Given these limitations, what can we take away from the present analysis by Hernandez and colleagues? First, similar to adult BiVAD trends, the use of pediatric BiVAD support continues to decrease over time and this is likely related to a number of factors, including the movement toward earlier implantation of LVAD support along with greater proficiency in managing pre- and postoperative RV failure (ie, afterload reduction with pulmonary vasodilators, RV inotropic support, and judicious fluid management). Second, differences in patient characteristics likely account for a significant portion of the differences in outcome, although it is difficult exclude the possibility that LVADs may perform better than BIVADs in low-risk patients and/or BIVADs may perform better than LVADs in high-risk patients because no suitable controls were available. Thus, simple answers and blanket recommendations regarding BIVAD use are unhelpful and probably unsafe. Instead, as noted by the authors, the choice of BiVAD versus LVAD support should be dictated by the risks for severe and persistent RV failure after VAD placement. Continued multicenter learning opportunities are crucial to furthering our understanding of what factors predict severe and persistent RV failure. Through refinements in patient selection, surgical implant strategies, and medical management practices, the pediatric community can move closer to answering the elusive question in pediatric heart failure of "to BiVAD or not to BiVAD?"

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Commentary: Two sides of the same coin: Competing biventricular assist device outcomes from Pediatric Interagency Registry for Mechanical Circulatory Support data

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CENTRAL MESSAGE

The typical argument for poorer outcome with BiVAD (vs LVAD) is a difference in the patient's characteristics. Hernandez et al attempted to shed a light on this classic subject using the Pedimacs data.

The last decade has witnessed a substantial stride in the field of pediatric ventricular assist devices (VADs). Among various improvements achieved over time, less frequent use of biventricular assist device (BiVAD) would represent

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maturation of the field. The third annual report of Pediatric Interagency Registry for Mechanical Circulatory Support (Pedimacs) describing 508 devices in 423 patients aged <19 years implanted from September 2012 to December 2017[1] reported left ventricular assist device (LVAD) support in 342 (81%) and BiVAD in 64 (15%) patients. Although BiVAD support is still more frequent than in the adult counterpart (2.6%),[2] there has been a clear downward trend[3,4] in the frequency of BiVAD use. As have been repeatedly demonstrated,[3,4] the Pedimacs report again showed poorer outcome with BiVAD than with isolated LVAD. A typical argument for this repetitious observation is the difference in patient's characteristics (ie, BiVAD for sicker patients).

In this issue of the *Journal*, Hernandez and colleagues[5] sought to address the aforementioned argument using the Pedimacs data by comparing the 2 strategies (BiVAD vs LVAD) in a similar-characteristic population through propensity score matching. The key finding of the study is the lack of obvious inferiority in survival with BiVAD compared with that with LVAD; mortalities at 6 months were 15% versus 10%, respectively. The only difference identified is significantly greater bleeding complications with BiVAD. The authors have concluded that the previously reported inferior outcome with BiVAD is likely driven by patient characteristics and therefore the choice of BiVAD strategy should be dictated by the clinical situation and not by a perceived adverse outcome profile of BiVAD support. Although this appears to be a fair statement, it also needs to be emphasized that the study is not completely free from type 2 error; due to the reduced sample size with the propensity match, the study might not have had adequate statistical power to detect the clinically relevant difference. This could be the reason why completely opposite conclusions (ie, BiVAD is inferior vs not inferior) were derived by the 2 separate reports (ie, Pedimacs annual report[1] vs the study of Hernandez and colleagues[5]), despite the fact that both studies stem from the same root (ie, Pedimacs data).

We completely agree with the authors' statement that the decision regarding BiVAD should be dictated by the clinical status of each individual patient. The critical question to be asked is, then, what is the "clinical status" that justifies adding the complexity with BiVAD? As mentioned, clinicians have learned over the last decade that preimplant right ventricular failure doesn't necessarily mean an addition of right VAD support is required. Decreasing BiVAD use despite increasing patient complexity is a reflection of pediatric community's maturation. Even in the VAD support for the failing Fontan circulation, which represents an extreme end within the spectrum of right heart failure (ie, "zero" ventricular function for pulmonary circulation), the systemic VAD support is appropriate in many instances as long as the pulmonary vasculature is adequate, with excellent survival (95% at 6 months).[6]

When the mitral valve is being replaced, the tricuspid valve also oftentimes has anatomical/functional abnormalities to some degree. Concomitant tricuspid valve replacement, however, is not indicated only because such an addition won't increase the mortality of mitral valve surgery. Rather, adding the complexity is justified when it will provide an additional benefit. What we need to learn more about VAD strategy would be in what clinical situations BiVAD provides survival benefit over an isolated LVAD support. Hernandez and colleagues should be congratulated for their effort to shed a light on this classic subject that is still important in the current era. We hope that this editorial will stimulate further debate in the community.

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