Normal Size of the Thoracic Aorta in Thai Population

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Objective: *To study average diameters of normal thoracic aorta in Thai population.*
Material and Method: *Eight levels of aortic diameters were collected from 100 adult patients who underwent a thoracic helical CT scan for various non-aortic diseases. Two perpendicular diameters were measured. Mean, minimal, maximal and standard deviation (SD) of all data were analyzed.*
Results: *There were 51 males, 49 females. Mean age was 57.7 years (range 18 to 92). Average aortic diameter (mean ± SD) was 28.55±5.16 mm at aortic annulus, 34.63±4.74 mm at aortic sinus, 33.62±5.07 mm at ascending aorta, 32.43±4.62 mm at proximal to innominate artery level, 30.68±4.27 mm at left common carotid taking off level, 28.77±3.94 mm at left subclavian taking off level, 27.59±4.02 mm at descending aorta just distal to left subclavian artery level and 23.28±3.65 mm at diaphragmatic level. Male aortic diameters are larger than female's. Aortic diameters increased with age in all levels.*
Conclusion: *Average thoracic aortic diameters in Thai population were proposed. Sex, age and various aortic levels determine size of the thoracic aorta.*

Keywords: *Thoracic aorta, Thai population*

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Thoracic aortic diameters widely used for treatment considerations were based on literatures which measurement was obtained from Caucasian population[1-4]. The average body size of Thai and Southeast Asian is smaller than Caucasian. Normal size of the thoracic aorta in Thai should be assumably different from European aortic size as in literatures. Since there is little published data of normal size of Southeast Asian aorta[5] and nowadays endovascular surgery play a major role in management of thoracic aortic disease, to know the normal size of thoracic aorta enhance benefit in proper management of aneurysmal patients.

Material and Method

The study has been approved by the Siriraj institutional review board. The approval number was Si. 181/2008.

Patients

We included adult patients who underwent a thoracic helical CT study for various non-aortic diseases and age group more than 17 years old. Patient with any sign of aortic disease or connective tissue disease were excluded from this study. Demographic data was shown in Table 1.

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Measurements

Aortic diameters will be measured at eight intrathoracic levels: Aortic annulus, Aortic sinus, Ascending aorta, Proximal to innominate artery, Left common carotid taking off, Left subclavian taking off, Descending aorta just distal to left subclavian artery, Diaphragmatic level (Fig. 1). Imaging was acquired from 64 slides CT scan (GE light speed and SIEMEN definition) and reconstruction with a GE workstation. The slices were manually adjusted for each aortic level to get an oblique plane. The diameter of the vessel was measured with an electronic caliper in two perpendicular directions. Mean of those diameters was used for further calculations. All images were reconstructed and analyzed by single researcher.

Statistical analysis

The average size (and SD) of thoracic aorta at 8 different levels will be reported along with their 95% CIs. Correlation between size of thoracic aorta and age will be explored using scatter plot and Pearson's

Table 1. Demographic data of patients

	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)	BSA (m^2)
Mean	57.05	160.34	60.22	23.30	1.62
Median	58.50	160.50	60.00	22.85	1.62
SD	14.47	8.26	10.78	3.68	0.16
Minimum	17	140	40.0	15.52	1.27
Maximum	90	176	89.0	32.00	2.03

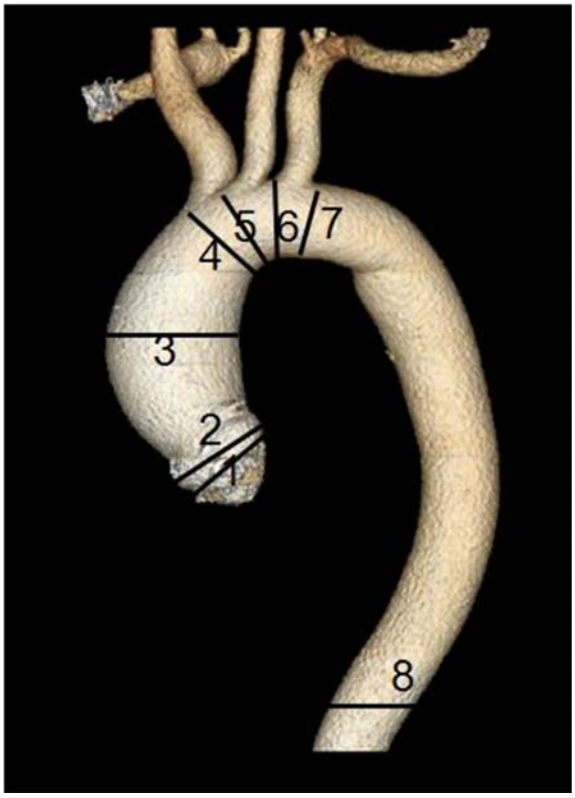

Fig. 1 Levels of measured aortic diameters: 0 = Aortic annulus; 1 = Aortic sinus; 2 = Ascending aorta; 3 = Proximal to innominate artery; 4 = Left common carotid taking off; 5 = Left subclavian taking off; 6 = Descending aorta just distal to left subclavian artery; 7 = Diaphragmatic level.

correlation. Difference in size of thoracic aorta according to gender, BMI and BSA will also be assessed using unpaired t-test. The data was calculated using SPSS version 13.

Results

Average aortic diameter (mean ± SD) was 28.55±5.16 mm at aortic annulus, 34.63±4.74 mm at aortic sinus, 33.62±5.07 mm at ascending aorta, 32.43±4.62 mm at proximal to innominate artery, 30.68±4.27 mm at left common carotid and aortic arch junction, 28.77±3.94 mm at left subclavian and aortic arch junction, 27.59±4.02 mm at descending aorta just distal to left subclavian artery, 23.28±3.65 mm at diaphragm level (Table 2).

In all aortic area male has larger aortic diameter than female, and there was statistically significant in every levels (Table 3). As Pearson correlation there was a significant increase of the aortic diameters when age was increased (Table 4, Fig. 2).

Discussion

Nowadays, thoracic aortic disease was not uncommon disease and because our population tend to have increasing lifespan so the aortic disease will be raising. Management of aortic disease was mostly depended on the diameter. In Caucasian population, there were many studies proposed normal diameter of the aorta, using various modality[1-4]. However, in Thai population, there is still lack of data on this issue[5]. The decision to manage aortic disease mainly depended on the Caucasian data. The average body size of Thai and South East Asian is smaller than Caucasian's then normal size of the thoracic aorta may be difference from the literature.

Endovascular surgery was increased in use and planning of this procedure was mainly achieved by information from CT scan, the normal diameter of Thai population based on CT scan will be benefit in decision making of management in Thai patient.

In this study the authors proposed normal diameter of various levels of thoracic aorta. The aortic sinus was in the greatest diameter and then the aortic size gradually decreased to the diaphragmatic level. The diameter of male aorta was significant larger than female's in all levels. Diameter was also increased with age, body mass index (BMI) and body surface area (BSA). The correlations of sex, age, BMI and BSA in aortic diameter support previous report literature.

Compared to data from Caucasian[1-4] Thai

Table 2. Aortic diameters at various thoracic levels

Diameters (mm)	Min - max	Mean	SD
Aortic annulus	18.20 to 41.00	28.55	5.16
Aortic sinus	25.35 to 48.00	34.63	4.74
Ascending aorta	19.55 to 45.35	33.62	5.07
Proximal to innominate artery	20.65 to 45.05	32.43	4.62
Left common carotid taking off	19.70 to 41.35	30.68	4.27
Left subclavian taking off	18.70 to 39.10	28.77	3.94
Descending aorta just distal to left subclavian artery	17.55 to 38.50	27.59	4.02
Diaphragmatic level	13.35 to 34.80	23.28	3.65

Table 3. Comparison of aortic diameters at various thoracic levels between male and female

Diameters (mm)	Sex	Mean	SD	*p*-value	Mean difference M-F (95% CI)
Aortic sinus	M	36.60	4.06	<0.001	4.02 (2.31, 5.73)
	F	32.58	4.55		
Ascending aorta	M	35.04	4.44	0.004	2.90 (0.96, 4.83)
	F	32.14	5.30		
Proximal to innominate artery	M	33.89	4.08	0.001	2.96 (1.22, 4.71)
	F	30.92	4.71		
Left common carotid taking off	M	32.02	3.48	0.001	2.73 (1.11, 4.34)
	F	29.29	4.60		
Left subclavian taking off	M	29.84	3.20	0.005	2.18 (0.67, 3.69)
	F	27.66	4.34		
Descending aorta just distal	M	28.84	3.36	0.001	2.56 (1.04, 4.08)
to left subclavian artery	F	26.28	4.26		
Diaphragmatic level	M	24.84	3.11	<0.001	3.17 (1.85, 4.48)
	F	21.67	3.50		

Table 4. Correlation between aortic diameters and age, BMI, BSA

	Pearson correlation coefficient		
	With age	With BMI	With BSA
Aortic annulus	0.242 (p = 0.015)	0.124 (p = 0.230)	0.382 (p<0.001)
Aortic sinus	0.364 (p<0.001)	0.192 (p = 0.061)	0.450 (p<0.001)
Ascending aorta	0.589 (p<0.001)	0.289 (p = 0.004)	0.364 (p<0.001)
Proximal to innominate artery	0.605 (p<0.001)	0.339 (p = 0.001)	0.407 (p<0.001)
Left common carotid taking off	0.620 (p<0.001)	0.269 (p = 0.008)	0.334 (p = 0.001)
Left subclavian taking off	0.571 (p<0.001)	0.294 (p = 0.004)	0.346 (p = 0.001)
Descending aorta just distal to left subclavian artery	0.468 (p<0.001)	0.320 (p = 0.001)	0.407 (p<0.001)
Diaphragmatic level	0.563 (p<0.001)	0.276 (p = 0.007)	0.452 (p<0.001)

population had smaller aortic diameter at all levels. This finding was corresponding with data obtained from Northern Thai people[5]. Those may be due to difference in body size or ethnic differences.

This study still had limitations. First, the present study was a review of thoracic CT in patient

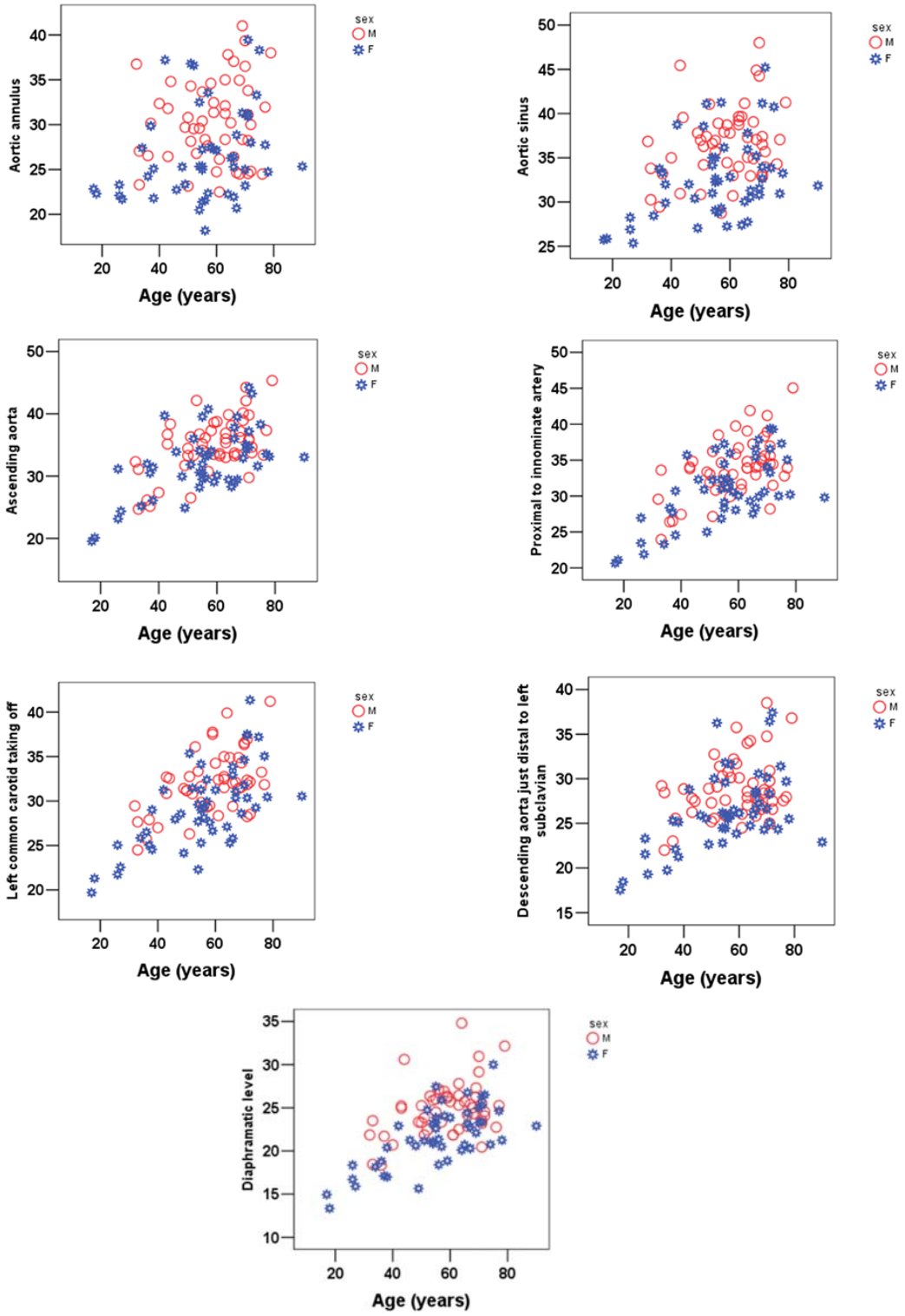

Fig. 2 Scatter plot of aortic diameters with age.

underwent a thoracic helical CT study for non-aortic disease then there was may not represent real normal population. However, as protocol of inclusion and exclusion criteria, the authors try to exclude all diseases

associated with vascular abnormality. Second, almost of the patient was elderly, mean age was 57 years old. The aortic diameter may represent a larger size than normal diameter in younger age group. Third, even the authors think Thai population should have smaller diameter of aorta than Caucasian population, direct comparison has not been done. The further study for comparison of Thai population and Caucasian will add this study more benefit.

Conclusion

Average thoracic aortic diameters in various levels of Thai population were proposed. Sex, age and various aortic levels determine size of the thoracic aorta.

What is already know on this topic?

The normal size of thoracic aorta in Western population have been published many series in the literature.

What this study adds?

This study adds data of normal size of thoracic aorta in the central population of Thailand in the mean age of 57.7 years old by CTA measurement.

Potential conflicts of interest

None.

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ขนาดปรกติของหลอดเลือดแดงใหญ่ทรวงอกในประชากรไทย

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จุดประสงค์: เพื่อศึกษาขนาดปรกติของหลอดเลือดแดงใหญ่ทรวงอกในประชากรไทย

วัสดุและวิธีการ: ทำการรวบรวมขนาดของหลอดเลือดแดงใหญ่ทรวงอกทั้งหมด 8 ระดับ จากผู้ป่วย 100 คน ที่มาทำ CT Scan ด้วยโรคอื่นๆ ที่ไม่ใช่โรคของหลอดเลือดแดงใหญ่ โดยใช้การวัดขนาด 2 แกนในแต่ละระดับจากนั้นจึงหาค่ากึ่งกลาง ค่าต่ำสุด ค่าสูงสุด และค่าเบี่ยงเบนมาตรฐาน เพื่อรายงานผล

ผลการศึกษา: ในการศึกษามีผู้ป่วยชาย 51 คน ผู้ป่วยหญิง 49 คน อายุเฉลี่ย 57.7 ปี (ช่วงอายุทั้งหมด 18 ถึง 92 ปี) พบว่าหลอดเลือดแดงใหญ่มีขนาดเฉลี่ย 28.55±5.16 มม. ที่ aortic annulus, 34.63±4.74 มม. ที่ aortic sinus, 33.62±5.07 มม. ที่ ascending aorta, 32.43±4.62 มม. ที่ proximal to innominate artery, 30.68±4.27 มม. ที่ left common carotid taking off level, 28.77±3.94 มม. ที่ left subclavian artery และ 23.28±3.65 มม. ที่บริเวณกระบังลม โดยผู้ป่วยชายมีขนาดหลอดเลือดแดงใหญ่โตกว่าหลอดเลือดแดงใหญ่ของผู้ป่วยหญิง และขนาดของหลอดเลือดแดงใหญ่จะโตเพิ่มขึ้นตามอายุในทุกตำแหน่ง

สรุป: การศึกษานี้รวบรวมขนาดปรกติของหลอดเลือดแดงใหญ่ในประชาการไทยไว้และพบว่า เพศ อายุ และตำแหน่งมีผลต่อขนาดของหลอดเลือดแดงใหญ่