Lung donation after cardiac death of recent heart transplant recipient

In June 2008, Gift of Life Michigan was notified of a potential donor. After the initial chart review, it was determined that the patient would be a candidate for donation after cardiac death. Two things made this case interesting: (1) the patient was an organ recipient himself, having received a heart transplant just a short time before his death, and (2) even though this was a donation after cardiac death and the patient had recently received the heart transplant, the patient's lungs and the left kidney were successfully recovered and used for transplant. (*Progress in Transplantation.* 2009;19:232-234)

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Every day, the number of people waiting for a life-saving organ increases. As of May 3, 2009, the Organ Procurement and Transplant Network reported that 101 976 people were on the transplant waiting list.[1] Because of the overwhelming number of people on the waiting list, there is a push to use organs that previously would not have been used. Such organs include lungs recovered from a donor through the process of donation after cardiac death (DCD) and organs that have already been transplanted.[2,3] These scenarios could reduce the number of people waiting for a life-saving organ. Studies such as the one by Mason and colleagues[3] show that lungs recovered from DCD patients perform just as well as lungs from donors who are brain dead.[3] The following case review, with permission from the legal next of kin, describes how both of the preceding scenarios played a critical role in determining the process of consent to recovery.

Case Review

In June 2008, Gift of Life Michigan was notified of a potential donor after the patient had met clinical triggers (score of 5 or less on the Glasgow Coma Scale, receiving mechanical ventilation, and with a neurological injury). The patient had been transferred from an outlying hospital because of his need for an emergent craniotomy and ventriculostomy. He was a 42-year-old man who was at home with his family when he began shaking, fell to the floor, and became unresponsive. A computed tomography scan of his head showed a large parenchymal hemorrhage in the right basal ganglia extending to the right frontal lobe and the right temporal lobe and dissecting to the right lateral ventricle with intraventricular hemorrhage in the lateral, third, and fourth ventricles. A subarachnoid hemorrhage was apparent in the foramen magnum and the upper cervical region. A mass effect and a midline shift from the right to the left also were present, along with hydrocephalus in the left lateral ventricle and an infarction in the left insular cortex. Upon receiving the grave prognosis, the family had expressed interest in organ and tissue donation. A donation coordinator was then sent on site to evaluate for donation and to speak with the family.

The donation coordinator performed an initial chart review, which revealed an extensive medical history. The patient had a 15 pack-year smoking history

and drank approximately 6 beers per week for 15 years. In the fall of 2004, he had nonischemic dilated cardiomyopathy and chronic heart failure diagnosed. Upon learning of this diagnosis, he quit smoking and drinking. His condition continued to deteriorate, and he required surgical placement of an implantable cardioverter defibrillator in the fall of 2005. In November 2007, he had a cerebral vascular accident and a transient ischemic attack, was hospitalized, and was discharged asymptomatic 1 week later.

On May 21, 2008, during a routine follow-up, he underwent cardiac catheterization. Results of the catheterization demonstrated a worsening of his heart condition, and he was admitted to the hospital. He was evaluated for heart transplantation and 10 days later was listed as status 1A. Each candidate awaiting heart transplantation is assigned a status code that corresponds to how medically urgent it is that the candidate receive a transplant.[4] Status 1A is reserved for patients who, according to United Network for Organ Sharing (UNOS), have the most urgent need for a heart transplant. On June 13, he received a heart from a healthy 26-year-old who had died in a motor vehicle collision. He was discharged 13 days after receiving the transplant. Less than 24 hours after being discharged, he collapsed at home, which led to his current hospitalization with a subarachnoid hemorrhage.

After the initial chart review, the donation coordinator spoke to the patient's family about organ donation. At this time, neurological function was minimal. The family agreed to wait 24 hours to see if he would progress to brain death. Because the patient had just received his new heart, the family had a strong sense of urgency to pursue the option of donating the heart to someone else, which would be possible only if he were to reach brain death. The donation coordinator knew that retransplanting the heart was possible; it had been done before.[2] The coordinator reviewed the situation with the hospital staff and answered all questions they had. The coordinator, with help from the hospital staff, was able to create a plan of action. The donation coordinator then left the hospital, and the case was monitored for the next 24 hours.

The following day, the patient still had minimal neurological function. The family had discussed among themselves that if he was not brain dead, they would want to withdraw support. Once the family had made the decision to withdraw support, the option of DCD was offered. The family was ecstatic that donation was still a possibility. The opportunity to donate helped the family bring meaning to the loss, because donation enabled them to help others.[5] The family agreed to DCD, and the donation coordinator proceeded with obtaining consent and the patient's medical/social history. The family did give time constraints: they wanted to withdraw support at 2 AM, which was 11 hours from the time of DCD consent.

As the case progressed, it became clear that there was a potential for lung recovery, an expanded use of DCD donors.[3] The patient was receiving nitroprusside at 3.4 μg/kg per minute with a systolic blood pressure in the 170s. The patient had been intubated for only 1 day, and the initial Po_2 was 540 mm Hg. The ventilator mode for the duration of his hospital stay was airway pressure release ventilation.[6,7] The settings were as follows: rate, 8 breaths per minute; tidal volume, 650 mL; and a high positive end-expiratory pressure, 18 cm H_2O. The Po_2s, from the time of Gift of Life Michigan's involvement to the operating room, ranged from 523 to 540 mm Hg. Two chest radiographs obtained during the organ procurement organization's involvement showed no acute cardiopulmonary diseases. The physician performed a bronchoscopy with consent from the family, which showed that the lungs had normal anatomy and appeared suitable for transplantation. The bronchoscopy report stated that no thick secretions were present within the lungs; the only secretions found were at the distal end of the endotracheal tube. The physician did use a small amount of saline (<5 mL) to obtain a specimen for a Gram stain, which did not reveal any organisms. After all of the information was gathered, lung allocation began.

Seven transplant centers declined the lungs because the type of donation was DCD and because of the patient's previous heart transplant. One lung transplant center, however, did provisionally accept the lungs, at which point the donation coordinator contacted them. They were very interested in the lungs and requested a posttransplant cardiac catheterization. Because the patient had received a heart transplant approximately 2 weeks prior, the donation coordinator contacted the hospital where the transplant took place to obtain the posttransplant cardiac catheterization. The heart transplant center faxed the cardiac catheterization report to the donation coordinator at the hospital and it was then uploaded into UNET, an organ allocation system run by UNOS. After the lung transplant center reviewed all of the information, they accepted the DCD lungs and stated that they would be able to perform the transplant surgery at 2 AM, the time when the family wanted to withdraw support.

When the lung team arrived, the patient was transported to the postanesthesia care unit. The intention going into the operating room was to recover both lungs and kidneys. The liver, pancreas, and intestines were not able to be placed. The centers declined acceptance because of the donor's age, medical history, size, and weight, the type of donation being DCD, and the distance. The time constraints that the family had placed prevented us from exhausting the match runs,

which are the lists of potential recipients that are generated by UNOS. The heart was ruled out before surgery because the donation was DCD. The patient was extubated at 3:34 AM and became asystolic at 3:45 AM. His family was present. Declaration and reintubation occurred at 3:50 AM. The warm ischemic time was minimal, which strongly indicated that the lungs could be transplanted successfully.[8]

The surgery was uneventful, and both lungs and both kidneys were recovered. Per Gift of Life Michigan's policy, because the donation was DCD, biopsy samples of both kidneys were obtained and machine preservation was used. Needle biopsies of both the left and right kidney showed 1+ arteriosclerosis and mild fibrosis, which may have been mixed with an edematous component. Also, both biopsies showed that the vessels were slightly thickened and there appeared to be 1 small artery that was occluded. Biopsy specimens of both the left and the right kidney showed no glomerulosclerosis and no inflammation. The kidneys were placed after surgery so that there would be ample information to offer to the transplant centers about flow and renal resistance during machine preservation.

Outcomes

The match run generated by UNOS for the potential kidney recipients was exhausted for the right kidney, but that kidney was not accepted because of low flows and high resistance. The right kidney had a starting flow of 59 mL/min and a resistance of 0.45. Resistance is calculated as follows:

systolic renal pressure + 2(diastolic renal pressure) /3(flow)

At no time during the 17 hours of machine preservation did the flow exceed 75 mL/min or the resistance decrease to less than 0.31. After the kidney list was exhausted, the right kidney was disposed of by Gift of Life Michigan because there was no consent for use of the organs for research or education.

Without the generosity of this family, the transplants would not have been possible. Thanks to the constant collaboration between the hospital staff and the staff at the organ procurement organization, 4 organs were recovered and 3 organs were transplanted. The lungs and left kidney, as of January 2009, approximately 6 months after the recipients received their transplants, were still functioning and improving the lives of the recipients.

Financial Disclosures

None reported.

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