

Thoracic aortic dimensions in a Sri Lankan cohort; a computerized tomography-based study

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Abstract

Introduction

In adults the Thoracic aorta (TA) begins from the ascending aorta at the level of the manubrio sternal joint and arches backward and to the left over the left main bronchus and ends at the level of 4th thoracic vertebra. From this level it continues as descending thoracic aorta (DTA). The TA diameter decreases progressively from the ascending aorta (ASA) to the DTA. In addition the diameter of the TA also varies according to the age, gender and race. It is believed that diameters of the arteries including the thoracic aorta may be smaller in Sri Lankan population. Therefore this study was done on the diameters of the thoracic aorta because accurate knowledge of these diameters are essential to define abnormalities, and to plan interventions.

Methodology

The patients who underwent contrast-enhanced computerised tomographic scans (CECT) of chest for non-aorta-related diseases at the National Hospital of Sri Lanka in Colombo were included. The imaging was done using a Toshiba Aquilion scanner with 3D reconstructions. Omnipaque 300 (Iohexol) intravenous contrast agent. Data on age, gender, and ascending (D1) and descending aortic (D2) diameters were collected. Aortas with variations, unclear images and images with artefacts were excluded. Statistical significance was regarded as a p-value of less than 0.05.

Results

Total of 50 CECT were evaluated. 28 images were analysed. Mean age was 56.0 years (20-81). 16 (57.1%) were males. The mean diameter at the mid ascending aorta (D1) was 27.6 mm (21.0 - 34.0). The mean diameter at mid DTA (D2) was 21.9 mm (15.6 - 33.0). This difference was statistically

significant ($P < 0.0001$) compared to values reported from other races in literature. Similarly the D2 in the present study was 21.9 mm (15.6- 33.0). This difference was also statistically significant ($P < 0.0001$).

Conclusion

This study findings indicate that the diameters of the thoracic aorta in the study population is smaller than the western population. This is likely to be the case with the all Sri Lankan population. Therefore country wide study is needed to confirm the above findings. Further, the aortic aneurysm size definition and the size threshold for aortic aneurysm repair have to be redefined in the Sri Lankan population.

Introduction

In adults the thoracic aorta (TA) begins from the left ventricle of the heart at the level of aortic valves as the ascending aorta (AA). AA ends at the level of the manubrio sternal joint and continues as the aortic arch (ARC). The ARC arches backward and to the left over the left main bronchus and ends at the level of 4th thoracic vertebra and continues as descending thoracic aorta (DTA). DTA enters the abdomen through the diaphragmatic hiatus at the level of the twelfth thoracic vertebra (T12). The diameter of the TA reduces from the ascending aorta (AA) to the DTA. In addition the diameter of the TA also varies according to age, gender, body size and the race [1].

The normal ascending aortic diameters are 36mm and 38mm in females and males respectively [2]. Similarly the normal diameters of the descending aorta in females and males are 25.4 mm and 34.5 mm [3]. The aorta and other arteries are thought to be smaller in diameter among the south Asian and Sri Lankan populations. For example in a computed tomographic (CT) imaging based study done in Sri Lanka, The abdominal aortic dimensions were significantly lower in Sri Lankan population when compared with the western population [4].

However no similar studies have been done to assess the diameters of the thoracic aorta. Furthermore, thoracic aortic surgeries are frequently performed. Knowing the diameter of

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the thoracic aorta in Sri Lankan population will assist in clinical decisions i.e. to define the aortic aneurysm and thresholds for intervention. It also helps in choosing the correct sized graft for thoracic aortic surgeries. The current study evaluates the diameter of the thoracic aorta from CT images.

Materials and methods

This is a retrospective cross sectional descriptive study done at the National hospital of Sri Lanka, Colombo (NHSL). The patients who underwent contrast enhanced computerized tomographic scan (CECT) of the chest at the radiology department at the NHSL for non-aorta related diseases were considered for inclusion. Imaging was done with multi-detector Toshiba Aquilion 16 slice CT scanner with 3 dimensional (3D) reconstructions. As an intravenous contrast agent, Omnipaque 300 (Iohexol) was used (volume used was approximately 80 ml, i.e. 1ml/kg). The timing was done automatically by selecting the region of interest (ROI) at the arch of the aorta (approximately 20 seconds).

The images were analysed at workstation (console) using Vitrea software by the radiologist and the vascular surgeon in the arterial phase (axial, coronal, sagittal, and 3D views). Data on age, gender and aortic diameters (ascending and descending) were collected. Aortas with arch branching pattern variations, non-clear images (due to wrong timing of the contrast), inadequate exposure and images with artefacts (due to Central Venous lines, previous surgeries, and mediastinal pathology) were excluded.

The diameter of the aorta was measured as follows. The ascending aorta diameter was measured in the middle of AA (mid ascending aortic diameter D1) (Figure 1). The descending aorta diameter (D2) was measured at the level of the fourth thoracic vertebra. The maximum axial luminal diameter was measured in two directions (at right angles to each other). The average diameter was calculated and entered into the data sheet. A “p” value of less than 0.05 was considered statistically significant.

Results

Total of 50 CECT were evaluated. 22 (44.0%) CECT scans were excluded. 28 images were analysed. Mean age was 56.0 years (20-81). 16 (57.1%) were males and 12 (42.9%) were females. The mean diameter at the mid ascending aorta (D1) was 27.6 mm (21.0 - 34.0). The mean diameter at mid DTA (D2) was 21.9 mm (15.6 – 33.0). The mean D1 in males were 28.83 mm (22.8-34.0) and the mean D1 in females was 25.95 mm (21.0-32.6) this difference was statistically significant (p-

0.04). Similarly the mean D2 in males was 23.05 mm (16.0 to 33.0) and the mean D2 in females was 20.45 mm (15.6 to 24.0) this difference was also statistically significant (p-0.04).

In patients less than 55 years of age, the mean D1 was 26.79 mm (21.0 - 34.0) and the mean D1 in patients more than 55 years was 28.13 mm (23.0 - 33.0). However this difference was not statistically significant (p-0.18). Similarly the mean D1 of females less than and more than 55 years were 24.82 mm (21.0 – 27.3) and 27.1 mm (23.0 – 32.6). However these differences were also not statistically significant (p- 0.13). Furthermore the mean D1 of males of less than and more than 55 years were 29.16 mm (22.8 – 34.0) and 28.69 mm (23.0 – 33.0). These differences were also statistically not significant (p- 0.40).

However in patients less than 55 years the D2 was 20.34 mm (16.0 - 22.6) and the mean D2 in patients more than 55 years was 22.97 mm (19.0 - 29.0). This difference was statistically significant (p-0.04).

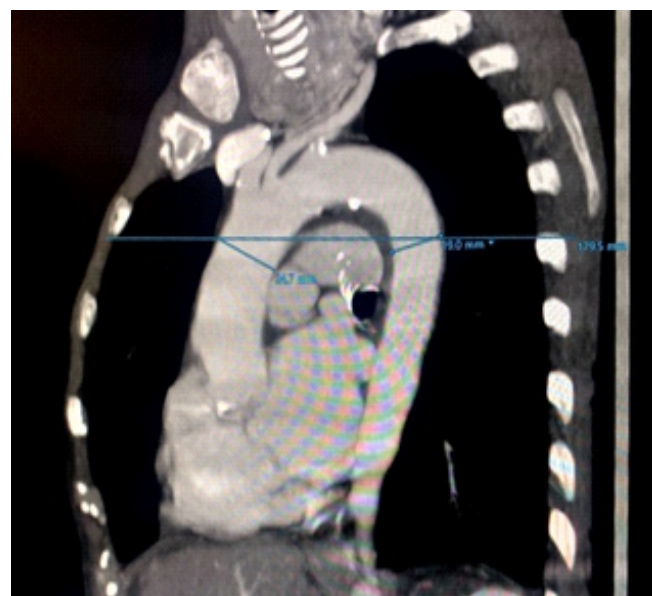


Figure 1: Measurement of diameters

Discussion and Conclusions

The mean D1 of individuals in this study was 27.6 mm (21.0 - 34.0). The mean D1 in males were 28.83 mm (22.8-34.0) and the mean D1 in females was 25.95 mm (21.0-32.6). This was compared with the D1 values from other studies. In a study done among 2353 individuals in Korea, the mean diameter of the ascending aorta was 34.1mm. When compared with the mean D1 of the present study, this difference was statistically significant (P < 0.0001) [3]. Similarly the mean D2 in the

Korea, the mean D2 was 24.8mm. This difference was also statistically significant ($P < 0.0001$). In another study done in Germany among 70 Individuals [5], diameter of the ascending aorta was 29.4 mm. This diameter also was significantly larger when compared to the current study population ($p=0.018$).

In another study done at the United States among 1442 individuals, the mean D1 of male and females were 33.6 mm and 31.1 mm [6]. This difference in D1 was statistically significant when compared to the present study diameters.

These findings indicate that the diameters of the ascending aorta and the descending aorta were significantly smaller in the current study compared to other populations in the world.

The thoracic aortic diameter is known to increase with aging. Studies have reported that the thoracic aortic diameter increases by 0.7 mm to 1.7 mm per decade [7] [8] [9]. In the present study the mean D2 in patients less than 55 years was 20.34 mm (16.0 - 22.6) and the mean D2 in patients more than 55 years was 22.97 mm (19.0 - 29.0). This difference was statistically significant ($p=0.04$). Whereas the mean D1 in patients less than 55 years was 26.79 mm (21.0 - 34.0) and the mean D1 in patients more than 55 years was 28.13 mm (23.0 - 33.0). However this difference was not statistically significant ($p=0.18$). This is probably due to the smaller numbers of individuals in this study.

This study finding indicates that the diameters of the thoracic aorta in the study population are smaller than the western population. Therefore the Sri Lankan population is also likely to have smaller diameter thoracic aorta. Therefore a country wide study with a larger population is needed to confirm the above findings in Sri Lankan population. These marked differences in diameters suggest that the aortic aneurysm size definition and the size threshold for aortic aneurysm repair have to be redefined in Sri Lankan population.

Limitations

The number of subjects included in this study is small compared to other similar studies mentioned above. This is a drawback in this study. Also as mentioned earlier the diameter of the aorta is also known to vary with patients' comorbid conditions (hypertension), height and BMI [8]. These factors were not assessed in this study because the current study was a retrospective study from the records at the radiology department. Therefore the above details cannot be accessed.

This is also a drawback in this study. Therefore similar studies are needed in the future with a larger countrywide sample.

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