Ex Vivo Coronary Angiographic Evaluation of a Beating Donor Heart

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Coronary artery disease in the cardiac transplant population has been identified as a cause of worse long-term outcomes and accelerated graft vasculopathy. Pre-existing double or triple vessel in the donor heart is associated with a 61.5% post-transplant 30-day mortality.1 Significant angiographic donor heart coronary artery disease is generally considered a contraindication to transplantation. As a result, pretransplant screening for coronary artery disease in the donor population is recommended in male donors >45 years of age and female donors >50 years of age with no cardiovascular risk factors. In the presence of risk factors, the screening age should be reduced by 5 to 10 years.2 In such marginal donors, invasive coronary angiography is the mainstay of investigation for coronary artery disease, although stress echocardiography has also been used successfully before organ harvesting.3–5 Failure to perform pretransplant coronary angiographic screening of marginal donor populations may be associated with significant financial ramifications related to retrieval cost if the allograft is subsequently found to be unsuitable for transplant. However, preharvest coronary angiography may not always be feasible because of unavailability of cardiac catheterization at the donor institution and the need for urgent concurrent intra-abdominal organ procurement. Delay in procuring and transporting donor organs to recipient centers may also increase cold ischemic times, resulting in compromised donor organ viability.6

The traditional technique for donor heart preservation involves simple hypothermia to reduce the graft organ metabolic rate.7 Continuous hypothermic perfusion and continuous warm-blood perfusion have been postulated as alternative means of prolonging the transport time of harvested organs and improving clinical outcomes after transplant. Sterile donor graft perfusion, oxygenation, and metabolic homeostasis can be maintained continuously within a perfusion box during organ transport and, as a result, the deleterious effects of cold storage may be avoided.7 The feasibility of warm-blood perfusion box transport of cardiac grafts has been demonstrated, and the effect on clinical outcomes is the subject of ongoing clinical trials evaluating the effectiveness of the organ care perfusion system in the preservation of donor hearts.8,9

We describe a case of an ex vivo coronary angiography performed on a beating donor heart contained within a sterile warm-blood perfusion chamber when preharvest coronary angiography could not be performed.

After brain death resulting from a road traffic accident in an interstate location, a 40-year-old smoker with a strong family history of ischemic heart disease was approved for multiple organ procurement. Abdominal and cardiothoracic surgical teams worked simultaneously to harvest the organs, which were subsequently flown to recipient centers in multiple locations. Preharvest coronary angiographic screening was not possible because of the time constraints imposed by geographical distance and concurrent intra-abdominal organ procurement for a high-urgency liver transplant recipient. External inspection of the heart at the time of harvest raised concerns about underlying coronary artery disease. The donor heart was transported in a sterile beating-heart perfusion chamber (Organ Care System, Transmedics) to our institution for potential transplantation. Ex vivo coronary angiography of the beating heart was undertaken on arrival at our center.

A Tuohey-Borst valve was attached to a port on the perfusion box in coaxial alignment with the allograft aorta. Diagnostic catheters were introduced through the Tuohey-Borst valve into the aortic root using a 0.035-inch guide wire. Next, 6F Judkins L3.5 and R4 catheters were used to cannulate the left and right coronary ostia, respectively. The image intensifier arm (Artis Zeego, Siemens) was manipulated around the perfusion chamber that was set up on the floor of the cardiac catheterization laboratory. Cineangiographic images were obtained in multiple orientations as determined by the structure of the perfusion chamber. The C-arm of the image intensifier was rotated 90° to a horizontal beam orientation. The design of the ex vivo perfusion circuit requires the donor heart to be instrumented inside the sterile chamber in a prone orientation with approximately...
45° of superior angulation of the aorta. The initial cine image was obtained in the horizontal plane perpendicular to the long axis of the perfusion box (Figure 1).

Subsequent images were acquired by rotating the C-arm through various angles in the vertical plane equivalent to anterior and posterior angulation with respect to the heart (Movie I in the online-only Data Supplement). Horizontal rotation of the perfusion chamber through 90° allowed additional imaging through the long axis. Imaging revealed significant triple vessel disease, and the allograft was subsequently deemed unsuitable for transplantation (Figures 1 through 3; Movie I in the online-only Data Supplement).

We demonstrated that ex vivo coronary angiography can be performed successfully on a beating heart from a marginal donor and contained within the portable TransMedics Organ Care System device in a situation in which preharvest screening cannot be performed. In this case, the angiographic findings significantly altered the suitability of the organ for transplant.

Disclosures

None.

References


Figure 1. Still frame image demonstrating selective angiography of the right coronary artery using a Judkins R4.0 diagnostic catheter. The arrow indicates severe stenosis.

Figure 2. Still frame image demonstrating selective angiography of the left coronary artery using a Judkins L3.5 diagnostic catheter. The left main stem bifurcation and severely diseased left anterior descending artery (arrows indicate stenosis) are demonstrated.
Figure 3. Still frame image demonstrating selective angiography of the left coronary artery using a Judkins L3.5 diagnostic catheter. The severely diseased circumflex artery (arrows indicate stenoses) is demonstrated.
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