See Article page 134.

Commentary: Virtual fit reality and tailored approach in ventricular assist device implantation

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CENTRAL MESSAGE

Tailoring the surgical approach using virtual fit reality of individual patient's morphology may be key in successful implantation of ventricular assist devices outside the standard fit criteria.

Recent technical advances in medicine have made several new tools available to surgeons in the preoperative and intraoperative care of patients for more precise diagnosis, planning, and execution of surgical procedures. The application of 3-dimensional (3D)-printing, computer modeling, high-resolution computed tomography CT scan and reconstruction, 3D echocardiography, and, more recently, virtual reality are examples of these sophisticated technological advances used by surgeons toward a personalized patient approach.¹⁻³

Tailoring the surgical approach based on individual patient anatomy using advanced technology may be key to the success of complex congenital heart operations, organ transplantation, and mechanical circulatory support device implantation. Recently, virtual heart transplantation has allowed donor-recipient size matching to be individualized,⁴ expanding the potential donor pool for pediatric heart transplant recipients. This represents a movement away from using generalized assumptions about heart size, chest wall anatomy, and spatial relationships of cardiothoracic structures to determine size match. Furthermore, virtual implantation of the total artificial heart

(Syncardia) has been shown to expand the eligibility for device placement in patients whose body surface area (BSA) falls outside predefined standard fit criteria for the 70-cc and 50-cc devices.⁵

The article by Davies and colleagues⁶ in this issue of the *Journal* is a welcome addition to the literature. The authors examined the use of virtual reality simulated implantation from cross-sectional imaging to evaluate intrapericardial placement of the Heartware HVAD and Heartmate3 intrapericardial pumps in children. Tailoring the surgical approach based on individual morphology using this advanced technology appears to be critical for obtaining a successful operative outcome when attempting to implant an adult device in a very small child. By helping surgeons choose the best choice and fit for VAD implantation in pediatric patients, virtual fit testing is yet another advancement to facilitate the implantation of these adult VADs in children and to explore the lower limits of patient size.

Although previous studies have used this methodology,^{4,5} this study is unique in attempting to define measurement criteria based on the apex to mitral valve distance as determined by virtual fit testing as a more accurate approach to device placement than BSA and weight. As the authors state, virtual fit testing allows for more accurate assessment of pump placement, particularly the angle of the inflow cannula toward the atrioventricular valve.

Virtual fit testing is another tool in the armamentarium for individualized precision medicine enabling a personalized

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surgical approach in choosing the best VAD suited to each patient's unique anatomy.

It is important to note that despite the advances afforded by technology in allowing us to be as precise as possible, we are still limited by the dynamic nature of the heart, whose size and shape continuously remodels and readjusts based on the patient's hemodynamic status, especially after implantation of a VAD. Although technology and virtual reality fit may be sophisticated tools aiding the surgeon for a precise individualized patient approach, we could many times be mislead, faulted, or we could underestimate the change of the heart's size and shape that occurs after VAD implantation by the ongoing dynamic remodeling that the heart undergoes that may result in a better fit of the VAD than initially thought.

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