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EDITORIAL COMMENT

The Added Dimension in Pediatric Mitral Valve Repair

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Surgical repair of congenital mitral valve (MV) lesions in children is generally favored over valve replacement, when possible, to allow for patient growth and to avoid the need for anticoagulation. MV repair, however, is challenging due to the diverse and complex morphology which affects both the valve itself and subvalvar apparatus. Comprehensive and accurate echocardiographic assessment is critical both preoperatively and postoperatively to gauge the surgical result. Two-dimensional (2D) transthoracic, epicardial, and transesophageal echocardiography are the most frequently used imaging methods for MV assessment in the majority of cardiac centers around the world. Despite developments in three-dimensional (3D) echocardiography, most of the publications to date are based on 2D studies which may be due to lack of familiarity, expertise, or the necessary equipment.[1]

There are strong reasons for favoring 3D echocardiography techniques to assess, monitor, and assist in the decision-making in children with MV disease. The range of morphology is well visualized by 3D techniques and effective orifice area (EOA) and regurgitant area can be measured without assumptions about the shape of the MV orifice or regurgitant region.

In this issue of *JACC: Advances*, Lang et al[2] report on 206 young patients who underwent MV surgery at a single center over a 16-year period. All patients were on a biventricular pathway and lesions such as atrioventricular septal defect were appropriately excluded. Echocardiographic measurements were performed preoperatively (within 7 days before surgery) and postoperatively either at discharge or at 10 days after surgery. Patients were divided into 3 groups depending whether disease was predominantly MV stenosis, regurgitation, or mixed. Half of the patients were infants and almost a third of patients required reoperation at a median of 9 months after initial repair. The 5-year survival was 94% emphasizing that significant risk of reoperation and mortality persist even at a large center with a high degree of surgical expertise. A central finding of the study was that changes in 3D-EOA and 3D-vena contracta regurgitant area (VCRA) were more strongly associated with reoperation than changes in mean gradients (for mitral stenosis) or 2D-VCRA in the case of MV regurgitation. The development and presentation of decision-tree algorithms based on the 3D echocardiographic findings is particularly welcome because it represents a practical and evidence-based way of bringing the findings into clinical practice.[2]

Inevitably, with a retrospective analysis, there are a number of aspects of the study design which mean that caution should be exercised in their interpretation. During the 16-year period, different ultrasound systems, probes, and operators were involved in study acquisition. MV regurgitation severity was extracted from the echocardiographic reports, which were generated by different echocardiographers introducing the variability of subjective assessment by multiple operators. The key findings relate to 3D echocardiography, but only a minority of patients (42%) had preoperative and postoperative 3D echocardiographic data available. A key decision time for cardiologists and surgeons is during the intraoperative period to gauge the adequacy of repair. The echocardiograms analyzed in the current study were performed postoperatively either at hospital discharge or at 10 days after surgery. Future work is

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likely to need to be prospective to develop decision-making tools based on intraoperative findings, which will be complicated by factors such as changing hemodynamics in the immediate post-bypass period. In classifying their patients, Lang et al divided them into 3 groups (stenosis/regurgitation/mixed) but their own data (Table 1) underscore the complexity and huge variability of the surgical substrate in this group of patients. The 3D approach utilized multiplanar reformatted images which is appropriate and logical to measure both EOA and VCRA but applying this takes time to post-process and analyze and not as immediate as 2D techniques which is relevant to potential intraoperative application.

The paper is timely and particularly welcome at a time of technological innovation which will bring 3D approaches to younger and smaller patients. The introduction of pediatric 3D transesophageal probes facilitates adoption of a 3D intraoperative approach to new cohorts of patients, particularly infants with MV disease.[3] Further developments, such as artificial intelligence, might also assist with automation of measurements to produce rapid, accurate, and repeatable measurements such as EOA and VCRA which are relevant to MV repair.[4]

The group at Boston Children's Hospital has previously published on the application of structured prospective reporting of surgical results using the Technical Performance Score which was initially reported using postoperative scans but has also been reported by that group and others for intraoperative evaluation.[5,6] The approach taken in the current paper of Lang et al might also be refined in this manner and incorporated within the Technical Performance Score scoring system. This would assist with "real-time" assessment of surgical repair with factors known to impact on late outcome which may assist in patient care particularly relating to durability of repair and later reintervention.

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