Review Article

Clinical Usefulness of Three-Dimensional Echocardiography

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PREAMBLE

Over the past several years, live real time three-dimensional echocardiography has evolved into a clinically useful modality which has provided significant incremental information over the most widely used two-dimensional echocardiography in many cardiac disease entities. This is mainly because unlike two-dimensional echocardiography which provides only a thin, slice-like view of a cardiac structure at any given time, the three-dimensional technique encompasses a large region of the heart containing many cardiac structures which can be displayed from any vantage perspective and angulation including en face views. Thus the technique provides a comprehensive assessment of cardiac structures which may be difficult to do with two-dimensional echocardiography.

However, it is important to realize that three-dimensional echocardiography is based on two-dimensional echocardiography and if the acoustic window is poor, the quality of three-dimensional echocardiography will be poorer and therefore one needs to obtain, in a given patient, the best quality two-dimensional images for three-dimensional acquisition.

The reason three-dimensional echocardiography has not completely replaced the two-dimensional technique is the poorer quality of three-dimensional images as compared to two-dimensional images and the fact that a larger data set is possible only when the images are acquired over two or more beats rather than a single beat.

Table 1: Major clinical applications of three-dimensional Echocardiography in clinical practice

Valvular stenosis orifice planimetry for assessment of severity (mitral, aortic, tricuspid and pulmonary stenosis).
Native and prosthetic valvular regurgitation site determination and vena contracta planimetry to quantify severity (mitral, aortic, tricuspid and pulmonary regurgitation).
Assessment of individual prosthetic valve leaflet motion, thrombus (usually protruding from prosthesis) and pannus (usually does not protrude from prosthesis).
Valvular prolapse Assessment of individual mitral valve scallop/ segment prolapse and chordae rupture.
Aortic dissection and aneurysm. Differentiation from artifact as dissection flap appears sheet like on three-dimensional echo and not linear.
Global left ventricular (LV) and right ventricular (RV) volumes and function. LV mass. Regional function. Diagnosis and assessment of LV/RV non-compaction/thrombus.
Characterization of valvular masses. Vegetations and abscesses. Assessment of extent of valvular destruction.
Characterization of cardiac masses and tumor mimics. Thrombus in cardiac cavities and left atrial appendage (individual lobes can be examined). Differentiation of thrombus, myxoma, hemangioma, lipoma/fibroma and malignancy.
Differentiation of bicuspid from tricuspid aortic valve. Enface planimetry of congenital and acquired cardiac defects.Planimetry of other obstructive lesions (sub/supravalvular stenosis, hypertrophic cardiomyopathy, atrial membranes, etc.).

CONCLUSION

Thus, two-dimensional echocardiography remains the basic technique for non-invasive cardiac evaluation in day to day clinical practice with three-dimensional echocardiography playing a pivotal role providing important supplementary information in many cardiac diseases. Tables 1 and 2 summarize the clinical usefulness of three-dimensional echocardiography.

Table 2: Utility of Live / Real Time Three - Dimensional Trans-esophageal Echo-cardiography in Percutaneous Interventional Procedures

Guides atrial septal puncture.
Facilitates balloon valvuloplasty (mitral, aortic and pulmonary valves) and transcutaneous aortic valve replacement.
Accurate evaluation of congenital cardiac defects, rim size.
Evaluation of mitral and aortic paraprosthetic leaks.
Facilitates selection of appropriate closure device for 3 and 4 above and closure of left atrial appendage.
Provides guidance for catheter and device navigation (for example placement of mitral clip).
Assesses residual defects after closure.
Assesses complications such as encroachment or embolization of closure device.

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