See Article page 134.

Commentary: One size might not fit all: Planning ventricular assist device implantation in young children

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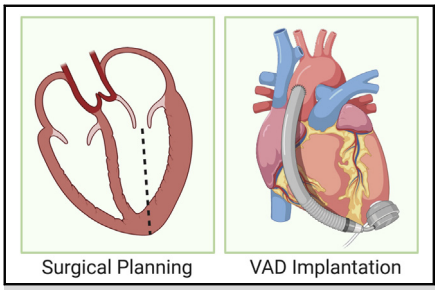

Surgical planning aids the implantation of adult ventricular assist devices in young children. Illustration created with BioRender (https.biorender.com).

CENTRAL MESSAGE

Preoperative planning facilitates the implantation of ventricular assist devices in young children.

Often the most complex situations in pediatric cardiothoracic surgery involve intraoperative decision making while utilizing unconventional techniques under time pressure. Thoughtful preoperative surgical planning can facilitate ventricular assist device (VAD) implantation in children.

The Berlin Heart EXCOR is the only Food and Drug Administration–approved VAD for use in small children.[1] However, the associated morbidity, large driver, and lack of discharge to home capability compares poorly with the more current intrapericardial, continuous-flow VADs approved for use in adults. Therefore, adult devices are being increasingly used in children. The HeartWare HVAD is a relatively small intrapericardial, continuous-flow device that has been implanted in children with a body weight as low as 13 kg and body surface area as low as 0.6 m^2.[2,3] Sometimes adjunct techniques are necessary, which may involve modification of the sewing-ring with felt bumpers or excision of the mitral valve and papillary muscles to avoid cannula obstruction.[4] However, implantation of the HVAD in young children requires a personalized surgical strategy to confirm that the device will fit in both the ventricular cavity and the thoracic cavity.

A useful method to determine whether the HVAD can fit in the left ventricular (LV) cavity of a child was described by Peng and colleagues.[5] This method is based on the distance in diastole from the tip of the anterior mitral valve leaflet to the LV apex (Figure 1). We have found this method to be reliable and reproducible.

In this issue of the *Journal*, Davies and colleagues[6] describe virtual reality–simulated implantation for fit-testing the HVAD in children. This involves a computer-generated experience based on computed tomography (CT) scan reconstructions to simulate the fit of a HVAD phantom in relation to the child's heart and chest wall. For a good LV fit, the tip of the simulated HVAD inflow should lie distal to the plane of the mitral valve annulus and away from the mitral valve leaflets. Unlike echocardiography, CT scans do not resolve valvar structures well, and used in isolation this method of fit testing may be inferior to the method described by Peng and colleagues.[5] In contrast, virtual reality fit-testing is well suited for testing the thoracic fit, because chest wall structures are better resolved by CT. Therefore, virtual reality fit-testing allows for accurate prediction of the relationship between the HVAD and the chest wall. The authors used this information to guide the location of pump fixation to the chest wall.

These considerations indicate that a single method may not suit all patients when planning VAD implantation in children. Intraventricular fit may be assessed most reliably by the echocardiographic distance between the anterior leaflet of the mitral valve to the LV apex in diastole. In contrast, intrathoracic fit may be assessed most reliably using virtual reality–simulated implantation based on CT scan

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reconstruction and in combination provide the surgeon with the necessary information to tailor the VAD implantation technique to the specific patient.

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