

## Aortic Diameter and Degree of Systemic Hypertension in South East Nigeria

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### Abstract

*Background: The aorta, one of the largest blood vessels in the body, has an unusual closeness to the left ventricle. It contains bar receptors which control blood pressure. It is understandable that it would enlarge when there is increased blood volume load to the heart and to it. Objective: A prospective study done to determine the relationship between level of blood pressure and aortic diameter. The study done over three years involves 200 hypertensive's attending the cardiology clinic in Enugu, Nigeria. They had routine Chest radiograph as part of their investigations for hypertension. Results: There were 134 females and 66 males. All had increased aortic diameter which increased progressively with age up to the age of 79. Female group had a more significant diameter increase ( $p$ -value =0.004) Males and females diameters when compared had statistically significant difference ( $p$  value =0.001) . Mean aortic diameter measured on plain chest radiograph in this study is  $6.93 \pm 1.3$ . Conclusion: Aortic diameter increased progressively with age and this was more significant in females. There was no correlation between aortic diameter and blood pressure in these respondents. The chest radiograph has been found to be invaluable in management of hypertension as aortic widening was easily visualized in the chest radiograph of these hypertensives.*

**Keywords:** Aortic diameter, Chest Radiograph, Hypertension.

### 1. Introduction

The aorta is one of the great vessels in the body and as a result of its anatomical location receives the large volume of blood pumped by the highly muscular left ventricle. In a frontal radiograph of the chest, the normal ascending aorta is obscured by the shadow of the superior vena cava in the right superior medias tinum.<sup>i,ii,iii</sup> The posterior part of the arch of the aorta hidden in the mediastinum behind the cardiac shadow. It is therefore not visualized as a separate structure. In systemic hypertension, the descending aorta is compelled to carry more blood at higher pressure and becomes visible as it enlarges. The normal aortic diameter is between 4cm to 6cm in adults but this range is exceeded in hypertension. Females are on the lower limit of normal A correlation of the aortic diameters of these patients and their various blood pressure measurements is the basis of the study. Hypertension is a principal contributor in cardiovascular disease in African populations. 93% of black South Africans have blood pressure that is uncontrolled.<sup>iii</sup>

The Aorta is the largest artery in the body and arises from the top of the left ventricle; the pumping machine of the heart. The aorta is about 30.5cm long and 2.5cm in diameter. It therefore carries majority of the blood supplied to the body at any given time. As a result therefore, imaging the aorta plays a great role in cardiovascular disease. The aortic arch and bra chiocephalic branches contain bar receptors which regulate systemic blood pressure. The first part of the aorta is the root which is made of three aortic sinuses extending from the aortic valve to the sin tubular junction where it becomes the ascending aorta.<sup>iii</sup>

These chambers may actually enlarge surprisingly enormously without reflecting on the mediastinal silhouette which is what we search for on the routine poster anterior chest radiograph. The ascending aorta seen on the right lung field passes superiorly, thus forming part of the right mediastinal border. The plain chest radiograph will reveal early ascending aorta enlargement in a postero anterior chest radiograph. Body size, age and sex affect the aortic dimension. Atherosclerosis and hypertension accelerate aortic dilatation and loss of compliance.<sup>ii,iv</sup> A study carried out in South Africa showed that every 15cm increase in waist circumference was associated with a 4.04mmHg increase in a 24hrsystolic BP and a 4.33mmHg increase in a 24hr diastolic BP<sup>3</sup>. Since hypertension alters aortic size and compliance, this paper hopes to reveal any correlation between degree of hypertension and aortic diameter and assert that aortic diameter can help prognosticate the blood pressure reading of the owner and influence treatment.

### **Materials and Methods**

The patients recruited for this study were known hypertensive's attending the cardiology clinic and had plain postero anterior chest radiographs that were reported by a Radiologist. The aortic measurement was taken just below the knuckle. Results were analysed with SPSS 17.0. Patients whose ages were not known were excluded from the study. Only adult patients were in this study group ( $\geq 18$ years).

### **Results**

Two hundred patients, one hundred and thirty four females and sixty six males were recruited; a ratio of 2:1. Most of the patients in this study was in the sixth decade of life. Table I shows sex distribution in males and females in systolic blood pressure. Most patients (172 out of 200) were in the 140—180mmHg systolic blood pressure. 116 females and 56 males. 10 females and 5males had blood pressure above 190mmHg. Table II shows sex distribution In Table III the mean aortic sizes were mostly higher in males than females. In the female respondents, 33 out of 134 (25%) were in the 60- 69 age group and had mean aortic diameter of 7.1cm. This was followed closely by the 50- 59 age group that had 30 subjects (22% of female respondents) with mean aortic diameter of 6.5cm. On the other hand, the 60-69 age groups was 19 males (29% of male respondents) with mean aortic diameter of 7.5cm.

P-value in systolic/aortic dimension=0.498

P-value in diastolic/aortic dimension=0.338

P-value in female age/aortic dimension=0.004 (very significant).

P-value in male age/aortic dimension=0.07 (not very significant).

Total p-value of age and aortic dimension= 0.001 (very significant).

### **Discussion**

The respondents in this population were mostly in the fifth and sixth decades of life.

The study by Anyanwu et al 4 had a mean aortic diameter of  $4.7 \pm 0.46$  in a normal Nigerian population. Umerah 14 reported that aortic dimensions of Africans that did not have cardiovascular disease are significantly higher than the values reported in Caucasian. Mean aortic diameter in this study involving hypertensives was higher, as expected ( $6.93 \text{cm} \pm 1.3$ ). There was no corresponding correlation between aortic diameter and systolic blood pressure in this study. Some respondents with blood pressure of 90mmHg had an aortic diameter of 7.41cm while respondents with systolic blood pressure of 160mmHg had aortic diameter of 7.17cm. The study by Okeahialam is in agreement with the present study as it revealed that aortic dimension is a poor specific index of degree of hypertension. On the contrary, the study by Rayner and his coworkers in South Africa did not agree with the present study. Their study revealed an interesting observation which showed that aortic knob width was directly related to both systolic and diastolic blood pressure in hypertensives. This study however showed increased aortic dimensions in agreement with the study by Ikeme et al in Nigeria which involved 183 chest radiographs of hypertensive Diastolic blood pressures, the following observations were made: All the patients had aortic dimensions above normal.

Majority of these patients had diastolic blood pressure of 90mmHg while the 100mmHg followed. 16 respondents had shocking diastolic pressure of 110mmHg. Aortic dimensions increased progressively till the age of 79 in both males and females. The p-value in females revealed a particularly strong correlation between age and aortic dimensions.

In males, there was also a progressive increase in aortic dimension with age which was not as significant as in females. However the combination of the two sex values yielded a very significant correlation of aortic dimension and age. Rayner and his co workers found that aortic knob width was more dilated in hypertensives than normotensives and was interestingly directly related to both systolic and diastolic blood pressure in hypertensives<sup>11</sup>. This supports the concept that progressive dilatation of thoracic aorta is part of aging and is exacerbated by hypertension. The study by Obikili established that aortic diameter correlates with age; aortic diameter revealed significant positive correlation with systolic but not diastolic blood pressure in hypertensive males.<sup>v</sup>

However, in hypertensive females, their study showed no correlation between aortic diameter and systolic or diastolic blood pressure. They also established that aortic arch diameter seemed to be good index of systemic hypertension for patients under 60 years but not for those above 60. Danbauchi reported that aortic arch width has significant relationship with age in patients less than 50 years and that aortic arch correlates with systolic and diastolic blood pressure.<sup>15</sup> Two groups of workers, O'Rourke<sup>6</sup> et al and Mitchel<sup>7</sup> et al reported little change in aortic diameter with age and attributed isolated systolic hypertension to relative narrowing of the descending aorta.<sup>vi</sup> Sugawara and his group in Japan and Texas observed a 3% increase in aortic diameter/decade.<sup>vii</sup> They felt this change was due to fracture of elastin fibres with subsequent remodelling. Some workers in Thailand (16) found that in Echocardiography, aortic root size is influenced by hypertensive status, age and gender.<sup>viii</sup>

Kim et al(15) in echocardiography, took measurements at the supra aortic ridge and ascending aorta and concluded that aortic diameters increased with increasing quartiles of diastolic and systolic pressures in their hypertensive patients.<sup>ix</sup> Towfiq<sup>16</sup> and others measured the ascending and descending aorta at the level of the carina in 200 adults who came for CT Scan and concluded that age and blood pressure were the most important factors affecting aortic size in adults.<sup>x</sup> Warner<sup>13</sup> and fellow workers in their Doppler work claimed that aortic diameter appeared to vary with BP M O'Rourke<sup>5</sup> summarized it all by observing that there have been many controversies over degree of aortic dilatation with age, sex differences and implications of diameter change to development of arterial hypertension and management of isolated systolic hypertension in older subjects.

### ***Conclusion***

There is strong correlation between age and aortic diameter particularly in females. The study showed no correlation between aortic size and the degree or severity of blood pressure. The authors feel the antihypertensive drugs may have affected the aortic dimensions in these patients. The chest radiograph remains invaluable in management of hypertension because it easily reveals recognisable aortic changes.

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