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Echocardiographic evaluation in systemic hypertension

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ABSTRACT

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. This study was conducted at Kamineni Institute of Medical Sciences, Narkatpally,Telangana State. The aim of this study was Echocardiographic evaluation of cardiac status in systemic hypertension patients. All patients of systemic hypertension whose diastolic blood pressure was persistently over 90mm Hg, were selected for study. This includes 50 hypertensive patients of age 30-60 years of both sexes. There were 33 males and 17 female. Hypertension was more common in mean age of 49 years, males are mostly effected than females. Left ventricular hypertrophy seen in 76% of patients, 58% of patients have diastolic dysfunction,6% patients have systolic dysfunction and 12% had both systolic and diastolic dysfunction. About 24% had no left ventricular dysfunction. Congestive heart failure was seen in 10% of patients, among them 4% with LV diastolic dysfunction, 2%systolic dysfunction and 4% with both dysfunctions were noticed.

Keywords: Echocardiography, systemic hypertension, left ventricular hypertrophy, Congestive heart failure, systolic dysfunction, diastolic dysfunction

Introduction

Hypertensive heart disease is the target organ response to systemic arterial hyper-tension. Patients with longstanding hypertension are at increased risk for developing left ventricular hypertrophy (LVH) and diastolic dysfunction [1]. Diastolic dysfunction is the earliest evidence of involvement of heart in hypertension. This is not pathognomic of hypertensive heart disease, as similar changes may be present in aged persons or patients having coronary artery disease, unrelated to hypertension. Left ventricular hypertrophy (LVH) is therefore considered as a hall mark of hypertensive heart disease, as systolic dysfunction usually appears late in course of disease.

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Patients with left ventricular hypertrophy have increased risk of angina pectoris, acute coronary syndrome, ventricular arrhythmias, sudden cardiac death (SCD) and congestive cardiac failure. Thus LVH has emerged as an independent risk factor for further adverse event unreleased to stage of hypertension. Arterial hypertension associated to LV concentric remodeling is the determinant of diastolic dysfunction but several other cardiac diseases, including myocardial ischaemia, and extra cardiac pathologies involving the heart are other possible causes. Arterial hypertension represents one of the most common risk factors for the development of heart failure, conferring approximately a twofold increased risk in men and a threefold risk in women relative to normotensive subjects [2].An early detection and prevention of LV dysfunction is an important goal in the management of hypertensive patient. A number of anti-hypertensive agents are available which not only controls BP effectively but also reduces the risk factors associated with cardiac dysfunction. Non-invasive investigations

that would provide an assessment of left ventricular status are chest X-ray, ECG, Radio nuclide ventriculography and echocardiography. Echocardiography provides a simple, safe, reproducible and accurate method and modality of choice to define left ventricular hypertrophy and dysfunction. The aim of this study is Echocardiographic evaluation of cardiac status in systemic hypertension patients

Materials and methods

This study is conducted at Kamineni institute of Medical sciences, Narkatpally, Telangana state after obtaining the permission from the hospital ethics committee from January 2016 to December 2017. Systemic hypertension Patients coming to the Medical OPD were included in this study.

Patient's age, sex, occupational history is noticed. Patients are enquired about their habits like alcohol intake, smoking, tobacco and gutka chewing. Family history of hypertension, diabetes, obesity, angina, dyspnoea, headache, myocardial infarction, weight loss, hematuria, drug history other relevant history was taken.

All patients of systemic hypertension whose diastolic blood pressure was persistently over 90mm Hg, were selected for study. But hypertensive patients with coexistent ischemic heart disease, congenital and acquired heart disease, corpulmonale, pregnancy with toxaemia, hyperdynamic circulatory states, chronic renal failure and cardiomyopathies were excluded, as these ontheir own accord, are likely to alter the function of the heart.

Patient's routine investigations like blood sugar, blood urea, serum creatinnie, Hb, CBC, urine routine and microscopy, X-ray chest, 12 lead ECG and lipid profile were done.

All selected patients will be subjected to echocardiography. The left ventricular dysfunction was assessed by

1) Left Ventricular Hypertrophy (LVH)
2) Diastolic dysfunction
3) Systolic dysfunction

Left Ventricular Hypertrophy: There are two methods of calculating LV mass from 2D echocardiography.

a) Area length method
b) Truncated ellipsoid method

For both methods require short axis view of left ventricle at papillary muscle level and apical four or two chamber at end diastole are required. Myocardial mass is equal to product of volume and specific gravity of myocardium (1.04 gm/ml).Built in software in ultrasound can make both methods available so that mass is automatically calculated, once all variables are fed. LV mass can also be estimated from 2D guided, M mode measurements of LV dimension and wall thickness at papillary muscle level without measuring left ventricular major axis, Dimension and simple geometric cube formula.

The following equation provides an accurate determination of LV mass, according to Devereux et al [3]

Left ventricular mass (gms) = 1.04 (LVID + PWT + IVST)° - LVID® x 0.8 + 0.6

where 1.04 specific gravity of myocardium 0.8 correction factor

LVID — Left ventricular internal dimension

PWT — Posterior wall thickness

IVST — Interventricular septal thickness measured at - end diastole

Diastolic dysfunction

Based on Doppler velocity pattern, diastole dysfunction is divided into three categories

a) Relaxation abnormalities b) Restrictive physiology c) Pseudonormalization

Relaxation abnormalities: Abnormal myocardial relaxation characterized by constellation of following abnormalities

Prolonged IVRT (lsovolumic relaxation time) > 110 m/sec,

Low E velocity (early filling velocity)

high A velocity (A velocity = Late filling velocity)

Revised E/A ratio (<1.0)%

Prolonged deceleration time (DT) > 240 m/sec

Restrictive physiology: is characterized by following diastolic parameters

Shortened IVRT (<60 msec)

High E velocity and low velocity

Increased E/A ratio > 2

Shortened deceleration time (< 150 msec)

Systolic dysfunction

To evaluate systolic two parameters are used , Fractional shortening or ejection fraction and Cardiac output.

Fractional shortening is percentage change in left ventricle cavity dimension with systolic contraction and can be calculated from following equation.

Fractional shortening = LVED-LVES) / LVED x 100%

Where LVES — LV end systolic dimension

LVED — LV end diastolic dimension

Ejection fraction represents stroke volume as percent of end diastolic left ventricular volume.

Ejection fraction = (EDV - ESV) / E «100%

Where EDV - End diastolic volume of LV

ESV - End systolic volume of LV

Quninomers and co authors proposed a simplified method for determination of ejection fraction by measuring LV internal dimensions

Ejection fraction = (% AD') + [C1 -% DA] [%AL]
Where % AD = [(LVED — LVES) / LVED*] x 100%.

Results

The present study was conducted in 50 hypertensive patients of age 30-60 years of both sexes. There were 33 males and 17 female. Age wise and sex wise distribution of hypertensive patients were shown in table 1.

Table 1: Age and Sex distribution of hypertensive cases

S. No	Age group	Males (No & %)	Females (No & %)	Total (No & %)
1	31-40	8(16%)	2(4%)	10(20%)
2	41-50	10(10%)	4(8%)	14(28%)
3	51-60	11(22%)	7(14%)	18(36%)
4	61-70	4(8%)	4(8%)	8(16%)
		33(66%)	17(34%)	50(100%)

Table 2: Prevalence of left ventricular dysfunction in hypertensive patients with or without congestive heart failure (CHF)

S.No	Dysfunction	No of cases (%)
1	Only diastolic dysfunction	29(58%)
2	Only systolic dysfunction	3(6%)
3	Both systolic & diastolic dysfunction	6(12%)
4	No LV dysfunction	12(24%)
5	Total diastolic dysfunction	35(70%)
6	Total systolic dysfunction	9(18%)

Left Ventricular dysfunction was present in 76% of hypertensive patients and 24% does not show dysfunction. Six patients have had both systolic and diastolic dysfunction. Out of 50 cases of hypertension 10% patients i.e. 5 of them presented with CHF. Among them 2 with LV diastolic dysfunction, 1systolic dysfunction and 2 with both dysfunction were noticed. In all diastolic dysfunction patients EF slope was reduced and E/A ratio altered. In echocardiographic findings of patients with systolic dysfunction there were reduced LV Ejection Fraction(LVEF), increased LV Internal Dimensions (LVID) in diastole and systole were observed. Increased LV dimension and reduced ejection fraction was present in all the cases of systolic dysfunction.

Table 3: Electrocardiographic findings

Total diastolic dysfunction(n=35)	Total systolic dysfunction(n=9)
EF slope reduced	Increased LV dimension
E/A ratio altered	reduced ejection fraction

Table 4: Comparison of LVH detected by X-ray, ECG and echocardiography

Method	No of cases LVH detected
Chest X-ray	2(4%)
ECG	6(12%)
Echocardiography	30(60%)

Table 5: Correlation between LV dysfunction and duration of hypertension

S.No	Duration in years	No of hypertensive patients	hypertensive patients with systolic dysfunction (n=9)	hypertensive patients with diastolic dysfunction(n=35)
1	>5	16(32%)	4(8%)	12(24%)
2	5 to10	15(30%)	1(2%)	14(28%)
3	<10	13(26%)	4(8%)	9(18%)

Table 6: LV dysfunction in hypertensive patients of different age groups

S. No	Age group	No of hypertensive patients	hypertensive patients with systolic dysfunction (n=9)	hypertensive patients with diastolic dysfunction(n=35)
1	31-40	10(20%)	1(2%)	5(10%)
2	41-50	14 (28%)	2(36%)	10(20%)
3	51-60	18(36%)	5(36%)	13(26%)
4	61-70	8(16%)	1(36%)	7(14%)

Table 7: LVH in hypertensive patients of different age groups

S. No	Age group	No. of hypertensive patients	Hypertensive with LVH
1	31-40	10(20%)	6(12%)
2	41-50	14(28%)	9(18%)
3	51-60	18(36%)	15(30%)
4	61-70	8(16%)	8(16%)

Table 8: Correlation between severity of hypertension and LVH

S.No	Severity of Hypertension	hypertensive patients with systolic dysfunction (n=9)	hypertensive patients with diastolic dysfunction(n=35)
	Prehypertension	3 (6%)	14(28%)
	Stage I	0	11(22%)
	Stage II	6(12%)	10(20%)

In patients with diastolic dysfunction 30% had unsatisfactory BP control and Patients with both diastolic and systolic dysfunction (12%) does not have satisfactory BP control but patients with only systolic dysfunction had satisfactory BP control.

Discussion

The end of natural history of untreated hypertension is an increased likelihood of premature disability or death from cardiovascular diseases. The pathogenesis of hypertension involves structural changes in the resistance arterioles described under term remodeling and hypertrophy. Hypertrophic remodeling clearly develops in larger arteries as an early manifestation of essential hypertension with close symmetry between vascular and cardiac hypertrophy.

Diastolic and systolic dysfunctions have been observed early in the course of hypertension and either or both may lead to heart failure. Such diastolic dysfunction may reflect more vigorous atrial emptying or abnormal diastolic relaxation. The earliest function cardiac changes in hypertension are in left ventricular diastolic function, with lower E/A ratio and longer isovolemic relaxation time [4]. Cardiovascular diseases are major leading health problems in the world [5], and hypertension is a major risk factor for cardiovascular diseases and stroke which have significantly higher morbidity and mortality [6]. 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 [7]

In the 2013 ESH/ESC Guidelines for the management of arterial hypertension, echocardiography is the second-line study based on medical history, physical examination, and findings from routine laboratory tests [8]. The guidelines recommended performing echocardiographic examination in patients who are suspected with having left ventricular hypertrophy (LVH), left atrial (LA) dilatation, or concomitant heart diseases .The 2014 Canadian Hypertension Education Program (CHEP) guidelines recommended the echocardiographic use in the selected patients [9]. Routine echocardiographic study is not recommended in all patients with hypertension (grade D: recommendations are based on expert opinion alone). However, the echocardiographic examination for the evaluation of LVH is useful in selected patients to define the future cardiovascular risk (grade C: recommendations are based on trials that have lower levels of internal validity and/or precision, trials reporting invalidated surrogate outcomes, or results from non-randomized observational studies).

We have chosen echocardiography as this can be employed safely in any setting without patient preparation, discomfort and convenience. This is non-invasive economical and can be repeated any number of times. Hypertension noticed in patients aged from 31-68 years with mean of 49 years, maximum numbers of cases were between 41-60 years being equally divided in 5th and 6th decades. In these patients ECG indicated LVH in only 6cases (12%) while radiography was even a poorer parameter which suggested LVH in only two cases (4%). Echocardiography therefore, was found to be far superior method.

Hypertensive left ventricular hypertrophy (LVH) represents a powerful predictor for cardiovascular morbidity and mortality, independent of other cardiovascular risk factors, even blood pressure itself. A normal ECG does not exclude the presence of LVH, and therefore patients should be evaluated further with imaging. Echocardiography is clinically useful in the detection of LVH and the assessment of diastolic function.[1]

In our study 76% patients suffering with LVH. I n our study 70% of patients were with diastolic dysfunction showed EF slope is reduced and alteration in E/A ratio less than one. Echocardiography is a useful imaging tool to measure LV diastolic function. Several echocardiographic modalities can be used to estimate LV filling pressure. Increased LA size and volume is one of indicator of increased LV filling pressure [10,11]. Enlarged LA diameter was found more than 20% of hypertensive patients in a large-scale study including a total of 2,500 uncomplicated essential hypertensives [12]. Enlarged LA can present long-standing elevated LV filling pressure, and increased LA size and volume were associated with poor long-term mortality and morbidity [13,14]. LV diastolic dysfunction is associated with increased mortality in middle-aged and elderly adults[15].

In our study 18% patients with severe systolic dysfunction showed reduced LVEF, increased LVIDd and Increased ‘ LVIDs ‘values were observed. Increased LV dimension and reduced ejection fraction was present in all the cases of systolic dysfunction. Several echocardiographic indices have been introduced to estimate LV systolic function. Among them, LVEF is the most used and the most practical systolic index that has been used as a prognostic factor in various cardiovascular diseases [16,17]

Out of 50 cases of hypertension 10% patients i.e. 5 of them presented with CHF. Among them 2 with LV diastolic dysfunction, 1systolic dysfunction and 2 with both dysfunctions were noticed.

Echocardiography provides a reliable, non invasive and sensitive method for detecting accurately LVH and LV systolic and diastolic dysfunction, which have important diagnostic, therapeutic and prognostic implications inpatients of systemic hyper tension

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