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Dilatation and Rapid Rate of Expansion of the Ascending Aorta in Vietnamese Population

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Abstract

Background: The thoracic aorta expands slowly with age; standard rate of expansion of ascending aorta is about 0.1 cm per 10 years. A diameter of an ascending aortic greater than 3.7 cm is considered to indicate dilatation. Though dilatation usually occurs with advancing age, there is no fixed upper limit of normal diameter of the ascending aorta that corresponds with age. Likewise, the rate of expansion is not constant for all individuals at a particular age. Expansion rate is influenced by various factors like smoking, obesity, and physical stature. Dilation and rate of expansion ascending aorta specific to ethnicity has not been studied or documented.

Objectives: This study explores the variation in the diameter of the ascending aorta, the rate of dilatation with age in the Vietnamese population, and compares these results to other ethnic groups.

Methods: This is an observational study using an institutional database. The study consists of one hundred and fifty patients divided into two groups; group one included seventy five patients of Vietnamese origin and group two included seventy five patients from Hispanic, Asian (excluding Vietnamese), Caucasian and African American ethnicities. Based on the age, patients in both the groups were further divided into three sub-groups: 45-60 years, 61-75 years and 75+ years; initial and subsequent follow-up of Trans-Thoracic Echocardiography (TTE) results are compared to visualize the difference in diameter of the ascending aorta in a specific age group and the rate of dilatation. Also, the institutional database was reviewed to investigate the associated risk factors of dilatation in patients of both the groups.

Results: The mean diameter (centimeter) of the ascending aorta in group one patients was higher than group two patients for age groups above sixty years. The mean diameter of an ascending aorta for both groups respectively is 3.47 ± 0.34 and 3.17 ± 0.34 (61-75 years, $p<0.005$), and 3.77 ± 0.31 and 3.24 ± 0.33 (75+ years, $p<0.001$). Medial annual growth rate of dilatation (centimeter/year) was almost double in patients of group one when compared to patients in group two, listed here respectively: 0.025 and 0.012 (less than 60 years, $p<0.05$), and 0.1 and 0.05 (above 75 years, $p<0.05$).

Conclusion: Patients of Vietnamese origin have an increased diameter of the ascending aorta along with a rapid rate of expansion of ascending aorta when compared to other ethnic populations, when age is held constant. This trend of a dilated ascending aorta and its rapid expansion rate is contradictory for a generally petite stature of the Vietnamese population.

Keywords: Ascending aorta; Dilatation; Rate of dilatation; Trans-thoracic echocardiography; Ethnicity

Introduction

Dilatation of the ascending aorta is a common incidental finding in elderly patients during echocardiography. Thoracic aorta expands slowly with age at the rate of 0.1 centimeter per decade [1]. A diameter of an ascending aorta greater than 3.7 cm is considered to indicate dilatation [2]. This dilatation represents the dimension of ascending aorta in adults that is greater than the 95 percentile for the normal person with respect to age, sex, and body size [3]. The various causes that accelerate dilatation are hypertension, bicuspid aortic valve, aortitis, and connective tissue disorders. Aneurismal dilatation is considered when the ascending aortic diameter reaches or exceeds 1.5 times the expected normal diameter (equal to or greater than 5.5 cm) [4]. The natural history of dilatation is slow expansion with a progressive increase in the risk of aortic dissection at larger aortic sizes. The rate of aortic expansion depends upon the etiology, diameter, and location.

Though, dilatation usually occurs with advancing age, there is no fixed upper limit of an ascending aorta's normal diameter corresponding to age. In a separate study to demarcate the upper limit of ascending aorta, it has been established that age, sex, and body size need to be taken into consideration [3]. Additionally, there is a difference in rate of expansion of ascending aorta based on the etiology of dilatation [5]. Studies regarding the moderate dilatation of aorta in bicuspid aortic valve patients suggest lowering the thresh old to monitor the rate of progression in these patients because of accelerated

rate of dilatation [1,6]. However, little information has been found concerning the association of ethnicity with dilatation of ascending aorta and the rate of its progression. Therefore, we seek to compare the diameter of ascending aorta in a Vietnamese population which tends to have a short and lean stature in comparison with the other ethnic groups. We further compared the rate of dilatation in these groups using follow up echocardiography reports.

Methods

Study subjects and data collection

We used the institutional echocardiography database to identify individuals sixty years and older who had multiple follow-up echocardiograms over the years. Evaluation of the ascending aorta is a routine part of echocardiographic examinations during the study, with each of the largest internal diameters of ascending aorta routinely obtained through the parasternal long-axis view.

Exclusion criteria for the study was patients with documented dilatation of aorta due to inflammatory aortic diseases, connective tissue disorders, bicuspid aortic valve, or a history of ascending aortic surgery.

Study cohort: age, ethnicity

One hundred and fifty patients were reviewed in the study and were divided into two groups. Group one included seventy five patients of Vietnamese origin and group two included seventy five patients from Hispanic, Asian (excluding Vietnamese), Caucasian, and African American ethnic origin. Based on age, patient in both groups were further divided into three sub-groups (45-60 years, 61-75 years and 75+ years) (Table 1).

Age Groups (years)	Group 1	Group 2
45-60	10	18
61-75	23	22
75+	42	34
Total	75	75

Table 1: Number of patients (n).

Statistical Analyses

The recorded data was compiled. All continuous variables were reported as mean ± standard deviation and categorical variables were summarized as percentages. Student's t test was used for comparison of categorical variables. As known, a p-value less than 0.05 is considered statistically significant. A two tailed T-test was used to calculate p-values.

Results

Comparison of patient population characteristics of both the groups are listed in Table 2. In group one, which included patients of Vietnamese ethnicity, out of seventy five patients, thirty one patients were female. Mean BMI of patients in this group was 24.8 ± 4.2. 79% (59) of the patients had hypertension, 31% (23) patients had diabetes mellitus, and 24% (18) patients had a history of smoking. In group two, which included patients from Hispanic, Asian (excluding Vietnamese), Caucasian, and African American ethnicities, out of seventy five patients, thirty six patients were female. Mean BMI of patients in this group was 27.6 ± 6.7. 84% (63) of the patients had hypertension, 25% (19) patients had diabetes mellitus and 32% (24) patients had a history of smoking.

	Group 1	Group 2
Body mass index, kg/m^2	24.8 ± 4.2	27.6 ± 6.7
Hypertension	79%	84%
Diabetes Mellitus	31%	25%
Smoking	24%	32%

Table 2: Patient characteristics.

When comparing the ascending aortic diameter between the two groups, the mean diameter (centimeter) of the ascending aorta in group one patients was higher than in group two patients for age groups above sixty years. The mean diameter of an ascending aorta for both groups respectively is 3.35 ± 0.3 and 3.08 ± 0.4 (45 to 60 years, p=0.08), 3.47 ± 0.34 and 3.17 ± 0.34 (61-75 years, p<0.005), and 3.77 ± 0.31 and 3.24 ± 0.33 (75+ years, p<0.001). The p-value for age group of 45-60 years shows that the diameter of ascending aorta of both the groups is not statistically different (Table 3).

Age Groups (years)	Group 1	Group 2	p-value
45-60	3.35 ± 0.3	3.08 ± 0.4	0.08
61-75	3.47 ± 0.34	3.17 ± 0.34	<0.005
75+	3.77 ± 0.31	3.24 ± 0.33	<0.001

Table 3: Mean aortic diameter (centimeter).

The mean follow-up duration for 2D echocardiography was 14 ± 4.5 months. On comparing ascending aortic expansion rate in both the study groups, medial annual growth rate of dilatation (centimeter/year) was almost double in patients of group one than of the patients in group two, listed here respectively: 0.025 and 0.012 (less than 60 years, p<0.05), 0.075 and 0.04 (61-75 years, p=0.45), and 0.1 and 0.05 (above 75 years, p<0.05). As the p-value for age group of 61-75 years shows, the diameter of the ascending aorta of both groups is not statistically different (Table 4).

Age Groups (years)	Group 1	Group 2	p- value
45-60	0.025	0.0125	<0.05
61-75	0.075	0.04	0.45
75+	0.1	0.07	<0.05

Table 4: Median Aortic Dilatation (centimeter/year).

Discussion

The Ascending Aorta (AA) is a portion of the aorta starting at the upper part of the base of the left ventricle beyond the aortic valve. It is

approximately 5 cm in size and has two distinct segments, an upper segment known as tubular ascending aorta and lower segment, known as aortic root, which is the usual site for dilatation [7]. Echocardiography enables qualitative and quantitative evaluation of ascending aorta. Views that show maximum diameter of aortic root should be used for measurements [8]. There is no screening protocol with age to identify dilatation in ascending aorta. Most patients with dilatation have no symptoms, and is usually an incidental finding on echocardiography done for unrelated purposes.

Across both genders, increasing body size is characterized by a modest degree of aortic dilatation, even in the absence of traditional cardiovascular risk factors [9]. In our study, it is noted that the Vietnamese population aortic dilatation varies from normal standards of diameter and rate of expansion. Vietnamese population with a mean BMI of 24.8 ± 4.2 have dilated ascending aorta for any given age group in comparison to other ethnic populations whose mean BMI is much higher at 27.6 ± 6.7. The Vietnamese population's ascending aorta has a diameter of 3.47 ± 0.34 and 3.77 ± 0.31 cm for the age group of 61-75 years and 75 years and above respectively. On the other hand, patients in group two had a mean aortic root diameter of 3.17 ± 0.34 and 3.24 ± 0.33 for age groups 61-75 years and 75 years and above respectively. These values correlate with the standard diameter of the ascending aorta [9].

Rate of dilatation of the ascending aorta is not constant for all individuals, depending on the underlying etiology causing the dilatation. Various causes that can accelerate dilatation are hypertension, history of smoking, and obesity. Conventionally, standard rate of dilatation in the ascending aorta is about 0.1 cm per 10 years [1]. Dilatation associated with genetic syndromes can be more rapid. Dilatations associated with bicuspid aortic valve have average expansion rates of up to 0.2 cm per year [4,10]. Marfan syndrome is associated with average expansion rates up to 0.3 cm per year. Loeys-Dietz syndrome can expand very rapidly up to 1.0 cm per year [4,11]. Our study shows that the Vietnamese population's dilatation rate of the ascending aorta is variable with a median of 0.075 cm per year and 0.1 cm per year for age groups 61-75 years and 75 years and above respectively. The patients in group two show a medial dilatation of the ascending aorta of 0.04 cm per year and 0.07 cm per year for age groups 61-75 years and 75 years and above respectively, correlating with the standard rate of expansion in the general population.

We recommend that patients with Vietnamese background should be evaluated within six months after the initial diagnosis of dilatation to assess the rate of growth. Follow up should be done bi-annually or at least annually unless the growth rate is greater than 0.5 cm per year, which requires more frequent follow-up. Surgical intervention as per the American College of Cardiology/American Heart Association is indicated for size 4.5 cm to 5.5 cm as class IIa recommendation (moderate) and for the size of ≥ 5.5 cm as class I recommendation (strong).

The present study has limitations. First, our patients comprised of an elderly population. Considering that the younger population does not develop dilatation, they were not included; moreover there is a limited sample size (less than 45) of Vietnamese patients in that subset for whom the echocardiography was done for unrelated cardiac indications. Secondly, only the risk factors for dilatation and expansion of aorta like age, hypertension, smoking status, and body mass index was considered in the study while other possible risk factors associated were not taken into account. This requires extensive review of the medical records and further investigations. Since progression of dilatation of ascending aorta is ill defined in this population, specific recommendations for frequency of imaging follow-up is not standardized.

Conclusion

The risk of aortic dissection is clinically important in individuals with moderate dilatation, but it is poorly quantified. The Vietnamese population has an increased diameter of ascending aorta for a given age and also has a rapid rate of expansion of ascending aorta in comparison to other ethnic populations of the same age range. This trend of dilated ascending aorta and its rapid expansion rate is contrary to the short and lean stature of the Vietnamese population. Hence, we recommend lowering the threshold for the follow up intervals and may be an early prophylactic thoracic aorta repair. Further studies specific to the Vietnamese population is needed to identify any genetic risk factors linked to dilation of the ascending aorta and its faster rate of expansion.

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