvesting Techniques

Technique Name	Reperfusion in donor prior to harvest but after death?	Cold Ischemic Time?
Direct Procurement- Cold Storage (DP-CS)	No	Yes
Direct Procurement- ex situ heart perfusion (DPP)	No	No
Normothermic regional perfusion- ex situ heart perfusion (NRP-MP)	Yes	No
Normothermic regional perfusion- Cold Storage (NRP-CS)	Yes	Yes

References

1. Tchana-Sato V, Ledoux D, Detry O, Hans G, Ancion A, D'Orio V, Massion PB, Amabili P, Bruls S, Lavigne JP, Monard J, Delbouille MH, Sakalihan N, Defraigne JO. Successful clinical transplantation of hearts donated after circulatory death using normothermic regional perfusion. *J Heart Lung Transplant*. 2019 Jun;38(6):593-598.
2. Macdonald P and Dhital K. Heart transplantation from donation-after circulatory-death (DCD) donors: Back to the future: Evolving trends in heart transplantation from DCD donors. *J Heart Lung Transplant*. 2019 Jun;38(6):599-600.