CARDIAC MAGNETIC RESONANCE IMAGING (CMRI) VS TRANSTHORACIC ECHOCARDIOGRAPHY FOR THE ASSESSMENT OF CARDIAC VOLUMES & REGIONAL FUNCTION: A COMPARATIVE STUDY

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ABSTRACT

Objective: to establish and compare metrics of cardiac volumes and function between CMRI and echo-cardiography in patients presenting for imaging evaluation of their cardiac function.
Study Design: Comparative cross-sectional study.
Place and Duration of Study: Magnetic Resonance Imaging Department of AFIC & NIHD Rawalpindi, from July 2018 till December 2018.
Material and Methods: All the patients who reported for their cardiac magnetic resonance imaging during our study duration due to atypical chest pain or suspected coronary artery disease were recruited in the study while patients with prosthetic valve, cardiac devices or claustrophobic patients were excluded. Data was collected after the informed consent of the patients. Cardiac Volumes and LVEF were measured using Simpson's biplane method in transthoracic echocardiography while in MRI analysis Ejection fraction was assessed by evaluation of the volumes of the endocardial contours in diastole and systole of the short-axis images. The included slice closest to mitral valve plane had myocardium in at least two-third of the circumference of the left ventricle. CMRI and Echo report parameters of the patients were entered and analyzed using SPSS version 23.
Results: Data of fifty patients were collected for the study out of which 42 (84.0%) were male patients while 8(16.0%) were female patients. Mean age of the patients was 53.4 ± 3 years. We found out that EF and other measured parameters were rather similar with cardiac MRI; as demonstrated with small mean differences. Mean left ventricular ejection fraction by cardiac MRI was 65% while mean left ventricular ejection fraction by echocardiography wad 55%. The mean LV End Diastolic Volume measured with MRI was statistically significant (<0.001) when compared with mean LV End Diastolic Volume measured by echocardiography.
Conclusion: Our study suggested that both the cardiac imaging modalities measured cardiac dimensions, volumes and functions closely similar as demonstrated by a very small bias. However, further study with large population is suggested.

Keywords: Cardiac magnetic resonance imaging, Cardiac volume, Tranthoracic echocardiography, Regional function.

INTRODUCTION

Cardiac magnetic Resonance Imaging(MRI) is increasingly being used in dynamic heart imaging in the expectation that measuring of the heart chamber dimensions, volumes, and functions will be better and reproducible compared with other non- invasive imaging methods such as echocardiography and nuclear cardiography[1-3]. This expectations stem from the high quality spatial resolution and additional precise definition of the CMRI border compared to the other technologies[4]. Although accurate and versatile, cardiac magnetic resonance imaging has previously been limited by technology and logistics. However, with recent technical developments, CMRI has reached a level of maturity and ease of use, which makes its use a practical reality[5-7].

In our part, little comparison information with echocardiography (echo), the long-term clinical standard for non- invasive cardiovascular imaging, in health and disease have limited the

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potential for CMRI to be integrated in an optimal clinical practice for cardiovascular metrics[8]. Coronary artery disease is routinely required by imaging, which is the most prevalent cardiovascular disease condition. For these 2 techniques there is little direct comparative information in our local setup[9-11]. Thus, in the valuation of left ventricular volumes and function, we have made comparisons between CMRI and echo in patients to determine correlations and systemic differences[10]. Although cardiac magnetic resonance imaging is often used to assess cardiac function, it may offer a more accurate functional evaluation, but it is not sufficient in comparison with the echoes in our local population[12-16]. The main study objective was to compare left ventricular volumes and global and regional functions assessed by cardiac magnetic resonance imaging (CMRI)and echocardiography in patients with recent atypical chest pain or suspected coronary artery disease.

MATERIAL AND METHODS

It was acomparative cross-sectional study carried out at Cardiac Magnetic resonance imaging department of AFIC & NIHD. Data was collected from June 2018 till December 2018. All the patients who reported for their cardiac magnetic resonance imaging during our study duration due to atypical chest pain or suspected coronary artery disease were recruited in the study while patients with prosthetic valve, cardiac devices or claustrophobic patients were excluded. Data was collected at cardiac magnetic resonance imaging department of AFIC & NIHD after the informed consent of the patients. Cardiac Volumes and EF were measured using Simpson's biplane method in transthoracic echocardiography while in MRI analysis Ejection fraction was assessed by evaluation of the volumes of the endocardial contours in diastole and systole of the short-axis images. The included slice closest to mitral valve plane had myocardium in at least two-third of the circumference of the left ventricle. CMRI and Echo report parameters of the patients were entered and analyzed at SPSS version 23.

RESULTS

Data of fifty patients was collected for the study out of which 42 (84.0%) were male patients while 8 (16.0%) were female patients. Mean age of the patients was 53.4 ± 3 years. We found out that EF and other measured parameters were rather similar with cardiac MRI; as demonstrated with small mean differences. Mean left ventricular ejection fraction by cardiac MRI was 65% while mean left ventricular ejection fraction by echocardiography wad 55%. The mean LV End Diastolic Volume measured with MRI was statistically significant (<0.001) when compared with mean LV End Diastolic Volume measured by echocardiography. Measures of cardiac dimensions, volumes and functions were compared between cardiac MRI and transthoracic echocardiography as shown in table.

Table: Showing cardiac dimensions, volumes & functions; comparison of Cardiac Magnetic Resonance Imaging findings vs Transthoracic Echocardiography findings.

Parameters	Echo Findings Mean ± S.D	MRI Findings Mean ± S.D	*p*-value
Left Ventricle Ejection Fraction (%)	55.0%	65.0%	0.55
LV Systolic Diameter(mm)	40.0 ± 0.5	36.2 ± 1.6	0.78
LV Diastolic Diameter (mm)	55.3 ± 2.3	50.9 ± 1.1	0.07
Septal Thickneess at R Wave (mm)	10.0 ± 1.2	8.9 ± 0.5	1.45
LV End Systolic Volume (ml)	64.4 ± 1.1	68.0 ± 2.9	1.33
LV End Diastolic Volume (ml)	165.5 ± 0.8	180.8 ± 0.1	<0.001
Stroke Volume (ml)	110.0 ± 2.7	130.3 ± 1.1	0.05
Right Ventricle (ml)	26.1 ± 3.1	30.0 ± 2.2	0.40
RV Function Tapse (mm)	17.8 ± 0.4	-	-
RV Dimension (mm)	26.5 ± 2.0	28.4 ± 1.3	0.97

DISCUSSION

Cardiac Magnetic resonance imaging (CMRI) with its high quality spatial resolution is generally regarded to be the gold standard in determining cardiac functions and volumes. Cardiac MRI is, nevertheless, contraindicated in some patients and this facility may not be present at all hospitals and is a fairly an expensive test[6]. The standard Transthoracic echocardiography is a widely available approach that can be performed in the bed without invasion. Standard echocardiography is the favored method for assessing left ventricular function from an economical point of view[7]. However, echocardiographic testing depends heavily on the cardiologists' expertise and for other reasons, has a high level of inter-observer variability in patients with obesity, obstructive pulmonary conditions, or a poor acoustic flask. The main focus of this study was to determine the difference between normal echocardiography of the transthoracic system and cardiac MRI[8].

Studies have been conducted previously to compare the cardiac functions and measured volumes with various imaging modalities, but with fewer patients and divergent results[9-12].

The diagnostic options for the evaluation of LVEF and the left ventricular function are numerous and often the availability of the images is the prerequisite for the choice in hospitals. In CHRISTMAS study, left ventricular function and volumes were compared in 52 heart failure patients by echocardiography, radionuclide ventriculography, and cardiac MRI. The results of CHRISTMAS study exhibited that LVEF calculated with these separate techniques was not inter changeable. They recommended that cardiac MRI should be the selective imaging modality for the measurement of volumes and LVEF[9]. Another resembling study comparing SPECT and echocardiography with MRI showed good overall relationships between left-ventricular volumes and LVEF in 21 patients with suspected coronary artery disease and hence proposed that such techniques can be used for LVEF measurement exchangeably but are recommended for the treatment of comparison volumes. In 110 patients with known or suspected heart disease, Malmet al[8] studied the precise and reproducible contrast echo and cardiac MRI. Their study demonstrated that standard echo measured LVEF and left ventricular volumes were further precise and reproducible when the intravenous material was added.

Our research study suggests the interchangeability between standard echo and MIR when evaluating LVEF. Cardiac MRI evaluates higher volumes than those with different methods when evaluating EDV. Different tracing methods and photography principles can cause the higher EDV measured by MRI.With the summation of MRI three-dimensional stacks, volumes are measured[17] while the volumes are measured with Simpson's biplane method in the echocardiography. The ventricular sizes with standard echo are calculated by the known tissue ultrasound speed and poor picture quality and different gain settings can miscalculate the size.

CONCLUSION

Our study suggested that both the imaging modalities measured cardiac dimensions, volumes and functions closely similar as demonstrated by a very small bias. However, further study with large population is suggested.

LIMITATIONS OF STUDY

Our study sample was a comparatively small because of Cardiac MRI being a new modality in AFIC & NIHD. The included patients were not pre-selected. A similar study with larger population is suggested for the future.

CONFLICT OF INTERST

This study has no conflict of interst to be declared by any author.

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