

Left Ventricular Systolic Function, Aortic Stroke Distance, Ejection Fraction and New York Heart Association Classification

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ABSTRACT

Objective: To determine an effective time saving measure of Left Ventricular (LV) Systolic Function having good correlation with different classes of New York Heart Association (NYHA) classification for Heart failure in patient with limited transthoracic window, Abnormal septal motions and Ischemic Cardiomyopathy with areas of hypokinesis, akinesis and dyskinesis.

Study Design: Prospective / Descriptive / cross sectional study

Place and Duration of Study: This study was conducted at the Department of Cardiology, DG Khan Medical College, Dera Ghazi Khan from October 2018 to December 2018.

Materials and Methods: A total number of 96 patients having cardiac failure with different classes of New York Heart Association Classification were divided into two groups. Patients in Group A has symmetrical LV geometry while in Patients in Group B has asymmetrical LV geometry. Ejection fraction and Aortic Stroke distance was calculated in both groups and these parameter were correlated and compared with different classes of NYHA classification.

Results: The ejection fraction and Aortic Stroke distance correlated very well with NYHA classes in patients with symmetrical LV geometry while in those with asymmetrical LV geometry the Aortic Stroke distance was a better correlate of NYHA class.

Conclusion: Aortic stroke distance is a better, time efficacious measure of LV systolic function which can be easily determined in patients with limited trans-thoracic window.

Key Words: Aortic Stroke Distance, Ejection Fraction %, Left Ventricular Systolic Function, NYHA Class

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INTRODUCTION

Heart failure is a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood (ACCF/AHA 2013).⁸⁻¹⁷ Filling is diastolic function and ejection is the systolic function of the ventricle. Incidence of heart failure increases with age and accounts more than 10 % after the age of 70 years. Echocardiography is the key investigation for the diagnosis and quantification of heart failure. Despite all controversies New York Heart Association (NYHA) classification provides valuable clinical assessment and mortality data on which heart failure patients can be classified.¹⁹ See Table 1.

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Annual mortality risk percentage for the patient in class I, II, III, IV is respectively 5 to 10 %, 20 to 30 %, up to 50 % and more than 70%.¹⁸ Echocardiographically determined Left Ventricular (LV) parameters can be correlated with this classification. We compared two echocardiographically determined parameters, 2D Ejection Fraction (EF %) and Doppler Index Aortic Stroke Distance (AoSD).^{1,2} Both of them are correlated with the clinical class of heart failure as given by NYHA class.

NYHA class	Description
NYHA class I	No Limitation of Routine Physical Activity
NYHA class II	Slight Limitation of Physical Activity
NYHA class III	Marked Limitation of Physical Activity less than Ordinary activity causes fatigue, palpitation and dyspnea
NYHA class IV	Symptomatic at rest no physical activity is possible without causes fatigue, palpitation and dyspnea

2D Echocardiographically determined ejection fraction (EF) is widely used as a measure of LV systolic function. CHARM program analyzed 7599 patients with symptomatic heart failure and found every 10 % reduction in LVEF below 45 % was independently associated with 38 % increase in the risk of all-cause mortality. However the ejection fraction calculated by 2D measures is often inappropriate in patients having LBBB, small segmental wall motion abnormality in the measurement plain of ischemic dilated myopathy with areas of dyskinesia, akinesia, hypokinesia and paradoxical wall motion. For these patients it is recommended to use aortic stroke distance as a supplementary and or surrogate measure of overall LV function. More over with Aortic Stroke Distance measurement cardiac output can be easily determined.

MATERIALS AND METHODS

This study was conducted in the Department of Cardiology, DG Khan Medical College, Dera Ghazi Khan from 1-10-2018 to 30-12-2018. A total number of 96 patients of cardiac failure were included in this study. They were divided in to two groups on the basis of their left ventricular geometry. First group (Group-A) has symmetrical LV geometry while in second group (Group-B), the LV geometry was asymmetrical. These two groups were further sub-divided in to four groups (A-1 to A-4 and B-1 to B-4) on the basis of their NYHA class. Each sub-group was having 12 patients on the basis of following criteria.

Inclusion Criteria: Patients with heart failure having dilated cardiomyopathy, hypertensive heart failure, ischemic dilated cardiomyopathy, left bundle branch block.

Exclusion Criteria: Patients having pericardial disease, aortic stenosis, aortic regurgitation and mitral regurgitation were excluded from the study.

Their echocardiographic ejection fraction by 2D method and aortic stroke distance were measured. The ejection fraction was determined by "Teichholz" method in the following way:

1. Parasternal long axis (plax) view was obtained through 2D, by 2.5 MH probe.
2. M-mode cursor was aligned across the right ventricle, intraventricular septum, and posterior left ventricular wall at the level of chordae tendineae or papillary muscle.
3. The measurements were recorded and ejection fraction was automatically calculated by the machine through its software package.

Aortic stroke distance was determined as follows:

1. Apical 4 chamber view was obtained, in few patients subcostal 4 chamber view was preferred because of their chest deformities.
2. Pulsed wave Doppler was used to record the velocity profile of LVOT.

3. Sample volume was placed within one cm proximal to aortic leaflets
4. When the stable tracing was obtained at the above position it was subjected to calculations in centimeters (cm) see figure 1.

RESULTS

The results obtained from 48 patients of Group-A with dilated cardiomyopathy having global systolic dysfunction with different NYHA class are given in Table-1. It is evident from the data that the reduction in ejection fraction and aortic stroke distance fairly correlates with the NYHA class patients in Group A-1 to Group A-4.

The data of 48 patients of Group-B were with heart failure due to ischemic heart disease with wall motion abnormalities or left bundle branch block or Ischemic dilated cardiomyopathy with and without diabetes had different NYHA class. Their results are given in Table-2. This is evident from the data that 2D determined ejection fraction shows a grey area of correlation with NYHA class IN Group-B patients. In Group B-2 and B-3. Patients having ejection fraction of 30% may fall in B-2 (NYHA class 2) or B-3 (NYHA class 3).

Table No.1: Group-A

NYHA class	Ejection fraction	Aortic stroke distance
Group A-1 (NYHA Class 1) (n=12)	≤ 45 %	≥ 18 cm
Group A-2 (NYHA Class 2) (n=12)	40-44 %	15-17 cm
Group A-3 (NYHA Class 3) (n=12)	25-39 %	10-14 cm
Group A-4 (NYHA Class 4) (n=12)	< 25 %	<10 cm

Table 2 (Group-B)

NYHA class	Ejection fraction	Aortic stroke distance
Group B-1 (NYHA Class 1) (n=12)	≥ 45 %	≤ 18 cm
Group B-2 (NYHA Class 2) (n=12)	20-45 %	15-17 cm
Group B-3 (NYHA Class 3) (n=12)	20-45 %	10-14 cm
Group B-4 (NYHA Class 4) (n=12)	<20 %	<10 cm

The aortic stroke distance in B-2 (NYHA class 2) would vary between 15 and 19 cm and in class 3 it would be between 10 and 14 cm. So aortic stroke distance in Group-B correlates better with NYHA class. Figure 2.

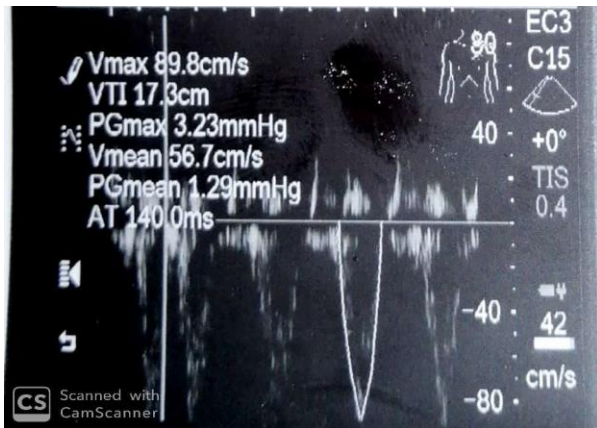


Figure No.1 Show calculated Aortic Stroke Distance of 17 cm from velocity profile obtained through Left Ventricular Fraction Out low Tracked (LOVT) while Patient's 2D Ejection Fraction was 52 %.

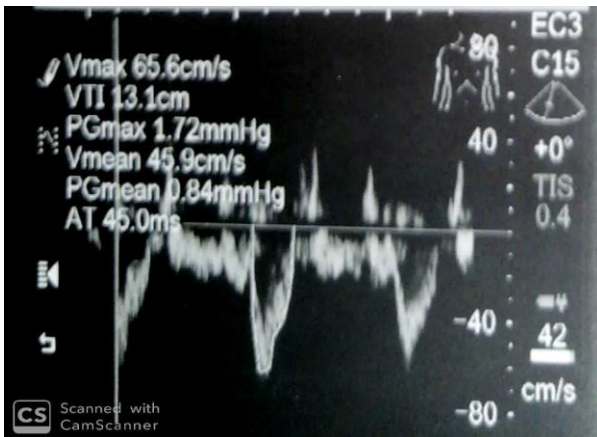


Figure No.2: Shows Aortic Stroke Distance (VTI) of 13.1 cm calculated in patient having NYHA functional class II, While his ejection fraction was 45%.

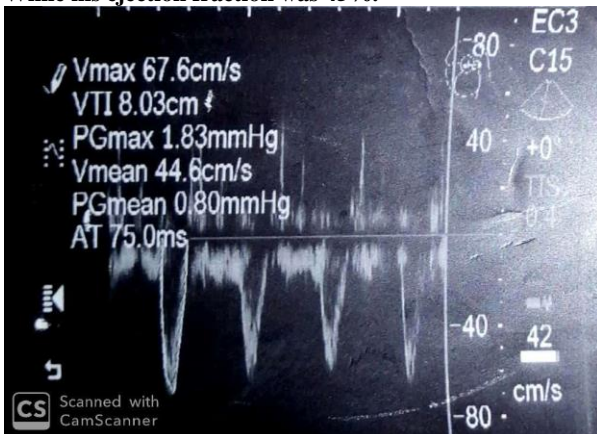


Figure No.3: Shows Aortic Stroke Distance of 8 cm from a patient with ejection fraction of 28 % with NYHA class III.

DISCUSSION

The ejection fraction predicts the outcome in patients with the ischemic heart disease and heart failure. This was initially described as fraction of left ventricular volume ejected per beat in 1962 by Folse and Braunwald using radioisotope indicator dilution technique.⁷ Now-a-days the ease of its measurement with echocardiography has virtually replaced all other methods of its assessments. However, the ejection fraction determination by 2D technique is inaccurate in patients having heart failure and LBBB, paradoxical septal motions and in patients with poor transthoracic window to obtain parasternal long axis view. The application of the Simpson's method to determine ejection fraction in these patients is much better than Teichholz method but it is time consuming and not used routinely.⁶ Similarly colour flow method of LV function assessment has inter observe limitations and is not used routinely.¹⁴ We conducted our study in which the values of ejection fraction were obtained in patients having global systolic dysfunction because of dilated cardiomyopathy and it was compared with the aortic stroke distance which is the ultimate measure of stroke volume and cardiac output.^{1,2,3,4,5,6} Correlation was fairly accurate in all NYHA classes of heart failure IN Group-A but when this correlation was obtained for the Group-B (patients with heart failure due to ischemia related syndromes, LBBB, paradoxical septal motion), there was a grey area of 2D determined ejection fraction between NYHA classes 2 and 3. However, the aortic stroke distance correlated very well with the NYHA class in these patients also. So, it is concluded that the aortic stroke distance is a better measure of left ventricular systolic function as compared with the 2D determined ejection fraction. It is recommended that the measurement of the aortic stroke distance should be added in the report while commenting on the LV function. This measurement is not only accurate but also time efficient (calculation only takes 1 to 2 minutes) and can be routinely used. However the accurate measurement only require careful placement of pulsed Doppler sample volume in Left Ventricular out flow tract where the velocity profile is stable.⁴ Portable machines equipped with Doppler package can be used to access and monitor the patients who are critically sick in ICU and lack invasive hemodynamic monitoring for the assessment of volume replacement and overload.¹¹

CONCLUSION

Aortic stroke distance is a better, time efficacious measure of LV systolic function which can be easily determined in patients with limited trans-thoracic window.

Author's Contribution:

Concept & Design of Study: Khalil Ur Rehman
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 Final Approval of version: Khalil Ur Rehman

Conflict of Interest: The study has no conflict of interest to declare by any author.

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