ASSESSMENT OF LEFT VENTRICULAR VOLUME AND EJECTION FRACTION USING SPECKLE TRACKING ECHO CARDIOGRAPHY

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Abstract
Background: The first time in Viet Nam, we applied speckle tracking echocardiography (STE), a new, non-invasive method for the assessment of left ventricular global function and left ventricular volume. **Material and Method:** Thirty three patients (10 males and 23 females, mean age 61±8.8 years, range 42-81 years) in regular sinus rhythm were studied. Left ventricular volume and EF by STE were compared with left ventricular volume and EF by 2D echo (Simpson's method) and M-mode in all patients. EF and left ventricular volume were triply measured by STE. **Result:** The results between three times by STE and between STE and Simpson were p>0.05, r=0.9-0.95; p>0.05, r=0.96. **Conslusion:** We concluded that EF values by STE is similar to 2D assessment and the results between three times of measurements by STE are not different.
Key words: *left ventricular, speckle tracking echocardiography (STE)*

1. INTRODUCTION

Over the past decades, transthoracic echocardiography is the first choice to evaluate cardiac function. There are thousands of studies to state the role of transthoracic echocardiography in quantification of left ventricular function. The most important parameters are ejection function (EF), end diastloic volume (EDV) and end systolic volume (ESV). The classic methods as M-mode echocardiography and two-dimensional echocardiography (2D) are used mostly. However, M-mode may not assess global myocardial function, 2D by Simpson'method takes so much time [8] [1]. Besides, the confidences of these methods depend on the experience of echocardiographer [8]. Today, a high technology century, it is necessary to have a new method about echocardiography. Not only high confidences are there but also saving time and global functional evaluation. Speckle tracking echocardiography (STE) hopes to satisfy echocardiographers and clinical physicians. This study aims to apply STE in evaluation left ventricular volume and ejection fraction.

2. MATERIALS AND METHODS

2.1. Patient

The study was approved by Hypertensive program, Bach Mai Hospital, Ha Noi, Viet Nam. We investigated 33 patients, diagnosed hypertension according to European Society of Cardiology's guidelines, 2007. We exclude the patients with bad quality echocardiographic images, coronary diseases, diabetes, valvular diseases and cardiomyopathy.

2.2. Methods

Transthoracic ultrasonography images were obtained by an experienced ultrasonographer using iE33 ultrasound systems, S4-2 probe. Each patient was examined by three methods, M-mode, 2D and STE.

- M-mode: using Teicholz'method.

- Two dimension: using Simpson's biplane method.

- Speckle tracking method: Two dimensional (2D) ECG-triggered, apical 4-chamber cine-loops were recorded with frame rates ranging from 42 to 70 fps for offline analysis.

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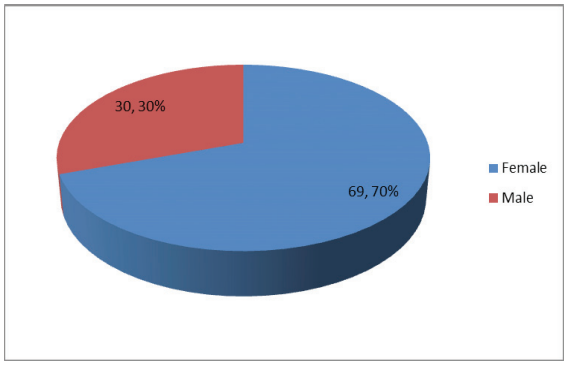
*- Received: 20/4/2013 * Revised: 20/5/2013 * Accepted: 15/6/2013*

3. RESULTS

3.1. The characteristic of study population

- Thirty three patients (10 males and 23 females, mean age 61±8.8 years, range 42- 81 years)
- Female 69.7%, Male 30.3%.



3.2. Differences in EF, EDV, ESV between STE, M-mode and 2D

	STE	M-Mode	ttest
EDV (ml)	82±22.1	89.8± 20.5	p=0.02, r=0.5
ESV (ml)	31.7±9.1	27.3±10.5	p<0.05, r=0.42
EF (%)	61.3±4	70.1±7	p<0.0001 , r= -0.1

Table 1. Differences in EF, EDV, ESV between STE and M-mode

Comment: EDV and EF of STE are lower M-mode, p =0.02 and p<0.05.

	STE	Simpson	ttest
EDV (ml)	82±22.1	57.8±13.7	p<0.0001, r=0.65
ESV (ml)	31.7±9.1	22±4.9	p<0.0001, r= 0.66
EF (%)	61.3±4	61.4±4.1	p>0.05, r=0.96

Table 2. Differences in EF, EDV, ESV between STE and Simpson.

Comment: There are some of differences in EDV, ESV between STE and Simpson. However, There are no difference in EF between two methods (p>0.05).

3.3. Differences in EF, EDV, ESV between three times of measurement by STE

	1st times	2nd times	ttest
EDV (ml)	82.7±23.1	81.1±23.6	p>0.05, r=0.8
ESV (ml)	31.7±9.3	31.9±9.2	p>0.05, r=0.9

Table 3. Differences in EDV, ESV between the first times and the second times of measurement by STE.

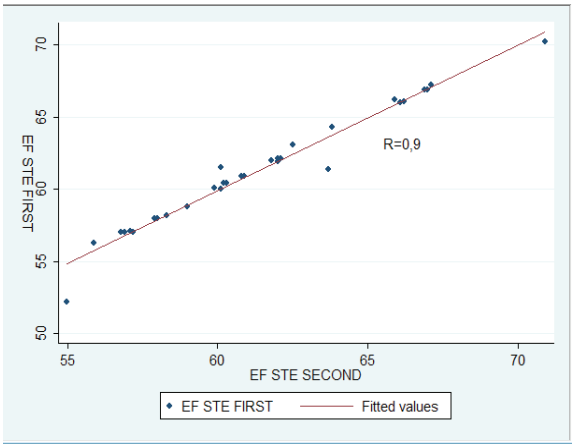


Figure 1. Correlation plot of the first EF and the second EF by STE.

	1st times	3rd times	ttest
EDV (ml)	82.7±23.1	82.1±22.4	p>0.05, r= 0.9
ESV (ml)	31.7±9.3	31.6±9.1	p>0.05, r= 0.93

Table 4. Differences in EDV, ESV between the first times and the third times of measurement by STE.

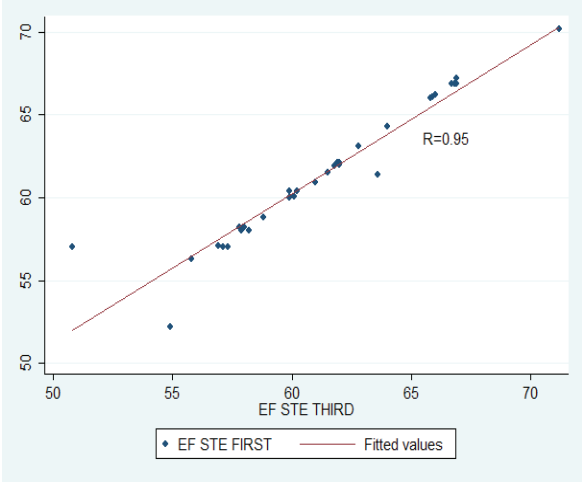


Figure 2. Correlation plot of the first EF and the third EF by STE.

	2nd times	3rd times	ttest
EDV (ml)	81.1±23.6	82.1±22.4	p=0.4, r=0.8
ESV (ml)	31.9±9.2	31.6±9.1	p=.08, r=0.9

Table 5. Differences in EDV, ESV between the second times and the third times of measurement by STE.

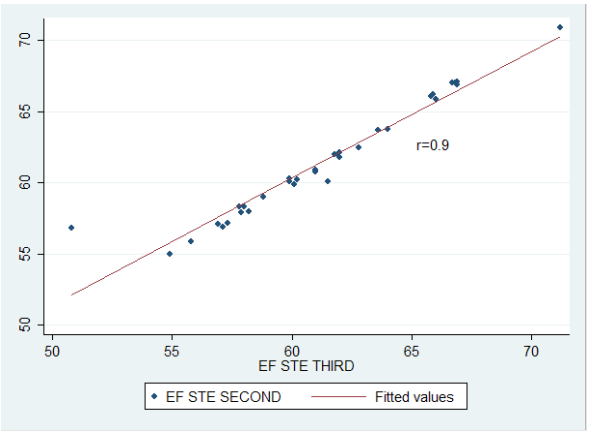


Figure 3. Correlation plot of the second EF and the third EF by STE.

Comment: In table 3, 4, 5 and figure 1, 2, 3 there are no difference in EDV, ESV, EF between three times of measurement by STE. In addition, there are best correlations in three times of measurement (r=0.8-0.9).

4. DISCUSSION

4.1. Differences in EF, EDV, ESV between STE, M-mode and 2D

According to Simona, Livi Tomasoni and Maurizio Turiel[13], although the parameters on M-mode echocardiography seem objective, they are semi-quantitative assessment of myocardial thickening and depend on echocardiographer. Moreover, the angle between ultrasound beam and myocardial wall affects the reality of the result. If this angle is not perpendicular, the result maybe higher than real result[3], not accuracy[12][14]. In table 1, EDV and EF by M-mode is higher than by STE (p=0.02 và p<0.05).

Evaluating EF by Simpson'methods often is used in clinical practice. In Celentano' study and et al[5], EF by Simpson has best correlation with EF by MRI, excellent correlation in female subjects. Ricardo A.Costa, et al [11] stated that EF by STE is similar to EF by Simpson.

Table 2, EF by STE and EF by Simpson have excellent correlation (p>0.05, r=0.96).

.In many studies, when comparing with MRI and sonomicrometry, cardiac function by STE do not differ[2][5][7]. Overall, STE appears to be highly reproducible and minimally affected by interobserver variability [13]. Besides, evaluation of cardiac function by STE takes less time than by Simpson[1][11]. Because, we click only 3 points in 4 chamber view (2 points in mitral valve annular, 1 point in apex), left ventricular volume and EF are calculated automatically by software. While, with Simpson'method we need manual draw along endocardial border in systolic and diastolic cycles. So, it takes so much time. Harvey Feigenbaum and et all took only 2-4 minutes to quantify global and regional cardiac function (17 regions) by STE[8].

4.2. Differences in EF, EDV, ESV between three times of measurement by STE

Many studies proved that STE has highly reproducible [1][4][16]. In the past, M-mode and 2D Simpson also were stated that they were reproductive but these methods were not precise in hypertensive patients, obesity and valvular heart diseases[10].

In table 3, 4, 5 and figure 1, 2, 3 there are no difference in EDV, ESV, EF between three times of measurement by STE. In addition, there are best correlations in three times of measurement (r=0.8-0.9). However, the limit of this study is we have not yet evaluated interobserver.

5. CONCLUSIONS

This study demonstrates that EF by STE is similar to those by Simpson and it has excellent correlation. EF and left ventricular volume do not differ between three times of measurement by STE. Assessment of left ventricular function by STE helps us to save time and to minimise variableness by intraobserver.

STE is a promising new technique to quantify regional and global myocardial function. It holds promise to reduce interobserver and intraobserver variability and not only to improve patient care but also to save time.

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