New research may lead to increased use of available hearts for transplant

January 6 2020

A new study provides hope that the number of children dying on the transplantation list while waiting for a new heart could potentially be reduced dramatically.

The study, published online in the *Annals of Thoracic Surgery*, demonstrates that many of the donor hearts deemed "high-risk" can be transplanted with the same survival rates as "low-risk" donor hearts.

"One in five children die awaiting a suitable donor heart, and some of these potential recipients missed their opportunity because they were offered donor hearts that transplant programs refused because they were thought to be of poor quality," says David Morales, MD, director of congenital heart surgery and Clark-Helmsworth Chair of cardiovascular surgery at Cincinnati Children's Hospital Medical Center. Dr. Morales is senior author of the study.

"However, these hearts were often transplanted into other donors with good results, and some of those potential recipients never got the opportunity to be transplanted. Our study demonstrates that traditionally perceived high-risk donors may have been associated with worst post-transplant survival because of the recipients they were transplanted into and not because of the donor hearts. While it's important to carefully consider potential donor hearts for transplantation, transplant programs should consider accepting hearts from certain donors traditionally considered poor quality."

For the study, the Cincinnati Children's researchers reviewed the United Network for Organ Sharing (UNOS) database for thoracic organ transplants between Jan. 2006 and Dec. 2015 in children up to 18 years old. They identified "high-risk" transplant donors as those above a certain age, those who needed cardiopulmonary resuscitation and those who died due to stroke. They matched low- and high-risk donors on characteristics of the recipient and then analyzed one-year survival outcomes.

The study found that transplant recipients considered "high-risk" by utilization and survival-based criteria led to similar survival as transplant recipients from "low-risk" donors.

"Currently, there is not a universal system by which transplant institutions list patients for transplant," says Dr. Morales. "In other words, hospitals accept organs and list patients for transplant under different criteria, often based not on the latest clinical data nor nationally accepted clinical standards but on a program's or provider's past experiences.

"A risk-based matching system that couples the optimal donor for a given transplant recipient to result in the best predicted outcome for each transplant, and achieving the highest survival years post-transplant for the entire community, are what we are striving for," he says. "Getting to transplantation is NOT the goal. Having the most children healthy and alive post-transplantation for the most years is the goal."

Based on their previous research in this area, Dr. Morales and several colleagues at Cincinnati Children's have received a grant from the National Heart, Lung and Blood Institute (NHLBI) to investigate creating a standardized risk-stratification model for children using machine learning to realize best pairings of donor and recipients to maximize survival.

Because organ utilization decisions for hearts and lungs vary significantly across programs and providers, the NHLBI designated grant money to help Cincinnati Children's investigate the potential to reduce wastage of pediatric thoracic organs and potentially create a better system or model. This would be a model in which local practices and emotions are not driving forces to listing and accepting organs, but a data driven algorithm that optimizes transplant matches and benefits the entire pediatric heart and lung transplant communities, says Dr. Morales.

Currently, a range of donor sizes (either weight or height) is used to determine which organs a certain recipient may be offered. This range is based on a program's experience, not national or well-defined standards, according to Dr. Morales. However, technology now exists that can allow scientists to use 3-dimensional modeling, virtual surgery and artificial intelligence to develop novel methods of precise size-matching of donor organs in hopes of increasing donor organ utilization for pediatric heart and lung transplantation.

Understanding the complete range of donor hearts or lungs that can fit into a recipient's chest cavity is crucial because it increases the potential donors a child can be offered. The existing colloquial approach to pediatric transplantation is one of the reasons children with end-stage heart failure face the highest waiting list mortality in all of transplant medicine, according to Dr. Morales.

"If novel virtual transplantation techniques are used, the number of acceptable donor hearts for each patient will increase because ranges will be individualized to that specific patient's heart size and not by a less precise estimation, such as age or weight," says Ryan Moore, MD, director of the Heart Institute Digital Media and 3-D Modeling Program.

More information: Kyle W. Riggs et al, Pondering Higher-Risk Pediatric Heart Donors: Can We Use More?, *The Annals of Thoracic*

Surgery (2019). DOI: 10.1016/j.athoracsur.2019.09.069