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CHARACTERIZATION OF LEFT VENTRICLE IN HYPERTENSIVE PATIENTS: ECHOCARDIOGRAPHY STUDY

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ABSTRACT

The Objective of this study is to characterize the echocardiographic features of the left ventricular among hypertensive Sudanese patients. 50 consecutive patients attending at Khartoum state Hospitals- Sudan and referred for echocardiogram. 20 (40%) were females 30(60%) were males. Their mean age was 52±13.5 years, which varied from 23-86 years .All Subjects underwent M-mode and 2D echocardiogram study. The left ventricle was assessed .The inter-ventricular septum thickness, left ventricular internal dimensions at end-diastole and end-systole, left posterior wall thickness and ejection fraction were evaluated .Measurements were described by mean and standard deviation .Data entry and analysis were done using the SPSS windows version 16. Results showed that the left ventricular diastolic dimensions were lower than those indicated by the international literature and accepted as normal limits. There is significant relationship between ejection fraction and left ventricle internal dimensions at p value<0.05. The results of this study strongly indicate the need for a larger scale study to further establish ethnic-specific and gender-specific echocardiographic characteristics for the hypertensive patients. New equations were established to predict the ejection fraction for hypertensive patients whom left ventricle internal dimensions are known.

INTRODUCTION

Hypertension is a heterogeneous disorder with a number of well defined as well as putative etiologies. The World Health Organization estimates that hypertension may cause 7.1 million premature deaths and 4.5% of the disease burden worldwide. Staessen (2003), Maatouk (2012). Hypertension is a major risk factor for stroke and cardiovascular diseases, and is thus associated with significant morbidity and mortality. Hypertensive heart disease is a complex entity that involves changes to the cardiovascular system resulting from arterial hypertension; it is therefore the major cause of hypertension-related complications. Cuspidi (2007), Cortigiani (2011).The development of Doppler echocardiography has offered new approaches regarding both insights into pathophysiology and clinical implications that affect hypertensive patients Cameli (2012), Kim (2012). For these reasons, it is obvious that echocardiographic assessment is very important in the clinical management of a hypertensive patient. We aimed at studying the contributions of echocardiography in the evaluation of a hypertensive patient as well as to characterize the basic echocardiographic parameters of the left ventricle over the hypertensive patients in order to highlight the suitability of echocardiographic examination for routine practice in hypertensive patients.

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MATERIALS AND METHODS

Study sample

50 hypertension patients were selected, 20(40%) were women and 30(60%) were men. Their mean age was 52±13.5 years, which varied from 23-86 years

Study Parameters

Two-dimensionally and M-mode, echocardiograms were recorded using ultrasound machine HDI 4000 scanner (Philips Medical Systems) equipped with a commercially available 8-13MHz linear transducer with color and power Doppler capability and GE medical system LOQIC5Expert, made by Yocogama medical systems. LTD –JAPAN – model 2302650, serial number 1028924, manufactured April 2005. M-mode recordings of the left ventricle were obtained with the patient in the supine and left lateral decubitus position. Measurements on the echocardiograms were obtained according to the recommendations of the American Society of Echocardiography, Schiller (1989). The inter-ventricular septum thickness, left ventricular internal dimensions at end-diastole and end-systole, left posterior wall thickness and ejection fraction had been evaluated.

Statistical methods

The parameters in our study were described as mean and standard deviation. Correlations were significant at P <0.05 Reference ranges for each measurement were calculated using 95% confidence.

RESULTS

The following tables and figures presented the data obtained from 50 patients who underwent echocardiography examination. All the patients were hypertensive. Patients who have got follow up treatment were 17(34%), and who haven't were 33(66%).

Table 1. Shows Dimensional Echocardiographic Approach to Hypertensive Patients

	Variables Measurements				
	EF*	LVED*	LVES*	IVS*	PW*
Mean	60.82	4.72	3.20	1.29	1.09
Std. Error of Mean	1.49	0.09	0.11	0.03	0.04
Median	63.00	4.55	2.90	1.30	1.05
Std. Deviation	1.06	0.64	0.80	0.24	0.29
Range	46.00	3.30	3.10	1.00	1.20
Minimum	32.00	3.50	2.20	0.70	0.50
Maximum	78.00	6.80	5.30	1.70	1.70

*Ejection Fraction (EF), left ventricle at end diastole (LVED), left ventricle at end Systole (LVES), Inter ventricular septum width (IVS), posterior wall thickness (PW)

DISCUSSION

Hypertension is the commonest of the cardiovascular risk factors, whose prevalence in Sudan is high among rural and urban residents respectively. Uncontrolled hypertension leads to a number of structural changes in the heart which eventually cumulates into interstitial fibrosis, myocardial wall thickness and functional alteration such as diastolic dysfunction. Noninvasive assessment of diastolic filling by echocardiography provides important information about left ventricular (LV) status in selected subsets of patients. This study was designed to study the contributions of echocardiography in the evaluation of a hypertensive patient as well as to characterize the basic echocardiographic parameters of the left ventricle over the hypertensive patients

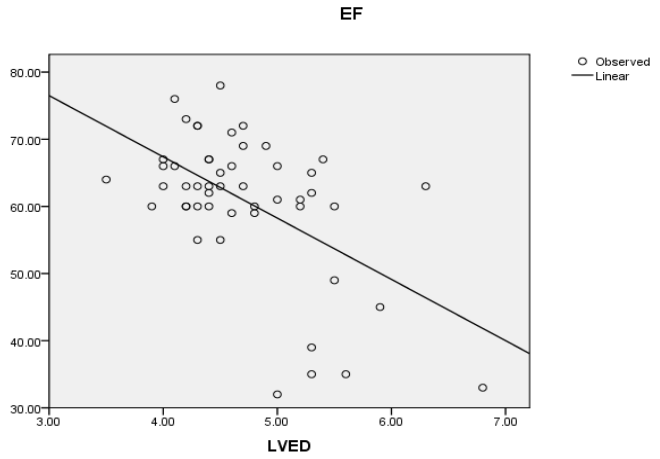

Figure 1. A scatter plot diagram shows linear relationship between LVED and EF in hypertensive patients .As the LVED increases the EF decreases (P value is 0.000).
y= -9.123x+103.8 R^2=0.301

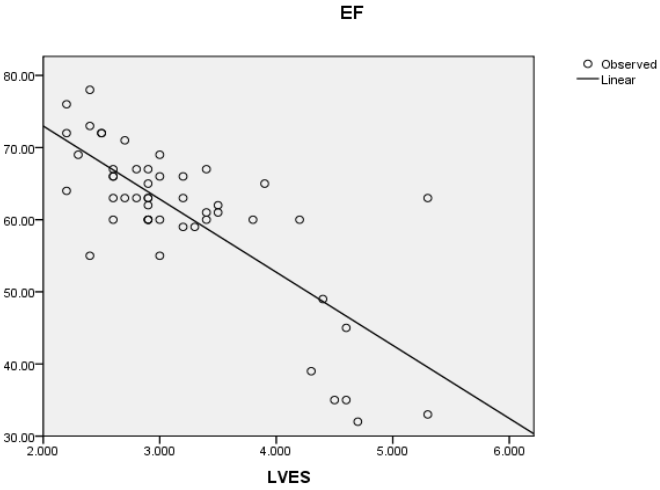

Figure 2. A scatter plot diagram shows Linear relationship between LVES and EF in hypertensive patients As the LVES increases the EF decreases (P value =0.000)
y= -10.13x+93.24 R^2=0.590

in order to highlight the suitability of echocardiographic examination for routine practice in hypertensive patients. The heart is the pump of the circulatory system, so it is reasonable that the increased arterial pressure affects it from the early stages of hypertension and it actually suffers the commonest hypertension related organ damage. Any provoked alterations involving either the anatomy or the functionality of the heart can easily be detected and imaged by echocardiography. This is why echocardiography is one of the very first examinations that a hypertensive patient is recommended to undergo. The echocardiographic assessment of the heart of a hypertensive patient is performed on a functional approach, which includes assessment of indices of function. All the echocardiographic reference parameters that we use to compare during echocardiographic studies are derived from those defined in the western world. We till date, don't have a proper reference range based on studies conducted in Sudan or Africa itself for normal or hypertensive Sudanese individuals. It is a well known fact that that the population in Sudan has a very much different genetic and physical make up as compared to the

Table 2. Model Summary and Parameter Estimation (Independent variable IVS, PW and Dependent parameter EF)

Ejection Fraction (EF)				
Independent Variable/Linear Equation	Model Summary and Parameter Estimates			
	R Square	Sig.	Constant	b1
Inter Ventricular Septum Width (IVS)	0.001	.807	58.821	1.540
Linear Equation*		y=1.540x+58.82	R^2=0.001	
Posterior Wall Thickness (PW)	0.016	0.379	55.768	4.634
Linear Equation*		y=4.634x+55.76	R^2=0.016	

**No significant relationship were found between EF (%) and IVS and PW values.*

population in the west. The difference in the body size in itself brings into question the reference range that we quote as normal values derived from studies conducted in the west. We have thus made an effort to study a hypertensive population in Sudan, for recording changes of echocardiographic parameters compared to what was found in the literature, Catherine (1999). Despite many technical limitations ;echocardiography is more sensitive than electrocardiography in identifying left ventricular hypertrophy and predicting cardiovascular risk, Levy (1990) thus assisting in the selection of appropriate therapy Cuspidi (2002). The relationship between increased left ventricular mass and cardiovascular risk was given in its latest guidelines, Ilercil (2001).

For the management of arterial hypertension; the European Society of Cardiology has included measurement of the dimensions of the left ventricle and further calculation of mass. Finally, it is well known that the variability of echo measurements is non-trivial. Schiller (1989), Bachenberg (1991), Helak (1981) Wallerson (1981). Echocardiography provides a reliable means of assessing left ventricular systolic function. Left ventricular ejection fractions, as well as endocardial and mid-wall fractional shortening, are the most practical systolic indices that have also been proposed as possible additional predictors of cardiovascular events. Table (1) shows proper evaluation included measurement of the left ventricle. The inter-ventricular septum thickness, left ventricular internal dimensions at end-diastole and end-systole, left posterior wall thickness and ejection fraction had been evaluated. The measurements showed that the ejection fraction (60.82%) reflects normal reference limits and values and partition values of left ventricular function Lang (2006). The other measurements: Posterior wall thickness (cm) was found to be larger 0.5-1.7cm than the normal limits 0.6-1.0cm Lang (2006). IVS showed also a larger range 0.24-1.3cm with mean value 1.29±0.03cm than standard normal measurements 0.6-1.1cm, Feigenbaum (1981).

LVED showed less value 4.72±0.09cm with range 0.64-4.55cm than the standards 4.8±0.4cm where LVES measures 3.20±0.11cm with range 0.80-2.90cm which considered greater than the standard normal values, John (1980). These measurements are useful in the determination of LV hypertrophy. Our measurements showed the difference in ranges between the hypertensive patients and the normal reference standard as one of the reference limits and partition values of left ventricular mass and geometry Lang (2006) and this lead to the diagnoses of the left ventricle changes in the presence of hypertension. Changes in LV measurements and geometry due to hypertension reflect the dominant underlying hemodynamic alterations associated with blood pressure elevation, Ganau (1992), Matsukubo (1977).

The changes in small vessel structure are in response to pressure elevation, with increase of wall thickness and relative reduction of lumen. The changes detected by echocardiography showed increase in left ventricular mass which is a consistent feature of hypertension. The justification of those changes is described as structural changes, Berkinst (2001). Hypertension cause changes as cardiac cell hypertrophy but the cardiac myocyte cell number does not increase. In addition hypertension causes considerable interstitial change and fibroblast proliferation Berkinst (2001). The Framingham study showed the hazard for developing heart failure in hypertensive, thus documenting the importance of assessing left ventricular function in hypertensive heart disease. The conventional way of assessing left ventricular function with echocardiography is via the left ventricular ejection fraction, determined by applying Simpson's method of discs Shahgaldi (2009). Figures (1,2) showed the linear relationship between LVES, and LVED with EF, it showed that as the LV measurements increases the EF decreases by certain values and we can predict the degree of reduction in the ventricle function by using these two equations:

$$EF = -9.123\ LVED + 103.8 \qquad R^2 = 0.301 \qquad \ldots\ldots\ldots Eq1$$

$$EF = -10.13\ LVES + 93.24 \qquad R^2 = 0.590 \qquad \ldots\ldots\ldots Eq2$$

Similarly, Blendea *et al*. (2007) reported that the alterations in left ventricular long-axis systolic and diastolic function could predict the onset of hypertension. Despite the widespread clinical use of the left ventricular ejection fraction, it should be kept in mind that it is a load-dependent systolic index. From this point of view, it is clearly very important to identify the slightest initial impairment of left ventricular function, using additional indices apart from ejection fraction that are not load-dependent. This was the reason for the introduction into clinical practice of mid-wall fractional shortening. Table (2) showed that EF has no significant relationship either between the posterior walls or interventriculer wall septum thickness. Notably, hypertensive patients with left ventricular hypertrophy and a normal ejection fraction have been found to have abnormal mid-wall fractional shortening, Devereux (2000).

Conclusion

This study attempts to describe the echocardiographic features of Left ventricular among hypertensive Sudanese patients. Echocardiography itself could be used for heart disease screening in clinical patients. We have established reliable regression equations for the calculation of basic echocardiographic parameters despite its technical limitations. Echocardiography is a significant tool for the evaluation of

hypertensive patients. Assessing a hypertensive patient echocardiographically does not simply represent adherence to a routine examination procedure that has limited clinical value. Conventional echocardiography, alongside newer, richer techniques, provides invaluable information about the extent of heart damage related to hypertension and cardiovascular risk, thus helping us to achieve better management and apply better treatment.

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