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# Commentary: Virtual reality in presurgical planning: The future is already here

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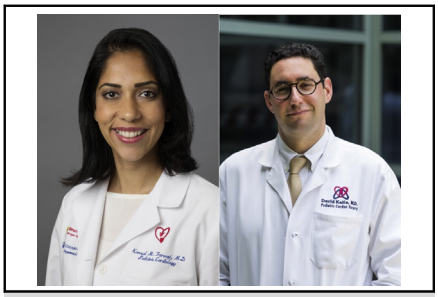

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**CENTRAL MESSAGE**

Virtual reality can be successfully applied for surgical planning in pediatric and congenital cardiac surgery and should be developed in the centers than can invest in this innovative technology.

The study by Davies and colleagues[1] in this issue of the *Journal* highlights the utility of virtual reality (VR) in the presurgical assessment of implantation of adult-sized ventricular assist device (VAD) in pediatric patients. The authors demonstrate the application of this innovative technology for intrapericardial placement of the Heartware HVAD and Heartmate3 in 3 patients with body surface area ranging from 0.65 to 0.67 $m^2$.

Given the benefit of VAD support in improving end organ function and post–heart transplantation mortality,[2,3] preprocedural planning for device placement should be optimized using innovative imaging modalities as described in this report. Variations in ventricular morphology, trabeculations of a systemic right ventricle that can obstruct the inflow cannula, and abnormal arterial spatial anatomy all add a level of complexity to VAD placement in patients with congenital heart disease. Unconventional technologies, such as VR, should be used in such challenging cases. The representation of the chest wall and cardiac mass in true 3 dimensions using VR enables assessment of the atrioventricular valve inflow and virtual alignment of the VAD inflow cannula. The authors were able to identify 1 patient in whom the position of the inflow cannula would have been in close proximity to the atrioventricular valve annulus, interfering with its function. These subtle anatomic insights are challenging to fully embrace from cross-sectional imaging, such as cardiac magnetic resonance imaging or computed tomography scans.

Given that the authors have highlighted the utility of this technology, one must consider the feasibility of adopting the technology in one's own center. This is not specifically addressed in this report. A good quality dataset from either magnetic resonance imaging or computed tomography is needed to perform a process known as segmentation to highlight the anatomic area of interest. Software to perform the segmentation, as well as personnel who are familiar with this process, are needed to create the digital reconstruction that is imported into the VR system. Cost is also associated with the computer and headset that allow the user to interact with the virtual environment. The applicability of this exciting and innovative technique for virtual fit of adult VADs in pediatric patients will be highly dependent on individual center VAD volume, as well as on the availability of funding to support such innovative and exciting endeavors.

Presurgical planning using VR also can be applied to many other procedures in our specialty, such as complex intracardiac biventricular repair. It will revolutionize the teaching and training for surgical residents and fellows. Finally, its main promise is certainly in intraoperative use during the actual procedure with the surgeon wearing a VR headset, allowing superposition of the VR image on the heart after sternotomy to virtually "cut" through the heart before actually doing it. The future is here.

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