Editorial

Pediatric heart transplantation in donation after circulatory death: is it a feasible reality?—in time, yes!

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Pediatric patients requiring heart transplantation (HTx) have diverse, critical needs, often facing significant challenges due to limited donors (1). Accordingly, there has been growing interest in expanding acceptable donor criteria. Donation after circulatory death (DCD) has emerged as an avenue to increase organ availability. The history of DCD in HTx dates back to the first successful HTx performed in South Africa in 1967 (2). As transplantation practices evolved, DCD organ use declined due to advancements in preservation methods, logistical challenges in coordinating donors and recipients, and the adoption of donation after brain death (DBD). The advent of cyclosporine and improved immunosuppressive protocols further shifted the landscape to identify other factors that could improve outcomes (3). The resurgence of DCD in HTx, with the advent of *ex-situ* perfusion technologies, has renewed its interest. These advancements allow for prolonged preservation and assessment of donor hearts, reducing logistical barriers, and thereby making DCD viable and a more promising option in adults and children (4-6).

However, this shift towards DCD has not been translated in children. In pediatrics, the harsh reality of waitlist mortality is evident, with approximately 17% dying each year awaiting HTx (7). Leveraging DCD donors could represent a transformation in addressing the critical shortage of organs. In the United States (US), the first pediatric HTx using a DCD donor was performed in the early 2000s marking a pivotal moment in the field. Its adoption has been limited due to ethical debates surrounding the process, as well as the aforementioned logistical and operational hurdles (8). Recent analysis of DCD utilization conducted using United Network for Organ Sharing (UNOS) data demonstrated since 2004, only seven DCD HTx were performed up to 2022, and only one center performed more than two DCD transplants (9). Another analysis of the International Society for Heart and Lung Transplantation (ISHLT) Registry found that only 23 pediatric DCD HTx were performed by 2018 (10). Therefore, despite acceptable survival rates, the global experience for pediatric DCD HTx remains very limited, and did not gain much traction at any program.

Technical and logistical challenges continue to limit the widespread adoption of DCD HTx in pediatrics. The primary methods for DCD heart procurement; direct procurement with normothermic machine perfusion (DPP), and normothermic regional perfusion (NRP) offer distinct advantages and limitations. In DPP, the heart is retrieved and connected to an *ex-vivo* perfusion system for assessment. Over five years, this technique has been a major driver of renewed interest in adult DCD HTx. However, presently available *ex-vivo* perfusion systems are restricted to use in donors weighing over 40 kilograms, which makes them applicable to certain children as small as 20 kilograms, such as Fontan patients. This restriction excludes infants and smaller children who gain to benefit most given their waitlist mortality. In one UK series, all recipients of DCD

HTx procured using DPP were over 20 kilograms (4). Alternatively, NRP approach uses a modified bypass/extracorporeal circuit to assess the heart *in-vivo* following circulatory arrest. In our view, NRP holds promise for smaller patients, as it is not limited by weight or size. Its integration into congenital heart programs remains limited, with feasibility and the willingness of pediatric teams to adopt this technique insufficiently developed. In addition to the ethical and geographic restrictions, NRP introduces logistical and human resource challenges. It necessitates stringent coordination, including two surgeons and two perfusionists who travel to the donor centers, complicating implementation and increasing costs. While some congenital programs have already established their NRP protocols, many donor hospitals have anti-NRP policies, resulting in the turndown of viable organs. This missed opportunity not only limits the potential expansion of donor heart pool but also hinders efforts to address the organ shortage in pediatric HTx. We believe the cost of either technique is modest when weighted against the benefit of saving intensive care unit days for those patients awaiting HTx.

With portable *ex-situ* donor organ perfusion and advancements in NRP techniques, there is an opportunity to expand the donor pools and reduce waitlist mortality. Realizing this potential requires addressing challenges. In our opinion, the first priority should be addressing logistical and policy-related barriers that hinder adoption of pediatric DCD HTx. We recommend establishing standardized protocols for pediatric DCD HTx, focusing on donor selection and streamlined procurement. Such protocols could unify practices, reduce viability-related nuances, and optimize donor utilization in a field grappling with severe shortages of donor hearts. These policies should be based upon consensus from programs, procurement organizations, and regulators. Standardizing such practices would enable centers to utilize more DCD organs, which are underutilized due to outdated, inconsistent protocols. Increasing public awareness about the DCD technique is essential. Understanding DCD, particularly how it adheres to the "dead donor" rule and ethical boundaries, is critical for acceptance. This could foster willingness to donate and support the use of DCD, aiding in policy modernization and alignment with current medical needs. By removing these barriers, fostering procurement collaboration, ethical clarity and practice development, we can move toward viable, consistent pediatric DCD HTx, reduce waitlist mortality, and improve outcomes for this vulnerable population.

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Footnote

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References

1. Schweiger M, Stiasny B, Dave H, et al. Pediatric heart transplantation. J Thorac Dis 2015;7:552-9.
2. Barnard CN. The operation. A human cardiac transplant: an interim report of a successful operation performed at Groote Schuur Hospital, Cape Town. S Afr Med J 1967;41:1271-4.
3. Kahan BD. Cyclosporine. N Engl J Med 1989;321:1725-38.
4. Laurence C, Nachum E, Henwood S, et al. Pediatric heart transplantation following donation after circulatory death, distant procurement, and ex-situ perfusion. J Heart Lung Transplant 2022;41:1104-13.
5. Ahmed HF, Kulshrestha K, Kennedy JT, et al. Donation after circulatory death significantly reduces waitlist times while not changing post-heart transplant outcomes: A United Network for Organ Sharing Analysis. J Heart Lung Transplant 2024;43:461-70.
6. Schroder JN, Patel CB, DeVore AD, et al. Increasing Utilization of Extended Criteria Donor Hearts for Transplantation: The OCS Heart EXPAND Trial. JACC Heart Fail 2024;12:438-47.
7. Almond CSD, Thiagarajan RR, Piercey GE, et al. Waiting list mortality among children listed for heart transplantation in the United States. Circulation 2009;119:717-27.
8. Boucek MM, Mashburn C, Dunn SM, et al. Pediatric heart transplantation after declaration of cardiocirculatory death. N Engl J Med 2008;359:709-14.

9. Ahmed HF, Guzman-Gomez A, Kulshrestha K, et al. Reality of DCD donor use in pediatric thoracic transplantation in the United States. J Heart Lung Transplant 2024;43:32-5.
10. Ahmed HF, Faateh M, Mehdizadeh-Shrifi A, et al. Pediatric Heart Transplantation Using Donation After Circulatory Death: An Analysis of the ISHLT Registry. The Journal of Heart and Lung Transplantation 2024;43:S151-2.

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