

Comparison of Various Techniques for Left Ventricular Ejection Fraction

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ABSTRACT

Objective: The purpose of this study is to compare the sufficient accuracy of three different techniques of echocardiography for left ventricular ejection fraction.

Study Design: Retrospective study

Place and Duration: Saidu Group Of Teaching Hospital, Saidu Sharif, Swat, KPK, From September, 2021 to February, 2022.

Methods: Total 90 patients of both genders with age 18-70 years were included. All the patients admitted to hospital with complaint of chest pain. After getting informed written consent detailed demographics of enrolled cases were recorded. All of these techniques (M-mode echocardiography, simpson's biplane mode and global longitudinal strain) were used to measure the left ventricular ejection fraction of patients within a 3-month period that did not include a myocardial infarction or revascularization. SPSS 23.0 was used to analyze all data.

Results: We found that 82 (91.1%) were male patients and 8 (8.9%) were females. Mean age of the patients was 53.6 ± 12.47 years and had mean BMI 25.8 ± 11.44 kg/m². Hypertension was found in 50 (55.6%) cases, followed by dyslipidemia in 35 (38.9%) patients, diabetes mellitus in 23 (25.6%) cases. Cigarette smokers were 15 (16.7%). We found that accuracy of global longitudinal strain was higher for left ventricular ejection fraction than that M-mode echocardiography and simpson's biplane mode but the difference was insignificant.

Conclusion: We concluded in this study use of these three techniques for LVEF was highly useful to diagnose accuracy but global longitudinal strain was showed better accuracy than that of simpson's biplane mode and M-mode echocardiography.

Keywords: Chest Pain, LVEF, global longitudinal strain, M-mode echocardiography, Simpson's biplane mode, Accuracy

INTRODUCTION

An essential goal of noninvasive cardiac imaging is the evaluation of left ventricular ejection fraction (LVEF) with sufficient feasibility, accuracy, and reproducibility. Patients experiencing heart failure are now categorised based on whether or not their LVEF is maintained. Prognosis in individuals with myocardial infarction [1], heart failure [2], and valve disease can be predicted in part by left ventricular ejection fraction. In addition, LVEF thresholds are used in current practice guidelines for decision making in various clinical scenarios, such as the recommendation for device implantation or pharmacological interventions in patients with heart failure [3,4] and the suggestion for valve replacement in individuals with severe valvular disease. [5] Clinical studies frequently use left ventricular ejection percentage as a primary or secondary end objective for participant selection. [6,7]

To assess global and localised left ventricular function, strain by speckle tracking echocardiography makes use of 2-dimensional grey scale pictures. Systolic function can be evaluated using peak global longitudinal strain (GLS). GLS may be more effective than LVEF in diagnosing and ruling out acute coronary heart disease, according to previous research [8, 9]. Furthermore, in post hoc analysis, GLS has higher intra- and inter-observer repeatability than LVEF [9,10].

Although 2DE is widely used, it does have a few drawbacks that are well acknowledged, the most notable of which are LV foreshortening and the inability to acquire distinct projections in the same cardiac cycle. Patients with irregular heartbeats are especially in need of the latter (i.e. atrial fibrillation). Using a 3D-array transducer, it is possible to get the apical four-two and three chamber views concurrently in the TP mode, overcoming these restrictions.

When comparing LV volume and EF, RT3DE has demonstrated excellent agreement with MRI and superiority over quantitative 2DE [11,12]. These results indicate that RT3DE can be used as a substitute for MRI in estimating LVEF.

Since it is conducted on still frames, quantitative 2D-EF using the BPS rule can be time demanding, and the endocardial boundary tracing can be challenging to accomplish, particularly in

patients with low picture quality. Clinical experience has shown that visual estimation of LVEF is faster and easier to do, even in patients with low picture quality.

The LV ejection fraction (LVEF) is often collected using three or more testing procedures in such individuals, which may result in duplicate data on LV systolic function and elevate healthcare expenses. Patients having left heart surgery with coronary angiography are at increased risk for radiation exposure and contrast-induced acute renal damage when ICLV is used. [13] Different non-invasive methods have been studied and compared to ICLV to see which is more accurate for assessing LVEF. [14,15]

The purpose of this study was to examine the reliability of LVEF measured using Simpson's biplane, M-mode echocardiography and GLS measured using speckle tracking echocardiography, even when performed by echocardiographers with varying degrees of experience.

MATERIAL AND METHODS

This retrospective study was conducted at Saidu Group Of Teaching Hospital, Saidu Sharif, Swat, KPK, From September, 2021 to February, 2022, and comprised of 90 patients. After getting informed written consent detailed demographics of enrolled cases were recorded. Patients were not included if they had no history of chest discomfort, had recently experienced an acute myocardial infarction, or had undergone percutaneous coronary intervention or coronary artery bypass grafting before the LVEF was assessed using all three diagnostic methods.

Without having suffered a myocardial infarction or undergoing surgical or interventional cardiac revascularization, each patient underwent Simpson's biplane, M-mode echocardiography and GLS all within a 3-month period.

Using a Vivid 7 Scanner, pictures and cineloops of echocardiographic exams were digitally recorded and then analysed. The two sets of echocardiographic examinations were done on the same patient during the same consultation, with each examiner being unaware of the other's recordings and findings. Two-dimensional grey scale echocardiography was used to record three cardiac cycles in a row from six different image planes, 3

apical and three parasternal. There were 55–95 frames per second.

echocardiographic recordings using same available commercially software (EchoPAC edition 112, GE Ultrasonography) for retrospective analysis on a dedicated workstation. Prior to examining either set of pictures, the examiners were kept in the dark of the patients' clinical histories and echocardiographic results. Pulsed Doppler flow across the left ventricular outflow tract indicated when the aortic valve had closed, marking the end of systole (LVOT). It was determined that the largest amount of negative strain (myocardial shrinking) or positive strain (cardiac lengthening) occurred during systole, and this was labelled as peak systolic strain. In an 18-segment LV model, GLS was manually quantified using speckle tracking echocardiography as the average segmental value from three apical imaging planes. The biplane Simpson method was used to determine LVEF. A novice echocardiographer assessed the quality of both expert and amateur pictures. When less than 60% of the endocardial boundary was visible in any conventional apical imaging plane, the quality of the image was considered bad. When between 60% and 74% of the endocardium was visible, the quality of the image was considered fair. The diameter of the left ventricle at end diastole was determined by taking a long-axis image of the chest from the parasternal position and measuring the distance from the sinus endothelium to the endocardium of the posterior wall when the heart was in the diastolic position, just above the mitral valve leaflets. Mitral inflow velocity during early diastole as assessed by pulsed doppler is denoted by an E wave. The value E' indicates the mitral annular velocity during the first portion of early diastole.

Each technique's LVEF was assessed by a single cardiology or nuclear medicine doctor. SPSS 23.0 was used to analyze all data.

RESULTS

We found that 82 (91.1%) were male patients and 8 (8.9%) were females. Mean age of the patients was 53.6±12.47 years and had mean BMI 25.8±11.44 kg/m². Frequency of obstructive coronary artery disease was 40 (44.4%) and non-obstructive CAD was 50 (55.6%).(table 1)

Table-1: Demographics of included cases

Variables	Frequency	Percentage
Mean age (years)	53.6±12.47	
Mean BMI (kg/m ²)	25.8±11.44	
Gender		
Male	82	91.1
Female	8	8.9
Disease Type		
Obstructive CAD	40	44.4
Non- Obstructive CAD	50	55.6

Hypertension was found in 50 (55.6%) cases, followed by dyslipidemia in 35 (38.9%) patients, diabetes mellitus in 23 (25.6%) cases. Cigarette smokers were 15 (16.7%).(table 2)

Table-2: Association of other diseases

Variables	Frequency	Percentage
HTN		
Yes	50	55.6
No	40	44.4
Dyslipidemia		
Yes	35	38.9
No	55	61.1
Diabetes Mellitus		
Yes	23	25.6
No	67	74.4
Cigarette Smokers		
Yes	15	16.7
No	75	83.3

We found that accuracy of GLS was higher for left ventricular ejection fraction than that of M-mode echocardiography and Simpson's biplane mode but the difference was insignificant.(table 3)

Table-3: Accuracy of LVEF

Variables	GLS	M-mode echocardiography	Simpson's biplane mode
LVEF			
Accuracy	0.86±1.89	0.74±1.25	0.68±0.48

DISCUSSION

Patients with cardiac artery disease and heart failure, in particular, can benefit from an accurate measurement of LVEF because of its prognostic significance and capacity to guide pharmacological and device therapy. The majority of patients experiencing chest discomfort are sent for a left heart catheter with angioplasty and Simpson's biplane mode because doctors believe it is cardiac in nature. With regards to coronary angiography, According to the research of Witteles et al.[16], ICLV was performed on 81.1% out 96,235 participants. M-mode echocardiography may expedite the development of contrast-induced acute kidney injury in individuals who are already at risk for this illness due to underlying conditions such kidney damage, diabetes, anaemia, hypovolemic, or heart problems. [17,18] Obtaining an LVEF value is a frequent part of the clinical evaluation process, and this is only one of several quasi-cardiac procedures regularly performed. It is possible that M-mode echocardiography provides redundancy on Left ventricular systolic function in people for whom LVEF measurements obtained via non-invasive cardiac techniques are trustworthy and equal to those obtained by M-mode echocardiography.

In current study 90 cases were presented. Among these 82 (91.1%) were male patients and 8 (8.9%) were females. Mean age of the patients was 53.6±12.47 years and had mean BMI 25.8±11.44 kg/m². Frequency of obstructive coronary artery disease was 40 (44.4%) and non-obstructive CAD was 50 (55.6%). Our findings were comparable to the prior researches.[19,20] In this study, we found that the mean LVEF obtained values using 2DE were quite similar to those using ICLV. Murarka et al. & Godkar et al. both found similar things.[21,22]

By using contrast echocardiography, Hoffman's [23] research team found that the mean LVEF values were greater and more equivalent to those acquired with ICLV. Nearly all investigations found a favourable and statistically significant correlation between ICLV and transthoracic echocardiography LVEF values. Most correlation coefficients fell between the 0.75 and 0.80 range, however they varied widely from 0.23 to 0.96. [24] While our study's correlation coefficient (0.69) was statistically significant, it was also one of the lowest published. The total correlation was reported to be 0.36 by Murarka et al.[25] (p 0.001). For patients and non dilated cardiomyopathy, the correlation coefficient was 0.23 (not significant), but the correlation value for individuals with ischemic cardiomyopathy was 0.75 (p 0.0001).

In clinical settings, Simpson's biplane mode is commonly utilized because of its accessibility and convenience. The left ventricular ejection fraction (LVEF) is inversely related to the left ventricular end-diastolic volume (LVEDV), so a lower LVEF correlates with a larger LVEDV. However, it may be challenging to properly estimate the LVEF with clinically-utilized biplane echocardiography, especially in the setting of pathological non - symmetric LV remodelling. The elimination of LV contour geometry assumptions in three-dimensional (3D) EC may lead to more reliable LVEF assessments.[26] In our study accuracy of global longitudinal strain was higher for left ventricular ejection fraction than that M-mode echocardiography and simpson's biplane mode but the difference was insignificant..

The predictive value of left ventricular ejection fraction (LVEF) was evaluated across echocardiographic techniques and diagnostic modalities. Results in this study revealed that LVEF was significantly predictive of all-cause death in the univariate Cox

regression models, despite large variability between LVEF readings from different techniques and modalities. However, direct comparison of the predictive impact for LVEF by multiple modalities was not feasible since LVEF was assessed by multiple methods for different patients. Small decreases in LV function, especially in ischemic heart disease, have been compared between GLS and LVEF in a number of prior research.

CONCLUSION

We concluded in this study use of these three techniques for LVEF was highly useful to diagnose accuracy but global longitudinal strain was showed better accuracy than that of simpson's biplane mode and M-mode echocardiography.

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