ORIGINAL ARTICLE

FREQUENCY OF AORTIC ROOT DILATATION IN PATIENTS WITH LONG STANDING ESSENTIAL HYPERTENSION

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Background: Aortic root dilatation poses a potential risk factor for development of aortic dissection. In people with hypertension, aortic root dilatation is connected to left ventricular hypertrophy, indicating the susceptibility to cardiac damage. Dilatation of ascending aorta is a major risk factor for development of aortic dissection and/or rupture of aorta if not treated surgically. It signifies 50% of all thoracic aneurysms. Objective of this study was to determine the frequency of aortic root dilatation in patients with long standing essential hypertension. **Methods:** One hundred and three patients with essential hypertension were selected for the study. The size of aortic root was measured by two-dimensional echocardiography calculating the maximum distance between the anterior and posterior aortic root walls' two leading edges at the end diastole. A parasternal long axis perspective was used to take images of the proximal aortic root. **Results:** The patients' age was 51±6.7 years, duration of hypertension was 10.7±2.9 years and weight of 87.5±6.5 Kg. Out of these patients, 79.6% were male and 20.4% were female, and out of the total, 19.4% had aortic root dilatation. Frequency of aortic dilatation was significantly higher in people older than 50 years, or having hypertension for more than 10 years (p<0.005). **Conclusion:** There was a high prevalence of aortic root dilatation in patients with essential hypertension.

Keywords: Hypertension, Longstanding, Aortic root, Dilatation

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INTRODUCTION

Elevated blood pressure remains a continual global issue that poses a significant threat to global health. The possibility of cardiovascular illnesses like ischemic heart disease and stroke is increased in hypertension (HTN), either alone or in conjunction with other metabolic disorders like obesity and diabetes.[1] Hypertension is coupled with atherosclerosis and end-organ damage.[2] Hypertension poses serious health concerns globally. The true incidence of hypertension is under reported due to its silent nature.[3]

Both males and females with cardiovascular risk factors have an increased risk of developing hypertension in later age.[4] Age, Body Mass Index (BMI), and arterial blood pressure, especially systolic blood pressure (SBP) are important prognostic factors for hypertension. Higher BMI, age, higher triglyceride levels, higher fasting blood glucose level, higher systolic and diastolic blood pressure blood pressure insulin resistance and high total cholesterol level are all connected with a greater occurrence of hypertension in both genders. However, the only significant markers in females are the waist-to-hip ratio and diastolic blood pressure.[4] Obesity, sedentary lifestyle, and a family history are prevalent risk factors for hypertension.[5] People who drink soft water over extended periods of time are more likely to develop hypertension.[6]

One important risk factor for the development of aortic dissection is aortic root dilatation (ARD).[7] In the hypertensive population, ARD is linked to left ventricular hypertrophy, indicating a greater burden of cardiac injury.[8] According to a study, 22% of patients with chronic essential hypertension had aortic root dilatation.[9] The American College of Cardiology advises taking measurements in a person at least twice on different dates to diagnose hypertension. Additional readings should only be taken if the first two readings differ by ≥10 mmHg. The average of the previous two readings of blood pressure is then noted.[10]

Ambulatory blood pressure monitoring is the most accurate method to diagnose hypertension which also aids in identifying persons with silent hypertension as well as white coat effect. Elevated sympathetic activity and obesity has a major role in pathogenesis of hypertension due to a combination of behavioural (high salt intake), psychological (mental stress), and lifestyle (physical inactivity) factors, as well as genetic influences (family history). Forty to fifty percent of middle-aged obese persons have hypertension. The sympathetic nervous system, especially the renal sympathetic nervous system, is more active in obese individuals due to a number of factors, such as hyperleptinemia and high sodium consumption, which causes hypertension. However, epidemiological research suggests that a significant risk factor for the development of essential hypertension is mental stress.[11]

There is a considerable risk of dissection or aortic rupture when the ascending aorta dilates as a

result of hypertension. It is responsible for half of all thoracic aneurysms. Based on aetiology and surgical management, it can be divided into two distinct types: 1) the aortic root aneurysm, which signifies the first part, the aortic root, which includes the sinuses of Valsalva, and 2) the supravalvular aortic aneurysms, located above the sinuses of Valsalva up to the brachiocephalic trunk. The supravalvular aneurysms can be corrected with a supracoronary tube graft while aortic root aneurysms need replacement of aortic valve. The aorta in humans enlarges with aging too, but the prevalence of aortic root dilatation among individuals with long standing essential hypertension has not been proven in studies performed in general population. This study is targeted at determining the prevalence of aortic root dilatation in patients with chronic essential hypertension.

MATERIAL AND METHODS

This cross-sectional study was carried out in Department of Cardiology, Ayub Teaching Hospital, Abbottabad from 15 Nov 2020 to 15 May 2021. A 95% confidence interval, an 8% margin of error, and an anticipated frequency of 22% aortic root dilatation in individuals with chronic essential hypertension yielded a sample size of 103 using WHO sample size software[9]. Non-probability sequential sampling was done. People of both genders between ages 30–70 years with essential hypertension for more than 5 years were selected for study. Those with non-hypertensive cardiovascular disease, valvulopathy, and diabetes were excluded.

Informed consent was obtained from all patients. Basic demographics were recorded, including age, gender, length of hypertension, and weight. Two-dimensional echocardiography was conducted while the patient was at rest and in the left lateral position. Devereux's method was used to measure left ventricular mass (LVM) which made use of the interventricular septum (IVS), inferolateral wall (ILW) thickness, and end-diastolic left ventricular internal diameter (LVIDd). To compute relative wall thickness (RWT), the formula (2×ILW)/LVIDd was utilized. When a female's left ventricular mass index for height was greater than 46.7 g/m or that of a male was greater than 49.2 g/m, it was considered left ventricular hypertrophy. Aortic root size was calculated using two-dimensional echocardiography by measuring the maximum distance between the anterior and posterior aortic root walls at the end of diastole. From a parasternal long axis perspective, images of the proximal aortic root were recorded.

Aortic root diameter was calculated and documented on specifically created proforma and SPSS-22 was used for data analysis. Qualitative variables, e.g., gender and aortic root dilatation were presented as frequencies and percentages. For quantitative parameters such as age, weight, and duration of hypertension, Mean±SD was measured. Aortic root dilatation was categorized according to weight, age, gender, and duration of hypertension. Chi-square test was used for mean comparison, and a $p \leq 0.05$ was considered as significant.

RESULTS

The mean age of the study population was 51±6.7 years, with a range of 30–70 years. Mean duration of hypertension was 10.7±2.9 years and mean weight was 87.5±6.5 Kg. Male patients were 79.6% and females were 20.4%. Aortic root dilation was observed in 19.4% patients (Table-1).

Frequency of aortic dilatation was significantly higher in people older than 50 years, or having hypertension for more than 10 years ($p<0.005$). There were no significant differences between males and females. The frequency of aortic dilatation was more in people weighing >80 Kg, but the differences were not significant. (Table-2).

Table-1: Frequency of hypertensive patients with aortic root dilatation (n=103)

Aortic Root Dilation	Frequency	Percentage
Yes	20	19.4
No	83	80.6

Table-2: Aortic root dilatation stratified in different parameters

Variables	Aortic Root Dilation		*p*
	Yes	No	
Age groups (Years)			
30–50	2 (5.1%)	37 (94.9%)	0.004
51–70	18 (28.1%)	46 (71.9%)	
Gender			
Male	16 (19.5%)	66 (80.5%)	0.962
Female	4 (19%)	17 (81%)	
Duration of hypertension (Years)			
5–10	1 (1.9%)	52 (98.1%)	0.000
>10	19 (38%)	31 (62%)	
Weight (Kg)			
≤80	1 (7.1%)	13 (92.9%)	0.212
>80	19 (21.3%)	70 (78.7%)	

DISCUSSION

Prevalence of ARD in arterial hypertension has been the subject of numerous published investigations. Some studies[12,13] suggest that prevalence of this syndrome ranges from 4 to 11.8%, although our observations of up to 17% is significantly greater. Many factors including age, gender, weight, and systemic blood pressure affect size of thoracic aorta. In autopsies and imaging investigations, age-related dilatation of the ascending aorta and aortic root has been documented.

IN a study in India[14] the aortic diameter was greater in hypertensives compared to normotensive individuals at annulus and sinotubular junction. Aging has a complex role in the metabolic, structural, and functional changes in major arteries and micro vessels in conjunction with aggravating factors such as heredity, disease, and environmental factors. In our study, age and HTN were

significant parameters affecting the aortic size. On applying multivariate analysis of the dependent variables, weight was most strongly related to the aortic size. Kim *et al*[15] observed that body surface area is inversely related to the aortic size. This is different from Pearce WH *et al*[16], who noted that BSA is a better predictor of size than height or weight. They reported that obese women were more likely to have ARD if they had a high stroke volume index, high diastolic blood pressure, a lower baseline systolic blood pressure, and a high average diastolic blood pressure at follow-up (p<0.05). However, normalized ARD was linked to non-obese females with lower baseline systolic blood pressure, average follow-up diastolic blood pressure, reduced stroke volume index, and longer follow-up duration (p<0.05).[16] We observed that in both genders, age and aortic root diameters correlated positively at all levels which is in accordance with Akintunde *et al.*[18] Vandroux *et al*[19] reported that age positively correlated with ARD in a large cohort among the normotensive Beninese population. Vriz *et al*[20] noted a comparable result in 1,043 healthy adults of age range between 16–92 years. In both these studies, the absolute aortic root diameters of males were greater than those of females. We observed the same pattern in our study.

CONCLUSION

The prevalence of aortic root dilatation in patients with essential hypertension is larger than previously reported, reaching a maximum of 19.4%. Our findings therefore point to the value of selecting the diagnostic criterion correctly which must be used on a single patient in order to define ARD.

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