The authors raise the issue of ventricular assist device (VAD) use in modification of the renal dysfunction and liver dysfunction in listed patients. However, these data are mainly for patients with cardiomyopathy and not necessarily for the highest-risk patients, such as infants with CHD. As the experience with VAD matures, this may change over time, particularly at large-volume centers. For patients with significant renal or hepatic dysfunction, the results of dual-organ transplantation may be superior to heart-only transplantation and merit increasing consideration. This analysis does not address perioperative and other transplantation-related factors that have shown to impact early mortality, such as graft selection, preservation, and bypass time, which are potentially modifiable risk factors.

Finally, considering the second question of when the risk is too high, as a community, should persistence in the face of such sobering results be the proper approach? As Riggs and colleagues suggest, some of these analyses should naturally be factored in during discussions with the families for listing. Taking an “informed risk” may be acceptable to

go along with the current UNOS listing status strategy of prioritizing patients at highest risk for waitlist mortality.

We congratulate and thank the authors for their important contribution.

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Commentary: Providing a “leg up” for those who “limp” to heart transplantation

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In this issue of the *Journal*, Riggs and colleagues² sought to quantify known risk factors associated with short-term mortality after pediatric heart transplantation (HTx). Their specific focus was on modifiable risk factors (MRFs) that

The growth of pediatric heart transplantation over the last 33 years is indicative of the need for evolving clinical care.¹

CENTRAL MESSAGE

Survival after pediatric heart transplantation is significantly influenced by preoperative modifiable risk factors. Identifying the impact of these factors will help guide management and resource utilization for these children.

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predict poor outcome: mechanical ventilation, liver dysfunction, and renal dysfunction. Using the United Network for Organ Sharing database, the authors evaluated the 1-year survival of pediatric HTx recipients from 2000 to 2017, excluding patients with ventricular assist devices (VADs).

Approximately one-third of the patients had at least 1 MRF at the time of HTx. These patients were younger, more likely to have congenital heart disease, and more likely to be on extracorporeal membrane oxygenation support. Multivariable analysis confirmed that each MRF had a significant association with increased mortality at 1 year. In an attempt to quantify the effect of MRFs, the authors showed that 1-year survival for a child with no MRF was 93%, but dropped to 64% if all 3 MRFs were present. Not surprisingly, survival for younger children or those with congenital heart disease was lower at all time points irrespective of associated MRFs.

It is interesting to note that each of the MRFs is a marker of disease severity and a consequence of inadequate cardiac output. The elephant in the room is the expanding role of VADs in bridging pediatric patients to HTx. VAD implantation has the potential to improve and even reverse organ dysfunction and to reduce waitlist mortality. Large database studies have demonstrated that post-transplantation survival is not worse for patients supported with a VAD.^{3,4} This has translated to clinical practice, with 30% of pediatric patients currently bridged to HTx with some form of mechanical circulatory support.

The report by Riggs and colleagues is certainly a step in the right direction to help guide efforts to optimize treatment for these complex patients. Ideally, this study will provide a foundation for developing a risk stratification model. Dating back to the Framingham Study's first attempts to create a multivariable risk function for coronary heart disease,^{5,6} such models have been instrumental in both adult and pediatric cardiac surgery in shaping evidence-based decision

making. The value of risk stratification models, as noted by Truett and colleagues in 1967,⁶ is the ability to develop a risk profile that enables physicians to predict the risk of a specific event based on incremental risk factors, that is, a model in which not all risks are weighted equally. The growing number of patients who require HTx, combined with the limited number of available organs, has created an environment that demands that our decision to move forward with transplantation or VAD be supported by the best possible data. The benefit of a risk stratification model for the transplantation population is that it would provide a tool to optimize medical management before HTx, provide accurate counseling to families, and provide a mechanism for resource allocation (eg, VAD utilization, waitlist priority).

Riggs and the team from Cincinnati should be commended on their pursuit to identify areas for improvement among patients limping toward transplantation. This is an extremely challenging patient population, and their study will provide a leg up for the medical community treating these children.

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