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Study of 200 hypertensive Sudanese patient's echocardiography

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Abstract

This is a prospective cross-sectional hospital-based staudy was to assess the left ventricular change in hypertensive patients using Echocardiography, carried out in period from September 2020 to january 2022, the sample included 200 hypertensive patients who checked at the different Center at Khartoum city. A questionnaire is used to collect the data and to 200 patients. Data was analyzed by using SPSS, results was presented as tables and figures. The chi-square test and independent t-test were used with p≤ 0.05 considering significance. more than half of the patients (59%) were female and (41%) were male, the age ranged between 35–95 years with mean age of 61.3±11.6 in addition more one third of them 36%) aged between 60 – 69 years. The current study showed that most of the patients 87% had normal ejection fraction, severe decrease 9%, mild decrease3% and the least moderate decrease 1%. In the present study all of the included patients had LVH, most of them 98% had severe LVH and only 2% were moderate, in addition more than half 54% of them had eccentric hypertrophy whereas 46% had concentric hypertrophy. The mean of LVIDD, LVISD, left ventricular mass, LVMI more in male than female and it is statically significant whereas mean of EF more in the female. There were no relationship between demographic data (sex, age and family history, DM and duration of HTN) and Left ventricle mass. Echocardiography should be routinely used in the diagnosis, management and follow up of hypertensive patients

Keywords: Hypertensive patients; Sudanese; Echocardiography; Ejection fraction

1. Introduction

Hypertension is a progressive cardiovascular syndrome arising from complex and interrelated etiologies. Early markers of the syndrome are often present before BP elevation is sustained; therefore, hypertension cannot be classified solely by discrete BP thresholds. Progression is strongly associated with functional and structural cardiac and vascular abnormalities that damage the heart, kidneys, brain, vasculature, and other organs and lead to premature morbidity and death.[1] Hypertension remains a major public health problem associated with considerable morbidity and mortality. Hypertensive heart disease is a constellation of abnormalities that includes left ventricular hypertrophy (LVH), systolic and diastolic dysfunction, and their clinical manifestations including arrhythmias and symptomatic heart failure. The classic paradigm of hypertensive heart disease is that the left ventricular (LV) wall thickens in response to elevated blood pressure as a compensatory mechanism to minimize wall stress. Subsequently, after a series of poorly characterized events ("transition to failure"), the left ventricle dilates, and the LV ejection fraction (EF) declines (defined herein as "dilated cardiac failure [2] The heart weighs between 7 and 15 ounces (200 to 425 grams) and is a little larger than the size of your fist. The heart is located in the thoracic cavity between the Lungs. This area is called the mediastinum. The base of the cone-shaped heart is uppermost, behind the sternum, and the great vessels enter or leave

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here. The apex (tip) of the heart points downward and is just above the diaphragm to the left of the midline. The heart is enclosed in the pericardial membranes, of which there are three layers. [3]

The vast majority (90 to 95%) of hypertensive patients will classify as having primary or essential hypertension. The etiology behind primary hypertension is poorly understood. structural, neuroendocrine, cellular, and molecular factors. These factors play integral roles in the development of hypertension and its complication s; however,elevated BP itself can modulate these factors.).However, it likely is a complex interplay between genetic and environmental factors. Several risk factors such as increasing age, family history, obesity, high sodium diets (greater than 3g/day), physical inactivity, excessive alcohol consumption have strong and independent correlations with the development of hypertension. [3.4].Obesity has been linked to hypertension and LVH in various epidemiologic studies, with as many as 50% of obese patients having some degree of hypertension and as many as 60-70% of patient with hypertension being obese.Elevated BP leads to adverse changes in cardiac structure and function in 2 ways: directly, by increase after load, and indirectly, by associated neurohormonal and vascular changes (4).Elevated 24-hour ambulatory BP and nocturnal BP have been demonstrated to be more closely related to various cardiac pathologies, especially in black persons. Hypertension has been found to precede the development of heart failure by an average of 14.1 years.[3]

The etiology of hypertensive heart disease is a complex in interplay of various hemodynamic, structural, neuroendocrine, cellular, and molecular factors. These factors play integral roles in the development of hypertension and its complication s; however,elevated BP itself can modulate these factors.).Obesity has been linked to hypertension and LVH in various epidemiologic studies, with as many as 50% of obese patients having some degree of hypertension and as many as 60-70% of patient with hypertension being obese.Elevated BP leads to adverse changes in cardiac structure and function in 2 ways: directly, by increase after load, and indirectly, by associated neurohormonal and vascular changes [3].Elevated 24-hour ambulatory BP and nocturnal BP have been demonstrated to be more closely related to various cardiac pathologies, especially in black persons. The pathophysiologies of the various cardiac effects of hypertension differ and are described in this section. [3].

Hypertension is a frequent, chronic, age-related disorder, which often entails debilitating cardiovascular and renal complications. Blood pressure is usually noted in combination with other cardiovascular risk factors. Diagnosis of hypertension increasingly relies on automated techniques of blood pressure measurement. The pathophysiology of essential hypertension depends on the primary or secondary inability of the kidney to excrete sodium at a normal blood pressure. The 15 central nervous system, endocrine factors, the large arteries, and the microcirculation also have roles in the disorder[5]

Prior to the 1970s, diagnosis of congenital and acquired heart disease was achieved by the combination of physical examination, electrocardiography (ECG), and invasive cardiac catheterization. Unfortunately, clinical examination and ECG are often not very specific diagnostic tools. Cardiac catheterization, although greatly augmenting noninvasive clinical information, can be a stressful and risky procedure, particularly in the young or very ill patient. Initial attempts at imaging the heart using reflected sound waves were made in the 1950s, with improvement in the experimental technology and its initial clinical applications in the 1960s.[6]. Echocardiography (ECHO) – is the use of ultrasound to examine the heart. Cardiac echocardiography is becoming an essential diagnostic tool for a variety of cardiac pathology. Acquiring the necessary knowledge will help non cardiac and the cardiac specialist to understand the echocardiography images and reports and in return will improve the care of the patients.[7]

Although the echocardiographic examination is usually recommended as a second-line study in the evaluation of hypertensive patients, it is one of most commonly used imaging modality and has given insights into pathophysiology and clinical implications in patients with hypertension. It can detect anatomical and functional changes easily in a real-time, quick, and reproducible manner. Echocardiography is more sensitive for the detection of asymptomatic organ damage that can be used as a determinant of cardiovascular risk. So, it is important in the clinical management in selected hypertensive patients. Because echocardiography can detect cardiac morphologic and hemodynamic change caused by systemic arterial hypertension, echocardiography is a powerful tool for the evaluation of target organ damage, which is essential for the evaluation of cardiovascular risk. Although echocardiography is not an essential first-line imaging study, echocardiography is an excellent tool for the assessment of future cardiovascular risks. Because of its non-invasiveness and easy accessibility, it is also a widely and most commonly used imaging modality in the cardiology practice. However, conventional echocardiography has many pitfalls in the interpretation of several echocardiographic parameters. To overcome this limitation, physicians should be aware of the pitfalls of conventional echocardiographic parameters. Second, doctors should analyze and interpret echocardiographic findings in conjunction with other findings from physical examination and routine examinations. Third, it is worthwhile for medical practitioners to learn other newer echocardiographc modalities. Aside from conventional echocardiographic modalities, newer echocardiographic methods including tissue Doppler imaging, strain echocardiography, or three-

dimensional echocardiography also have been introduced to evaluate hypertensive patients providing valuable information about the extent of cardiac damages thus helping us to give better treatment. [8]

Study Completed by C. Cuspidi et al. To provide updated information on the amount of subclinical changes in LV structure in modern human hypertension, They examined recent research on the prevalence of LVH, as measured by echocardiography. They looked at complete papers from the past ten years (1 January 2000–1 December 2010) that reported studies on adults or older people. Thirty studies in total were taken into consideration, with 37 700 treated and untreated individuals (80.3% Caucasian, 52.4% men, 9.6% diabetics, and 2.6% with cardiovascular disease). There were 23 criteria used to characterize LVH, and the prevalence ranged from 36% (for conservative criteria) to) to 41% (for less restrictive criteria). The prevalence of LVH was the same for males and women (range 36.0–43.5% versus 37.9–46.2%). Concentric phenotype was seen in a constant percentage (20%) of both genders, while eccentric LVH was more common than concentric hypertrophy (range 20.3–23.0 versus 14.8–15.8, respectively, Po0.05). LVH is still a very common biomarker of heart injury in the hypertensive population.[9]

Study Done by Mohamed Yousef, et al. study to 50 consecutive patients attending at Khartoum state the characterization of left ventricle in hypertensive patients 20 (40%) were females 30(60%) were males. Their mean age was 52±13.5 years, which varied from 23-86 years. their 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 [10]

2. Material and methods

An echocardiographic machine (SIEMENS-Medical Solutions USA, lns.685 East Middlefield Road Mountain view, CA 9403, USA) with Doppler & M-mode capabilities is used. The probe is of a SECTORE type. The transducer is a phased – array 3.5 MHZ, and ultrasound gel is applied to the transducer to prevent any attenuation or artifact and thermal paper printer was used. A questionnaire is used to collect the data and to number the patients.

2.1. Study design

This was prospective cross sectional hospital-based study

2.1.1. Study duration and site

The study was carried out in period from September 2022 to November 2022 in heart Center at Khartoum state

2.1.2. Study population

Hypertensive patients who arrived at the echocardiography department in the heart center hospital in Khartoum city

Inclusion criteria

All hypertensive patients, free from exclusion criteria, during the study period, were included.

2.2. Exclusion criteria

Cor-pulmonale, myocardial infarction, valvular heart disease, bundle branch blocks, pre-excitation syndrome and cardiomyopathy are excluded.

2.3. Sample size

200 Hypertensive cardiac disease patients, selection was done through simple random sampling.

2.3.1. Technique

From the ultrasound technique, in which there are six windows the so called :(Rt&Lt parasternal view, apical view, sub costal view, suprasternal view, and transoesophagal view); that use one or both of the two patient position, either left lateral decubitus or supine, from it the following results is collected: Left ventricular posterior wall (LVPW) size or thickness (using M-mode),Intraventricular septum (IVS) size (using M-mode),Left ventricular end systolic diameter (LVESD) (using M-mode),Left ventricular end diastolic diameter (LVEDD) (using M-mode),Valvular size, including aortic root, mitral valve, tricuspid valve and the pulmonary valve (using M-mode),Blood flow (using Doppler),Ejection fraction (EF).

2.4. Data collection

The data was collect by using data collection sheet which designed to satisfy all variable.

2.4.1. Study variable

- Dependent variables: LVH, left ventricular ejection fraction
- Independent variables: Age/year, gender, BMI, duration of the disease, regular medications, regular follow up visits, and the readings of hypertension

2.5. Data analysis

Data was analyzed by using SPSS Version 28 and Excel worksheet, results was presented as tables and figures. Descriptive statistics were present as (mean standard deviation) and frequencies as percentages. Multiple contingency tables were conduct and appropriate statistical tests were perform, chi-square test will be used for categorical variables and independent t-test was used to compare between means. In all statistical analysis, level of significance (p-value) will set at ≤ 0.05.

3. Results

Table 1 Sociodemographic characteristics of participants (n=200)

Variables	NO
Age, mean±SD	(61.3 ± 11.6)
⍰ 50	28 (14%)
50 - 59	48 (16%)
60 - 69	72 (36%)
70 -79	40 (20%)
≥ 80	12 (6%)
Weight, mean±SD	(73.5 ±11.7)
Height, mean±SD	(164.8 ± 6.8)
BMI, mean±SD	(26.6 ± 3.7)
Duration of hypertension, mean±SD	(11.2 ± 7.7)
≤ 5	72 (36%)
6 - 10	48 (24%)
11 – 15	24 (12%)
≥ 16	56 (28%)

Table 2 LV measurements by echocardiography (n=200) Descriptive statistis

Variables	Minimum	Maximum	Mean	Std. Deviation
LVIDD	33	78	48.1	7.3
LVISD	21	68	32.4	8.5
EF	20	70	58.1	10.7
PW thickness	6	15	9.6	2.2
IVS Thickness	6	18	10.9	2.7
left ventricular mass	199.2	2704.0	560.7	347.67
LVMI	115.4	1396.4	304.1	181.55

Table 3 Ejection fraction of patients (n=200)

Ejection fraction (EF)	Frequency	Percent
Normal	174	87.0
Mild	6	3.0
Moderate	2	1.0
Severe	18	9.0
Total	200	100.0

Table 4 Interventricular septal (IVS) thickness of patients (n=200)

Interventricular septal (IVS) thickness	Frequency	Percent
Normal	126	63.0
Mild	70	35.0
Moderate	4	2.0
Total	200	100.0

Table 5 Posterior wall (PW) thickness of LV of the patients (n=200)

Posterior wall (PW) thickness	Frequency	Percent
Normal	178	89.0
Mild	22	11.0
Total	200	100.0

Table 6 Left ventricle mass of the patients (n=200)

Left ventricle mass	Frequency	Percent
Severely enlarged	196	98.0
Moderately enlarged	4	2.0
Mild enlarged	0	0
Normal	0	0
Total	200	100.0

Table 7 Relative wall thickness of the patients (n=200)

Relative wall thickness indicate	Frequency	Percent
Concentric hypertrophy	92	46.0
Eccentric hypertrophy	108	54.0
Total	200	100.0

Table 8 Relationship between demographic data and Left ventricle mass by chi square test

Variables	N	Severely enlarged	Moderately enlarged	P. Valu
Gender(M/F)	Male (80)	97.6%	(2) 2.4%	0.794
	Female (116)	98.3%	(2) 1.7%	
Family history	Yes (152)	98.7%	1 1.3%	0.359
	No (44)	95.7%	1. 4.3%	
Diabetes mellitus	Yes (92)	97.9%	1. 2.1%	0.932
	No(104)	98.1%	1. 1.9%	
Duration of HTN	≤ 5 (72)	100%	0 (0.0%)	0.592
	6–10 (46)	95.8%	1(4.2%)	
	11–15 (24)	100.0%	0 (0.0%)	
	≥16 (54)	96.4%	1(3.6%)	

Table 9 Relationship between duration of HTN and LV measurements b ANOVA test

Variables	N	Mean	Std. Deviation	P. Value
LVIDD				0.122
≤ 5	72	46.33	6.80	
6–10	48	47.33	8.19	
11–15	24	49.42	8.99	
≥16	56	50.46	5.63	
Total	200			
LVISD				0.099
≤ 5	72	30.03	7.96	
6–10	48	32.13	8.70	
11–15	24	36.33	12.40	
≥16	56	33.86	6.24	
Total	200	32.36	8.50	
EF				.357
≤ 5	72	60.36	7.70	
6–10	48	56.88	12.32	
11–15	24	54.58	15.59	
≥16	56	57.86	9.85	
Total	200	58.13	10.65	
left ventricular mass				.613
≤ 5	72	512.6	422.8	
6–10	48	540.7	313.1	
11–15	24	636.5	403.3	

≥16	56	607.2	231.2	
Total	200	560.7	347.7	
LVMI				.694
≤ 5	72	0.415	0.106.	
6–10	48	0.410	0.127	
11–15	24	0.425	0.118	
≥16	56	0.386	0.110	
Total	200	0.407	0.113	

Table 10 Relationship between family history of LVH and LV measurements by independent T-test

Variables	Family history	N	Mean	Std. Deviation	P. Value
LVIDD	Yes	144	47.88	6.884	0.587
	No	46	48.83	8.505	
LVISD	Yes	144	32.70	8.413	0.830
	No	46	32.26	8.957	
EF	Yes	144	57.90	10.98	0.690
	No	46	58.91	9.65	
left ventricular mass	Yes	144	539.6	278.59	0.268
	No	46	631.4	518.67	
MI	Yes	144	292.6	146.08	0.251
	No	46	342.3	269.49	
Relative wall thickness	Yes	144	.4109	.114	0.493
	No	46	3924	.109	

Table 11 Relationship between DM and LV measurements by independent T-test

Variables	DM	N	Mean	Std. Deviation	P. Value
LVIDD	Yes (94)	94	48.26	6.0	0.820
	No (106)	106	47.49	8.3	
LVISD	Yes (94)	94	32.55	8.1	0.832
	No (106)	106	32.19	8.9	
EF	Yes (94)	94	58.0	10.9	0.909
	No (106)	106	58.25	10.6	
left ventricular mass	Yes (94)	94	564.2	294	0.924
	No (106)	106	557.6	392	
LVMI Relative wall thickness	Yes (94)	94	306.9	155	0.883
	No (106)	106	301.5	204	
Relative wall thickness	Yes (94)	94	.4071	.116	0.967
	No (106)	106	.4062	.112	

4. Discussion

The study included 200 patients with cardiac disease investigated by echocardiography, in echo department of Sudan heart center, Khartoum city, from the September to the November 59 (59%) cases were female and 82 (41%) were male, the age ranged between 35–95 years with mean age of 61.3±11.6 in addition more one third of them 72 (36%) aged between 60 – 69 years.

Table 1, figure 1, 2 and 3 showed that The study included 200 patients, 118 (59%) cases were female and 82 (41%) were male, the age ranged between 35–95 years with mean age of 61.3±11.6 in addition more one third of them 72 (36%) aged between 60 – 69 years. Mean weight of the patients was (73.5 ±11.7), mean height was (164.8 ± 6.8) and mean BMI (26.6 ± 3.7). Regarding the duration of the hypertension the mean was (11.2 ± 7.7), in addition there more than one third of the patients72 (36%) suffer from HTN less than 5 years. About half of the patient (47%) had diabetes mellitus and more than three-quarter of them (77%) had family history of left ventricular hypertrophy.

The table (3) showed that most of the patients 87% had normal ejection fraction, severe decrease 9%, mild decrease3% and the least moderate decrease 1%.

The table (4) showed that more than half of the patients 63% had normal Interventricular septal end diastole (IVSd), more than third 35% had mild and the least moderate 2%.

The table (5) showed that major of the patients 89% had normal posterior wall (PW) thickness and only 11% had mild posterior wall (PW) thickness.

The table (6) showed that LV mass index calculated by using the following equation: LV Mass = (0.8 * [1.04 * ((LVEDD + IVSd + PWd)3 - LVEDD3)]) + 0.6, Where: LV mass stands for the left ventricular mass, given in grams (g) LVEDD means the left ventricle end diastolic dimension, given in centimeters (cm) IVSd is the interventricular septal end diastole, given in centimeters (cm) PWd stands for the posterior wall thickness at end-diastole, given in centimeters (cm); and 1.04 is the heart muscle density in g/cm^3. Most than half of the patients 98% had Severe LVH and only 2% were moderate.

The table (7) showed that more than half 54% of the patients had eccentric hypertrophy whereas 46% had concentric hypertrophy.

Table 8 showed that: Mean of LVIDD more in male than female and it is statically significant (P= 0.004). Mean of LVISD more in male than female and it is statically significant (P= 0.004).Mean of EF more in female than male and it is statically significant (P= 0.017).Mean of left ventricular mass more in male than female and it is statically 34 significant (P= 0.002).Mean of LVMI more in male than female and it is statically significant (P= 0.014).there is no relation between sex and relative wall thickness (P= 0.483)

Table 9 showed that: There is no relation between duration of hypertension and mean of LVIDD (P= 0. 122) There is no relation between duration of hypertension and mean of LVISD (P= 0.099) There is no relation between duration of hypertension and mean of EF (P= 0..357) There is no relation between duration of hypertension and mean of left ventricular mass (P= 0.613) There is no relation between duration of hypertension and mean of LVMI (P= 0.657) There is no relation between duration of hypertension and mean of relative wall thickness (P= 0.694)

Table 10 showed that: There is no relation between age and mean of LVIDD (P= 0. 126) There is no relation between age and mean of LVISD (P= 0. 473) There is no relation between age and mean of EF (P= 0.855) There is no relation between age and mean of left ventricular mass (P= 0.600) There is no relation between age and mean of LVMI (P= 0.362) There is no relation between age and mean of relative wall thickness (P= 0.299) Table 10 showed that: There is no relation between family history of LVH and mean of LVIDD (P= 0. 830) There is no relation between family history of LVH and mean of LVISD (P= 0. 830) There is no relation between family history of LVH and mean of EF (P= 0. 690) There is no relation between family history of LVH and mean of left ventricular mass (P= 0.268) There is no relation between family history of LVH and mean of LVMI (P= 0.251) There is no relation between family history of LVH and mean of relative wall thickness (P= 0.493)

Table 11 showed that: There is no relation between DM and mean of LVIDD (P= 0. 820) There is no relation between DM and mean of LVISD (P= 0. 832) There is no relation between DM and mean of EF (P= 0. 909) There is no relation between DM and mean of left ventricular mass (P= 0.924) There is no relation between DM and mean of LVMI (P= 0.883) There is no relation between DM and mean of relative wall thickness (P= 0.967) In the present study all of the included

patients had LVH, most of them 98% had severe LVH and only 2% were moderate, in addition more than half 54% of them had eccentric hypertrophy whereas 46% had concentric hypertrophy. These results higher than results in pervious study conducted in Sulaimani Medical Teaching Hospital, Sulaimani, Kurdistan, Iraq which reported that about one third of the patients (30%) revealed LVH, among them two thirds (19%) were mild followed by moderate (7.5%) and 35 sever only (3.5%) as well as two thirds of them were eccentric left ventricular hypertrophy (20%)(Khaznadar *et al.*, 2018).Also pervious study in in A Tertiary Hospital in Tanzania revealed that the most prevalent diagnoses among patients were hypertensive heart disease (1236 patient; 62%) and dilated cardiomyopathy (145patients; 7%) while 450 patients (22.6%) had normal echo study (Mayala *et al.*, 2020). Further more systematic review study of echocardiographic studies from 1 January 2000 up to 31 December 2010 reported that LVH was prevalence ranged from 36% to 41% in the pooled population. Eccentric LVH was more frequent than concentric hypertrophy (Cuspidi *et al.*, 2012a). The current study reported that mean of LVIDD, LVISD, left ventricular mass, LVMI more in male than female and it is statically significant whereas mean of EF more in the female.Furthermore there was no relationship between demographic data (sex, age and family history, DM and duration of HTN) and Left ventricle mass. These results in the same line with pervious systematic review study of echocardiographic studies 1 January 2000 up to 31 December 2010 reported that LVH prevalence was not different between women and men(Cuspidi *et al.*, 2012a), but disagreement with pervious study in Tanzania that stated Hypertensive heart disease patients were prevalent among patients aged 50-84 years (70%, 865 patients) vs those aged 27-49 years (30%, 371 patients)(Mayala *et al.*, 2020). The possible explanation of higher prevalence of LVH among current study are most of the participates aged more than 50 years, duration of the HTN and high BMI as well as it's importantly to indicated that all of the patients included in this study were referred or admitted in the Heart health center because they suffer from the signs and symptoms of the LVH, subsquantly another study at the national level for screening LVH among hypertensive patients with different demographic background recommended to be done.

5. Conclusion

This study conclude that all of the patients had LVH and most of them were severe LVH. Eccentric LVH was more frequent than concentric hypertrophy. The mean of LVIDD, LVISD, left ventricular mass, LVMI more in male than female and it is statically significant whereas mean of EF more in the female.There were no relationship between demographic data (sex, age and family history, DM and duration of HTN) and Left ventricle mass.

Compliance with ethical standards

Acknowledgments

To the soul of my mother/Fatima ahmed Bashir and my father Esmeal Ahmed Esmeal .

Disclosure of conflict of interest

No conflict of interest.

Statement of ethical approval

Statement of ethical approval was obtained from the ethical committee of the hospital.

Statement of informed consent

Statement of informed consent was obtained agree from all Patients that was included in the study that there was no any information's concern patient name identifications will publish.

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