Clinical Applications of Three-Dimensional Echocardiography

Nathalie De Michelis, University of California, Irvine, CA, considers real-time 3D echocardiography (RT3DE) a safe, noninvasive imaging modality that is superior to 2D imaging. It can be used to assess left ventricular (LV) volume, mitral valve area, and cardiovascular function in patients with mitral stenosis, a use that is supported by the American Society of Echocardiography [Hung J et al. *J Am Soc Echocardiogr* 2007]. With improvements in automated contouring and its use of a correction factor of 1 mm, it is now possible to use RT3DE in individuals with reduced ejection fraction, atrial fibrillation, and abnormal cardiac rhythms to obtain accurate LV volumes.

"With the recent availability of right ventricular (RV) quantitation software that is practical and validated, RT3DE offers potential advantages over MRI in assessing the right heart, as it allows rapid acquisition of data with the ability to slice a 3D dataset from any angle," stated Judy Hung, MD, Harvard Medical School, Boston, MA. By assessing RV function, it is possible to obtain new information regarding the prognosis of cardiomyopathy, confirm RV volume overload, provide additional risk stratification in patients with shock postmyocardial infarction, and evaluate ventricular structure and function in congenital heart disease. This imaging modality may become a time- and cost-saving alternative to MRI for the quantitative assessment of RV size and function [Leibundgut G et al. *J Am Soc Echocardiogy* 2010].

3D imaging also may be useful for evaluating tumors of the heart and great vessels and selecting optimal surgical approaches prior to the removal of intracardiac masses, concluded Juan Carlos Plana, MD, FACC, University of Texas, MD Anderson Cancer Center, Houston, TX.

The size of an intracardiac mass (vegetation, tumor, or thrombus) is an important predictor of embolic events and response to treatment. 2D echocardiography (transthoracic) underestimates the size of cardiac masses by as much as 24.6% ($p<0.001$) compared with RT3DE, suggesting that RT3DE may be a better choice for the noninvasive evaluation of intracardiac mass size [Asch FM et al. *Echocardiography* 2006]. In addition, 3D imaging offers the advances of unlimited slicing and cropping, spatial manipulation and optimal visualization, and a single, easy acquisition approach that provides multiple points of information. Though evidence suggests that RT3DE offers the ability to improve and expand the diagnostic capabilities of cardiac ultrasonography, as with any new emerging technology, Dr. Plana cautions, "The enthusiasm to embrace a new technology must be tempered by a critical appraisal of the evidence supporting its use."

Leopoldo Perez de Isla, MD, Hospital clinic San Carlos, Madrid, Spain, discussed the use of RT3DE before, during, and after mitral valve stenosis intervention. RT3DE is a novel technique that allows the visualization of mitral valvular anatomy in any desired plane orientation. Compared with all other echo-Doppler methods, RT3DE has the best agreement with the invasively determined mitral value area [Zamorano J et al. *J Am Coll Cardiol* 2004] and can provide not only the anatomical structure of mitral valve apparatus but also the optimal plane of the smallest mitral valve orifice in patients with mitral stenosis [Xie M-X et al. *Am J Cardiol* 2005] and those who are undergoing percutaneous mitral valvuloplasty [Anwar AM et al. *J Am Soc Echocardiogr* 2010].

When used during intervention to determine annular dimension and, thus, guide correct device sizing, RT3DE may help optimize the outcome of percutaneous aortic valve implantation. In one study, RT3DE was able to successfully guide device implantation in 97% of patients (33 of 34) in whom the native valve was crossed with the percutaneous heart valve. Thus, 3D echocardiography may play an important role in determining case selection, in guiding device placement, and in detecting complications of percutaneous aortic valve implantation [Moss RR et al. *JACC Cardiovasc Imaging* 2008].

With more asymptomatic patients with MR being considered for surgery, accurate definition of the functional anatomy of the mitral valve is of paramount importance to aid clinical decision-making. Sunil V. Mankad, MD, Mayo Clinic, Rochester, MN, discussed the role of RT3D echocardiography for viewing the mitral valve in relation to MR repair. RT3D transesophageal echocardiography allows visualization of the mitral valve leaflets, orifice, and submitral apparatus in a manner that is not possible using conventional 2D echo. Mitral valve replacement or repair may be complicated by postoperative dehiscence of the valve or annuloplasty rings that result in clinically significant MR or hemolysis. In mitral valve dehiscence, RT3D transesophageal echocardiography provides additional information about the exact anatomical characteristics of the dehiscence that are not obtainable using conventional 2D echo, which may be helpful in planning the most appropriate corrective intervention [Kronzon I et al. *J Am Coll Cardiol* 2009]. Besides aiding in the surgical repair of MR, it also shows great promise in percutaneous periprosthetic leak closure.