



## The value of mitral valve E point septal separation as an index of assessment of left ventricular systolic function

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### Abstract

**Background and objectives:** There are several methods of assessment of left ventricular function utilizing M-mode echocardiography, the most popular one being geometrically derived ejection fraction, for which its validity is compromised in case of abnormal geometry or regional wall motion abnormalities. Mitral valve E septal separation estimated by M mode echocardiography or cardiac magnetic resonance imaging can be used as an index of left ventricular systolic function assessment. The aim of this study is to assess the value of mitral valve E septal separation estimated by M mode echocardiography in evaluation of left ventricular systolic function in patients assessed in two hospitals in Erbil city.

**Methods:** from March 2016 to May 2019, 564 patients were randomly selected in Rizgary and Erbil teaching hospitals were included in this study. For all cases; demographic data were recorded, echocardiography performed by cardiologists, ejection fraction estimated by the most appropriate method and mitral valve E septal separation estimated by M mode scanning.

**Results:** Means of age, ejection fraction, mitral valve E septal separation were  $52.4 \pm 14.8$ ,  $65.4 \pm 10.4\%$  and  $3.87 \pm 4.1$  respectively. Male to female ratio was 0.64 (220/344). There was strong highly significant negative correlation between ejection fraction and E septal separation, value of 6.9 mm was the upper normal level representing ejection fraction of 55%. The sensitivity and specificity of mitral valve E septal separation more than 7 mm as a reference to low left ventricular systolic function were 100% and 99%.

**Conclusions:** Mitral valve E septal separation is reliable and easily measurable index of assessment of left ventricular systolic function; value more than 7 mm is indicating abnormal systolic function with sensitivity of 100% and specificity of 99%.

**Key words:** Mitral valve E septal separation, Left ventricular systolic function, Left ventricular ejection fraction

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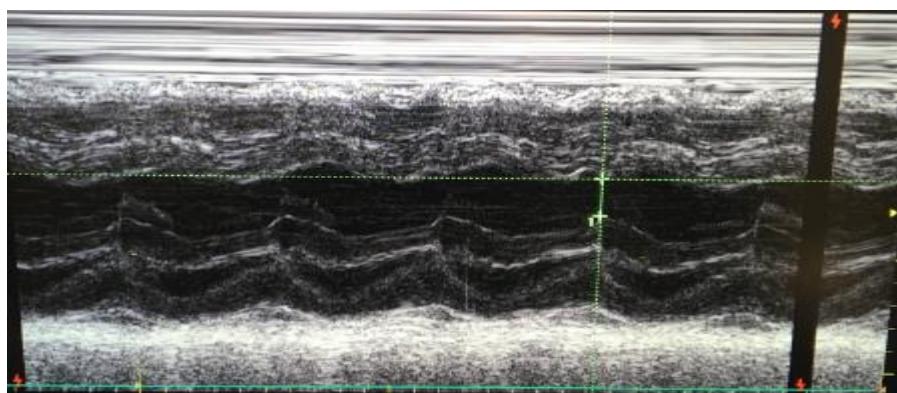
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## Introduction

There are several methods of assessing the left ventricular systolic function (LVEF); the most accurate is Simpson's method estimated by cardiac magnetic resonance imaging (MRI), using transthoracic echocardiography LVEF can be estimated by direct visual assessment, Teichholes method, modified Simpson's method, regional motion assessment, wall motion index, and Doppler echocardiography; however, each technique has its pitfalls<sup>1,2</sup>.

Mitral valve E septal separation (MVEPSS) which is the distance between the tip of MV E wave and interventricular septum (IVS) can be measured by M mode and it is an approach that is roughly correlates with LV

function, can be estimated by echocardiography and MRI but there is no solid correlation with LVEF and its estimation often meet difficulties by echocardiography as sometimes endocardial lining is hardly definable<sup>1, 2</sup>. The normal value of MVEPSS is variable some suggest normal value as less than 7 mm, others less than 10 mm. Some studies referred to EPSS superiority in assessing LVSF as a cut level of 7 mm<sup>3</sup>. Mitral valve E septal separation can be measured by direct ultrasound visualization of the heart in parasternal long axis<sup>4</sup>. Using M-mode, the marker is placed over the most distal tip of the anterior mitral leaflet figure (1).



**Figure (1)** M mode echocardiography scanning showing mitral valve E septal distance estimation (from echo lab of Hawler Teaching Hospital)

Mitral valve E septal separation estimation is valuable tool in emergency medicine to assess the left ventricular systolic function

(LVSF) as its estimation is simple not time consuming and can be translated to LVEF<sup>5</sup>. A correlation between MV EPSS and

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fractional shortening of left ventricle also was found by some authors, and had been shown as a moderate negative correlation<sup>6</sup>.

The utility of EPSS was investigated in predicting a normal or abnormal ejection fraction in patients with reversed septal motion, and to compare these results with patients with normal septal motion. It was determined that EPSS is valid as an indicator of the presence of a normal or abnormal ejection fraction regardless of abnormalities of septal motion<sup>7</sup>. The optimum method of LV systolic function

### **Patients and methods**

In this cross sectional study included 564 patients who visited the Echocardiography units of both Rizgary and Erbil Teaching Hospitals from March 2016 to May 2019. The patients were selected by randomized systematic sampling. Verbal informed consent was taken from the patients before participation in the study. All cases with mitral stenosis, aortic regurgitation and moderate to severe mitral regurgitation were excluded from the study as these valvular diseases may interfere with MV EPSS estimation. For every patient, the demographic data were labeled and

assessment depends on many factors including operator experiences, image acquisition and complexity of cardiac anatomy, MV EPSS is simple method of such assessment<sup>7</sup>. Many studies referred to significant negative correlation between MV EPSS and LVEF, making the MV EPSS as reliable index for assessment of LVSF<sup>8</sup>. This study is designed to assess the value of MV EPSS estimated by M mode echocardiography in evaluation of LV systolic function in patients investigated in Erbil city.

echocardiography done by either Vivid E9 echocardiography machine or Vivid E3 machine performed by experienced cardiologists. LVEF was estimated by the best reliable method appropriate for individual case (Teicholes or modified Simpson method) compared to M mode scanning of mitral valve E sepal distance<sup>9, 10</sup>. The data were analyzed using SPSS version 23 program. The data are presented in tables and figures. Correlation between LVEF and MVEPSS were assessed by Pearson correlation (r), significance level put at p-value  $\leq 0.05$ .

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## Results

The mean age of patients  $\pm$  standard deviation was  $52.4 \pm 14.8$  years, ranging from 11-85 years, meanwhile the standard error (SE) of mean 0.62, male to female ratio was 0.64 (220/344). Their LVEF was between

14-89%, 20 patients were with  $EF > 75\%$ , mean  $65.4 \pm 10.4\%$  SE of mean 0.46, their EPSS was between 0-30 mm mean was  $3.87 \pm 4.1$  SE of mean 0.17 as shown in table (1).

**Table (1):** Demographic data of patients included in the study.

| Parameters                             | Minimum | Maximum | Mean | SD   | SE of mean |
|--|---------|---------|------|------|------------|
| Age (years)                            | 11      | 85      | 52.4 | 14.8 | 0.62       |
| Left ventricular ejection fraction (%) | 14      | 89      | 65.4 | 10.4 | 0.46       |
| Mitral valve E septal separation (mm)  | 0       | 30      | 3.87 | 4.1  | 0.17       |

The Pearson's correlation coefficient ( $r$ ) was  $-0.77$ , 95% confidence (-0.83 to -0.71) with p-value of  $<0.001$ , this was indicating a strong (statistically defined as a coefficient

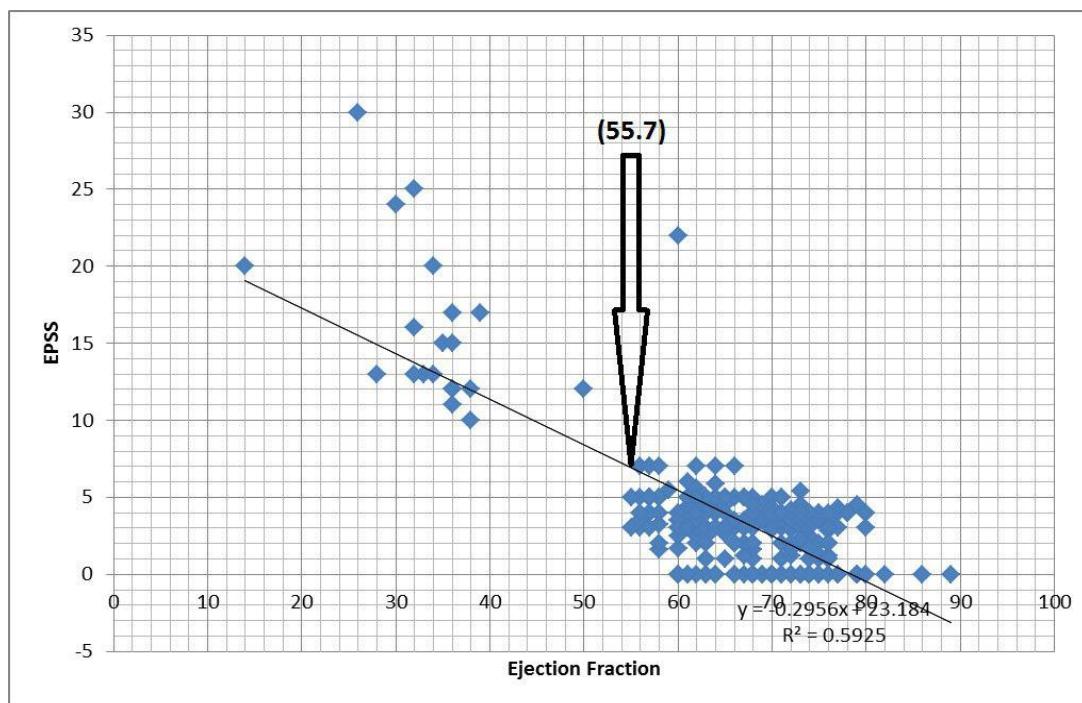
value of ( $r=0.6-0.8$ )) significant negative correlation between LVEF and MVEPSS which is statistically significant. As shown in table (2).

**Table (2):** Pearson correlation between MV EPSS and LVEF

| Pearson Correlation | Number of cases | p-value | 95% confidence |
|---------------------|-----------------|---------|----------------|
| -0.77               | 564             | 0.0001  | -0.83 to -0.71 |

The regression line showed  $r^2$  of 0.59, which is highly significant p-value of 0.0001, EPSS of 10 mm was equivalent to LVEF of 44.6%, LVEF of 44.6%, LVEF of 55% was corresponded to EPSS of 6.9 mm, LVEF 40% to EPSS 11.35 mm, LVEF of 35% to

EPSS of 12.83 mm and LVEF of 30% to EPSS of 14.3 mm ( $LVEF = 81 - 3.4EPSS$  in millimeters) (graph 1). The sensitivity and specificity of MV EPSS more than 7 mm as a reference to low LVEF were 100% and 99% respectively



**Graph (1):** Regression line between mitral valve E septal separation and left ventricular ejection fraction

## Discussion

The sample size included in the study was highly representative of the population as the standard error of means for age, LVEF and MV EPSS were low (0.46 and 0.17 respectively , wide range of age limit was included both genders though more female were included in the study.In this study comparative result found with a study done by Elagha and Fusiz whom found significant negative correlation between MV EPSS estimated by cardiac MRI and LVEF in their study which included 143 patients, the LVEF ranged from 12-79 %.The EPSS

ranged from 2.2-26.1 mm. Correlation coefficient revealed to be very strong ( $r = -0.92$ ; 95% Confidence interval for  $r = -0.95$  to  $-0.87$ ) with high significant level ( $P < 0.0001$ )<sup>1</sup>. Ahmedpour et al studied 108 patients with coronary artery disease who underwent coronary angiography and M-mode echocardiography. An abnormal EPSS (more than 7 mm) was found to be more sensitive (87%) and specific (75%) in detecting individuals with angiographically reduced ejection fraction (less than 50%) compared to other<sup>3</sup>. This study showed that

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MV EPSS of more than 7 mm is 100% sensitive and 99% specific to low LVEF, the differences are significant, our study included more cases and it can be more representative of actual value of MV EPSS. In this study comparative result found with a study done by McKaigney et al who showed in their study that measurements of EPSS by emergency department physicians were significantly associated with the calculated measurements of LVEF from comprehensive transthoracic echocardiography, subjective visual estimates, however, demonstrated only

### Conclusions

Mitral valve E septal separation is simple and reliable easily index of assessment of LV systolic function; MV EPSS of more

moderate agreement with the calculated LVEF, an EPSS measurement greater than 7 mm was uniformly sensitive at identifying patients with severely reduced LVEF, correlation value was  $r = -0.76$ <sup>5</sup>. The measurement of MV EPSS was so easy and rapid in most patients included in this study making it suitable for use by emergency junior doctors, similar result had been shown by Secko et al<sup>12</sup>. Silverstein et al found an equation by which LVEF can be estimated by MV EPSS, (LVEF=75-2.5EPSS in millimeters)<sup>13</sup>, in this study LVEF=81-3.4EPSS in millimeters.

than 7 mm is indication abnormal LV systolic function with sensitivity of 100% and specificity of 99%.

### Conflict of interests

The authors recorded no conflict of interests.

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