ELSEVIER

International Journal of Cardiology 123 (2008) 155–161

International Journal of Cardiology

www.elsevier.com/locate/ijcard

Assessment of left atrial volume and function by real-time three-dimensional echocardiography

Ashraf M. Anwar [a,b], Osama I.I. Soliman [a,b], Marcel L. Geleijnse [a], Attila Nemes [a,c], Wim B. Vletter [a], Folkert J. ten Cate [a,*]

[a] *Thoraxcenter, Erasmus MC, Rotterdam, The Netherlands*
[b] *Cardiology Department, Al-Husein University Hospital, Al-Azhar University, Cairo, Egypt*
[c] *2nd Department of Medicine and Cardiology Center, University of Szeged, Hungary*

Received 21 February 2006; received in revised form 4 August 2006; accepted 30 December 2006
Available online 17 April 2007

Abstract

Background: Determination of left atrial (LA) size and function is important in clinical decision-making. Calculation of LA volume (LAV) is the most accurate index of LA size.
Aim: To compare real-time 3-dimensional echocardiography (RT3DE) and 2-dimensional echocardiography (2DE) for calculation of LAV and function.
Methods: Fifty patients were studied using 2DE and RT3DE for calculating LAV including: Maximum (V max), minimum (V min) and pre-atrial contraction (V pre A) volumes. For 2DE, the formula: LAV = 8(A1) (A2)/3π (L) was used, while for RT3DE, offline analysis was performed using commercially available software. LA function indices including Total Atrial Stroke Volume (TASV), active ASV (AASV), Total Atrial Emptying Fraction (TAEF), active AEF (AAEF), passive AEF (PAEF), and Atrial Expansion Index (AEI) were calculated.
Results: Patients were classified into 2 equal groups: group I with normal V max (<50 ml) and group II with V max (≥50 ml). Good correlation was obtained between RT3DE and 2DE for LAV ($r=0.64$, $p=0.001$) in group I and ($r=0.83$, $p<0.0001$) in group II. In group I, LAV and functions showed no significant difference by both techniques, while in group II, the V min and V pre A were significantly lower by RT3DE than 2DE ($p=0.009$, 0.006). TAEF, AEI, and PAEF indices were significantly higher by RT3DE than 2DE in group II.
Conclusion: RT3DE provides a reproducible assessment of active and passive LA function by volumetric cyclic changes. It is comparable and may be superior to 2DE due to its higher sensitivity to volume changes.

Keywords: Left atrial volume; Left atrial function; Real-time three-dimensional echocardiography

1. Introduction

The left atrium (LA) serves as a reservoir, a conduit and a booster pump for blood returning from the lungs to the heart. Changes in LA size and function are associated with cardiovascular disease and are risk factors for atrial fibrillation, stroke and death [1–3]. Echocardiography is the most commonly used non-invasive imaging technique for estimation of LA size. The M-mode measurement of the LA antero-posterior dimension as indicator for size has several limitations due to geometric assumption made about LA shape and due to slightly diverging position and orientation of imaging planes [4]. It has been suggested that LA volume (LAV) may be a superior index for LA size [5]). Two-dimensional echocardiography (2DE) derived LAV has been shown to provide a more accurate assessment of LA size than M-mode but the problem of geometric assumption still remains [6,7]. Three-dimensional echocardiography (3DE) has demonstrated superior accuracy for measuring left ventricular volume

* Corresponding author. Thoraxcenter, Room Ba 302, Erasmus Medical Center, Dr Molewaterplein 40, 3015 GD Rotterdam, The Netherlands. Tel.: +31 1 04635669; fax: +31 10 4635498.
E-mail address: f.j.tencate@erasmusc.nl (F.J. ten Cate).

0167-5273/$ - see front matter © 2007 Published by Elsevier Ireland Ltd.
doi:10.1016/j.ijcard.2006.12.017

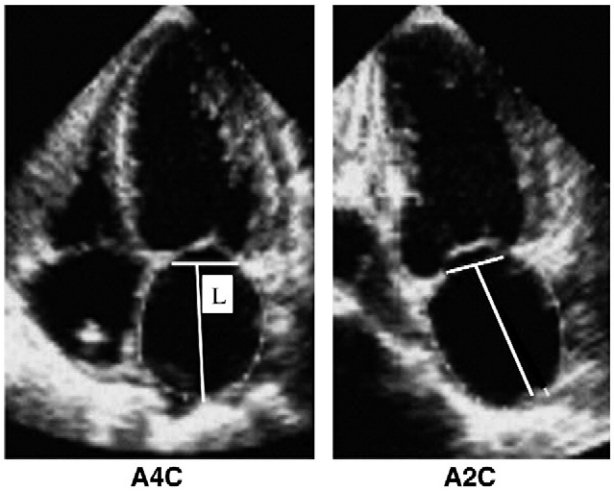

Fig. 1. Calculation of LAV using 2DE by manual tracing of LA endocardial border at apical 4-chambers (A_1) and apical 2-chamber views (A_2), L is the long axis, then apply the formula.

compared to conventional 2DE and the 3DE reconstruction has been validated for LAV quantification [8–10]. Real-time 3DE (RT3DE) allows fast acquisition from a single acoustic window of dynamic pyramidal data structure that encompasses the entire heart [11]. The purpose of the present study was to compare between 2DE and RT3DE for calculation of LAV and assessment of LA function in normal-sized and dilated LA.

2. Methods

The study retrospectively comprised randomly selected fifty patients in sinus rhythm with good 2DE image quality. A standard 2DE and RT3DE examinations were performed for all patients. 2DE was undertaken with the patient lying in the left lateral decubitus with quite respiration using both apical and parasternal views. 2DE studies were performed using a 3.5 MHz probe and a commercially available ultrasound system (Philips Sonos 7500, Best, The Netherlands). The following measures were taken: LA area at apical 4-chamber

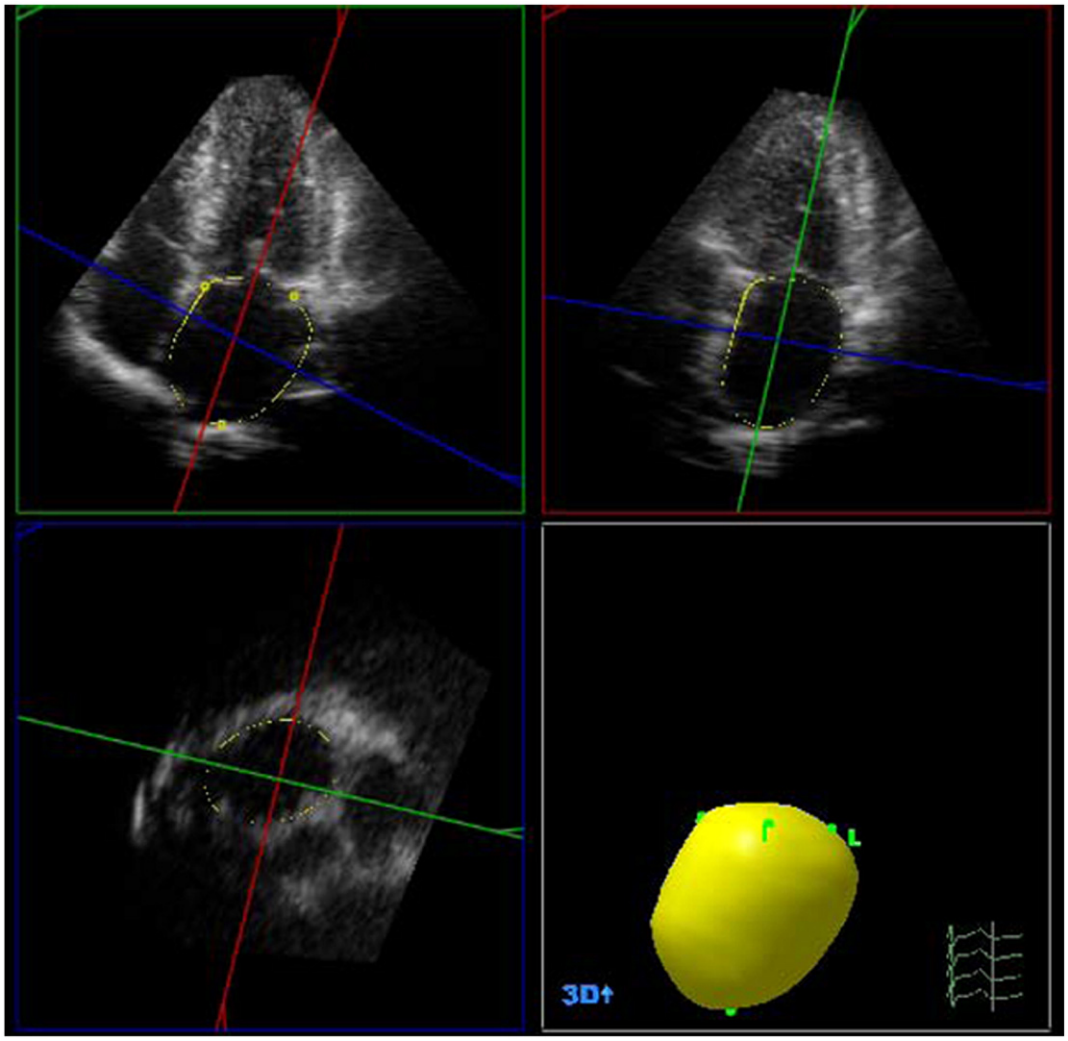

Fig. 2. Calculation of LAV using RT3DE by automatic tracing using Q-lab software. Upper 2 images is apical 4-chamber and 2-chamber views, by marking 5 points, the whole LA cast was obtained.