Extended Abstract
Volume 4:2, 2020

Research and Reports in Medical Sciences

Open Access

Euro Heart Congress 2020: Role of Three Dimensional Transthoracic Echocardiography in Detecting the Change of left Ventricular Global and Regional Wall Function

Zakarya Radman Hasan Saad

Cairo University, Egypt

Abstract

The role of the three dimEvaluation of left ventricular (LV) size and function are by far the most common reasons for performing echocardiography in the adult patient. The most important diagnostic, prognostic, and treatment decisions are measured based upon LV morphology analysis; the widespread availability of the bedside, occuring cost, and non invasive nature of echocardiography has made this technique the best method of choice in most situations for performing this analysis. Most of the echocardiographic departments perform an analysis called "eyeball" which gives an analysis of global and regional LV function and provide visual estimates of ejection fraction because existing quantification methods (from M mode and 2D Echo), however they are both time consuming and immensely difficult to perform. At a period of time where so many important and often costly decisions are being made upon with the help of this data it is incumbent upon departments that shows highly accurate data and are reproducible echo quantification methods are utilised—especially since the technique called "gold standard" of cardiac magnetic resonance (CMR) is not so widely available, is more costly, cannot be used on those with implanted pacemakers or defibrillators, and is disliked by many patients.

As mentioned previously, early 3D echocardiographic techniques depended upon the acquisition of multiple cross sectional (2D) images using freehand transthoracic or transoesophageal imaging. The spatial and temporal relationships of each image had to be registered and gating to the cardiac and respiratory cycle also performed before a time consuming reconstruction of a 3D dataset could be undertaken.

Acquiring the 3D datasets in real time ECG and respiratory cycle gating can largely be avoided and all of this can be achieved by using a matrix array probe. To test these the probe should contain complex electronics and 3–4000 individual elements which permits multidirectional beam steering and it has to allow a 3D dataset of approximately 30° × 60° to be acquired. Using which facilitates 3D visualisation of valve structures or part of the LV in real time. However, in order to capture a dataset large enough to cover the entire LV, the transducer has to positioned over the apex and several (usually four or five) smaller real time datasets have to be acquired whilst briefly holding the respiration and electronically "stitched" together over four or five sequential cardiac cycles. A pyramidal 3D dataset of 90° × 90° is obtained at a frame rate of 20–25 Hz can be acheived using this way. The dataset acquired using this tchnique is usually large enough and also fast enough to allow comprehensive analysis of the LV.

Despite the improved accuracy compared with 2DE, the majority of previous studies reported that 3DE measurements underestimate LV and right ventricular (RV) volumes when compared with cardiac magnetic resonance reference. This systematic error has been shown to be mostly a result of manual tracing of the endocardial boundaries on 3DE images too far into the ventricular cavity, where the eye has been perceived as the blood-tissue interface to be located on ultrasound images . This is because 3DE images do not always have sufficient spatial resolution to differentiate endocardial trabeculae from the compacted myocardium, especially in the right ventricle, and particularly during systole, when the trabeculae are compressed together as a result of increasing blood pressure. This finding underscores the need for further technological developments that would bring 3DE up to par with 2DE imaging in terms of spatial and temporal resolution and also for standardization of the measurement methodology with 3DE.

Conclusion

A 3-dimensional echocardiography is a non-invasive technique which can be performed in many clinical scenarios. Hence we conclude that it can be ideal for knowing daily performance and for serial follow-up examinations of left ventricular volume and function.

Inspite of the many improved techniques coming forth in the concept of three-dimensional echocardiography, the amount of time consumption has been the major limitation hampering its everyday use for daily diagnostic echocardiography and for volume and function assessment. Faster data acquisition by reducing the number of cross-sections for reconstruction of the cavity, using a high-speed rotation transducer or a volumetric real-time three-dimensional echocardiographic transducer is being investigated. Data processing and three-dimensional image reconstruction has been accelerated and on-line processing and reconstruction is under investigation. Development of various automatic border detection algorithms

along with the improvement of ultrasound spatial resolution and advances in other novel modalities such as harmonic, power-mode Doppler tissue imaging and development of stable intravenous ultrasound contrast agents that enhance the delineation of endocardium, should be able to avoid the need of manual border tracing and provide automatic, even on-line, volume measurement segment of inferior wall, basal segment of lateral wall and apex) than other segments.

The 3-D echocardiography provides objective and assessment of regional wall motion abnormalities in patients with ACS. However, it does not show superiority over the routine assessment of RWMA by 2D echocardiography.

Keywords:
3-D Echocardiography, ACS, wall-motion abnormality.

The mortality can be better predicted with GLS than EF by both 3DE and 2DE analysis, whereas 3D EF is a better predictor than 2D EF. Also, LV shape indices provide additional risk assessment. Left ventricular (LV) ejection fraction (EF) is the most commonly used echocardiographic parameter of LV function, known to be an independent predictor of mortality, and is routinely used to guide patient management. However, assessment of LVEF in 2-dimensional (2D) echocardiographic, both in case of qualitative and quantitative measurement is dependent on reader experience and imaging plane, and the value of its accuracy changes with image quality. The recent and newer techniques used in the quantitative evaluation of LV function consists of speckle tracking echocardiography (STE), which helps in the exact measurements of myocardial deformation parameters, such as global longitudinal strain (GLS). The strengths of GLS include better reproducibility and ability to detect subtle changes in myocardial function that precede changes in EF, as reported in a variety of disease states (). Studies have shown that GLS can also predict mortality, potentially more accurately than EF (). Most outcomes studies focusing on LV function were performed using 2D echocardiography (2DE).

Three-dimensional echocardiography (3DE) offers better reproducibility and higher accuracy than 2DE for the assessment of LV size and function () because it avoids apical foreshortening and is based on direct volumetric measurements without geometrical assumptions. Furthermore, because 3DE can track myocardial motion independently of the imaging plane, 3DE-derived GLS may also be more accurate and reproducible. Recently, LV shape has been gaining interest with the availability of 3DE analysis tools, and there is growing evidence that it may carry additional diagnostic and prognostic information. Accordingly, we can state from the hypothesis that:
1) 3DE parameters can be the better predictors of cardiovascular (CV) mortality than that of 2DE; 2) Similarly, 3D GLS can predict better CV mortality than 3D EF; and
3) 3DE-derived shape indices can also be used inorder to predict CV mortality. This study was designed to investigate the relationship between these indices and long-term survival.

Although 3DE analysis of left atrial (LA) volume has been a topic of investigation, the development of software tools specifically designed for LA quantification is still lacking. Nevertheless, similar to LV volume quantification, 3DE measurements of LA volume were shown to be more accurate and more reproducible than the traditional 2DE measurements . Importantly, the 3DE approach has significantly reduced the underestimation of LA volume compared with the magnetic resonance reference, thus underscoring the need for reevaluation of the cutoff values defining atrial enlargement . This could potentially result in reclassification of the presence and/or severity of diastolic dysfunction in a large proportion of patients, a clinically relevant issue that needs to be addressed, as recognized by the latest ASE/EACVI guidelines (). To settle this issue, normal values of LA volume need to be derived from 3DE images in a large number of normal subjects over a wide range of ages. Because only few published studies have to date focused on normative values of LA volume , the recent guidelines have not provided such values (). One of the important recent developments in the 3DE evaluation of LA size is that it can now be accurately measured automatically using new machine learning techniques, without the need for manual tracing of LA boundaries.

This work is partly presented at 8th World Heart Congress on May 11-12, 2020