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Assessment of Ventricular Volumes and Ejection Fraction using Echocardiography in Cardiac Diseases

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Abstract: *Assessment of Ventricular Volumes and Ejection Fraction using Echocardiography in Cardiac Diseases were the demographic and measurement information presented as mean ± standard deviation, for the age and body mass index was 53.46 ± 16.24 year and 25.48 ± 6.09 kg/cm^2, and the measurement data the end diastolic volume and end systolic volume was 98.51 ± 40.11 and 56.20 ± 23.22 while the ejection fraction 0.607 ± 0.149 percent. And correlate between the age group with the risk factor for hypertension patient was the biggest number of up normal patients in this study with 25 patients then the diabetes mellitus with 13 patients while the normal patients were 32 one. For the age group the patients in range 40-60 years represent a half of total number of patients.*

Using t-test to correlate between the ventricle volume and patients age were found that there is no significant difference between the end diastolic volume and systolic volume with patients age while there is a significant difference between the ejection fraction with patients age. correlate between the end systolic volume with patients age using regression equation found that the rate of change for the end systolic volume was decrease by rate 0.0799 for each year for patient's fig 1. correlate between the end diastolic volume with patients age using regression equation found that the rate of change for the end diastolic volume was increase by rate 0.0211 for each year for patient's. correlate between the ejection fraction with patients age using regression equation found that the rate of change for the ejection fraction was increase by rate 0.0002 for each year for patient's.

Keywords: *Echocardiography, Ventricular Volumes, End Diastolic Volume, Ejection Fraction*

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I. Introduction

Echocardiography has been characterized as the diagnostic method of choice for the morphological and functional study of cardiac structures because it has a good anatomical correspondence and good reproducibility in addition to being a low-cost, easy-to-perform procedure. Nonetheless, two-dimensional echocardiography, which is currently the most frequently used technique for the structural analysis of the heart, has limitations regarding the observation of the cardiac anatomy. This is due to the geometric assumptions for the calculation of cardiac diameters and volumes taken from a limited number of observation planes [1-7]. Greater anatomical divergence occurs in the presence of cardiac chamber dilatation. Three-dimensional echocardiography (RT-3D-Echo) was thus developed, enabling the structural visualization from multiple simultaneous observation planes, which provides greater proximity to real anatomy.

The assessment of cardiac volumes and ejection fraction has valuable diagnostic, prognostic and therapeutic implications for patients suffering from left ventricular dysfunction [8–14]. With the increased recognition of the process of cardiac remodeling, and the advent of therapeutic interventions to mediate this, single or multiple estimates of volumes and ejection fraction are frequently used to assess an individual's need for and response to treatment. Furthermore, many therapeutic trials use these parameters as a threshold for randomization or as a primary outcome measure. Currently, the three commonly used non-invasive methods are echocardiography (echo), radionuclide ventriculography and cardiovascular magnetic resonance.

Echocardiography has been widely used as it is readily available and non-invasive. It does, however, dsuffer a number of limitations. M-mode echo is acoustic window and operator dependent and relies on geometric assumptions that do not hold true in patients with dilated, remodelled ventricles [15]. The assumption that a single segment is representative of the entire left ventricular is particularly problematic in patients with wall motion abnormalities [16]. 2D echo overcomes some of these problems but still extrapolates data from a limited sampling of the left ventricle and is highly dependent on good endocardial border definition.

Accurate estimation of left ventricular (LV) volumes and systolic function using cardiac ultrasound is essential for the routine management of patients in clinical practice. Although several previous studies have demonstrated that real-time three-dimensional echocardiography (RT3DE) is more accurate for evaluating LV volumes and LV ejection fraction (LVEF) compared with M-mode and two-dimensional (2D) echocardiography. [17–28] Two-dimensional echocardiography remains the most widely utilized technique in routine clinical practice. The biplane Simpson's formula is recommended by the guidelines [29] as the preferred method for the calculation of LV volumes and LVEF. However, this method requires manual tracing of the endocardial borders

in the apical four- and two-chamber views, which is tedious and time consuming, and also dependent on the reader's experience. Moreover, accurate endocardial border tracing is difficult in still end-diastolic and endsystolic frames, particularly in the apical lateral segments.

The recent development of 2D speckle tracking echocardiography (2DSTE) has allowed automatic measurements of regional displacement, tissue velocity, strain, and rotation to be performed without the need for manual tracings. [30–35] We hypothesized that application of this methodology to the LV endocardial border would allow automatic measurements of LV volume and LVEF. Accordingly, the aims of this study were (i) to test the feasibility of 2DSTE for LV

volume and LVEF measurements in a large group of patients, (ii) to validate these measurements against cardiac magnetic resonance (CMR) reference, and (iii) to determine the accuracy of speckle tracking using RT3DE-derived LV volumes and LVEF, as a reference technique. So the aim of this study to assessment of ventricular volumes and ejection fraction using echocardiography in cardiac diseases.

II. Material and Methods

The study was conducted at Al-Neelain Center of Khartoum in Khartoum state. A total of 145 Sudanese patients with different heart diseases referred to assess myocardial perfusion on 2D echocardiogram, were selected using probability sampling technique. The following formula was used to determine sampling size Cochran's formula belowfor calculating sample size when the population is infinite as:

$$\mathbf{n} = \frac{(\mathbf{z^2})\mathbf{p} \times \mathbf{q}}{\mathbf{d^2}}$$

Independent variables: Gender, age (year), weight (kg), height (cm), body mass index, and risk factors such as diabetes, hypertension, smoking. Type of stress, MPI finding and Echo cardio graphic finding.

Echocardiography- GE–VIVID-E90: M-mode and two-dimensional echocardiography transthorathic with color Doppler using GE vivid –E 90 with transducer of 5 MHz and with concomitant registration of an electrocardiographic lead.

Data collection: The data was collected by data collection sheets, recording the measurements of the MPI SPECT and 2D echocardiogram quantities EVD(ml), ESV(ml), SV (ml), and EF (%). Data recording included the gender, age, weight, height, BMI, and finding.

Preparation of the patient and measurements:

Echocardiogram: All the individuals underwent M-mode,2dimentionalechocardiogram and Doppler transthorathic studies, performed at rest, with the patient in the left lateral recumbent position. Three consecutive measurements were acquired for each echocardiographic parameter at the end of the expiration; and the mean of these three measurements was used as the final parameter. In all the patients, the long axis view of the heart was used. All the echocardiographic measurements were acquired according to the standards established by the American Society of Echocardiography**.** Aorta, left atrium, interventricular septum, and posterior wall thickness, left ventricle in systole and diastole, and the right ventricle were evaluated. The beginning of the QRS complex (first deflection) was used as the area to obtain the measurements at the end of diastole and maximal incursion of the septal movement for the measurements of the systolic dimension of the left ventricle. The cavity and wall thicknesses were measured at the level of the mitral chords**.**

Volumetric measurements: Global function of LV is assessed by measuring the difference between the end –diastolic and the end –systolic value of 2D parameter divided by its end –diastolic value. EF, is calculated from EDV and ESV estimates. using the following formula

EF=(EDV-ESV) \ EDV

Method of data analysis: The present study used statistical package for social science (SPSS) as a base method for analysis data, analyzed the echo characteristics (gender, age, BMI, risk factors and echo finding) to get the frequency, percentage, and mean for each one. And used the linear regression analysis to demonstrate the relationships. On the other hand, the same characteristics of MPI.

III. Results

Table 1. show statistical parameters for all patients examined by echo-cardiography

Variables	*Mean*	*Std Dev*	*Variance*	*Min*	*Max*
Pt age	53.46	16.24	263.85	23	116
BMI	25.48	6.09	37.12	12.62	39.83
EDV ml	98.51	40.11	1609.08	28	219
ESV ml	56.20	23.22	539.15	16	124
EF %	0.607	0.149	0.022	0.23	0.91

Table 2. show correlation between the age group with risk factor:

Risk Factor	*Age Group*							*Total*
	20-30	*31-40*	*41-50*	*51-60*	*61-70*	*71-80*	*< 81*	
Null	1	6	11	7	3	3	1	32
DM	0	3	3	5	0	0	2	13
HBN	2	1	4	8	5	4	1	25
Smoking	1	3	1	1	4	0	0	10
DM+ HBN	0	3	1	1	4	1	0	10
HBN+ smoking	0	2	2	1	1	0	0	6
DM+ smoking	0	0	2	0	0	0	0	2
DM + HBN + Smoking	0	0	0	2	0	0	0	2
Total	4	18	24	25	17	8	4	100

Table 3. show correlate the of Ventricular Volumes Using ANOVA test

		Sum of Squares	*Df*	*Mean Square*	*F*	*P.value*
EF %	*Between Groups*	.988	39	.025	1.267	.202
	Within Groups	1.199	60	.020		
	Total	2.187	99			
EDV ml	*Between Groups*	81923.123	39	2100.593	1.629	.044
	Within Groups	77375.867	60	1289.598		
	Total	159298.990	99			
ESV ml	*Between Groups*	21943.967	39	562.666	1.074	.395
	Within Groups	31432.033	60	523.867		
	Total	53376.000	99			

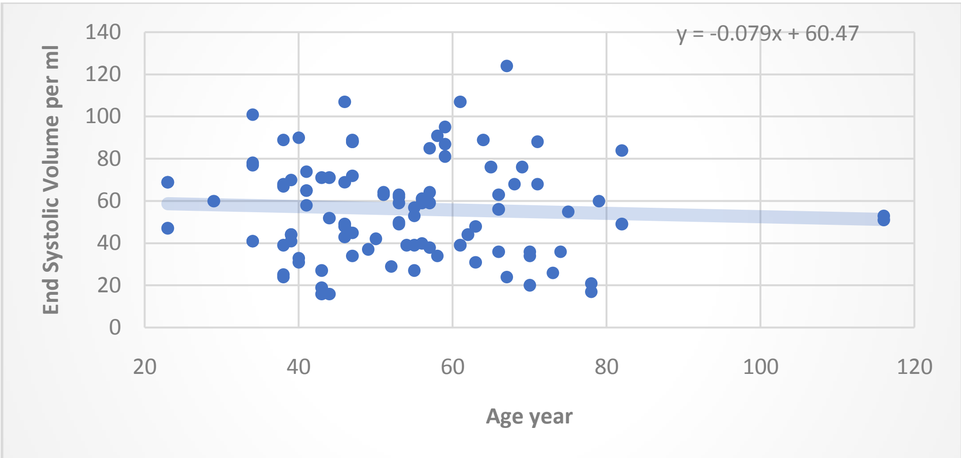

Figure 1. correlate between the end systolic volume with patients age

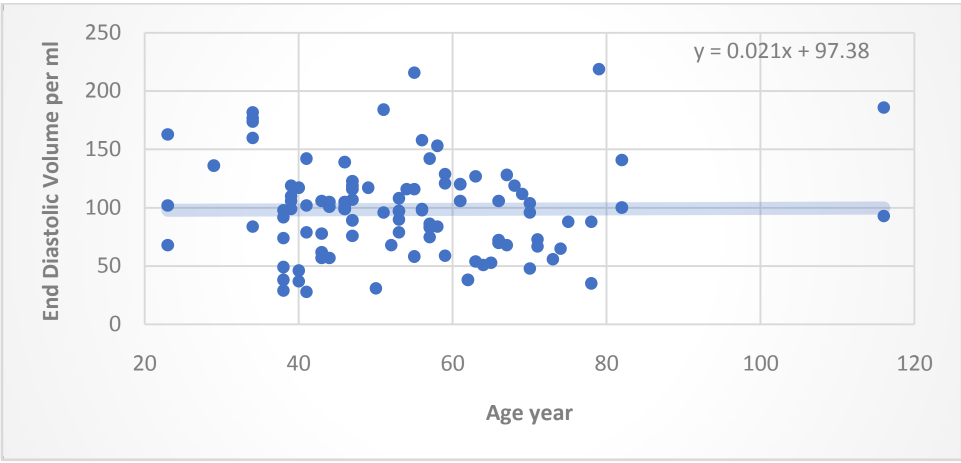

Figure 2. correlate between the end diastolic volume with patients age

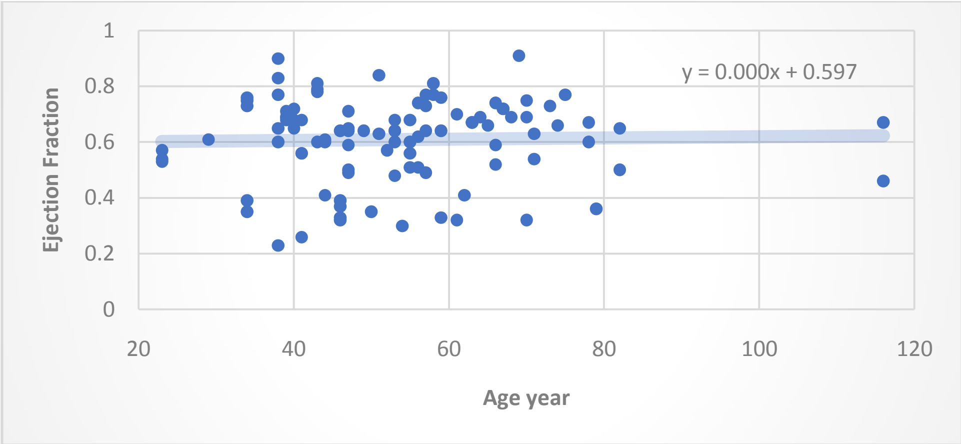

Figure 3. correlate between the ejection fraction with patients age

IV. Discussions

The demographic and measurement information were presents as mean ± standard deviation, for the age and body mass index was 53.46 ± 16.24 year and 25.48 ± 6.09 kg/cm^2, and the measurement data the end diastolic volume and end systolic volume was 98.51 ± 40.11 and 56.20 ± 23.22 while the ejection fraction 0.607 ± 0.149 percent as shown in table 1. Table 2. Correlate between the age group with the risk factor were the hypertension patient was the biggest number of up normal patients in this study with 25 patients then the diabetes mellitus with 13 patients while the normal patients was 32 one. For the age group the patients in range 40-60 years represent a half of total number of patients.

Using t-test in table 3. to correlate between the ventricle volume and patients age were found that there is no significant difference between the end diastolic volume and systolic volume with patients age while there is a significant difference between the ejection fraction with patients age.

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V. Conclusion

Assessment of Ventricular Volumes and Ejection Fraction using Echocardiography in Cardiac Diseases were the Correlate between the age group with the risk factor for hypertension patient was the biggest number of up normal patients in this study with 25 patients then the diabetes mellitus with 13 patients while the normal patients were 32 one. For the age group the patients in range 40-60 years represent a half of total number of patients.

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End systolic volume per ml = - 0.0799 (age) + 60.47
End diastolic volume per ml = 0.0211 (age) + 97.383
Ejection fraction percent = 0.0002 (age) + 0.597

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