Normative Reference Values of Abdominal Aortic Diameters of Sudanese Using Computed Tomography

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Abstract: Computed tomography angiography (CTA) is a standard tool for investigation of the abdominal aorta diseases. Currently, there are only a few published scientific articles devoted to the study of the infrarenal aortic size without pathology. The aims of this study were to use Computed Tomography (CT) to determine normal diameters for the suprarenal and infrarenal abdominal aorta in Sudanese population of asymptomatic, low-risk adult subjects and to study the variation in aortic diameters with age and gender. A total of 200 patients (108 males and 92 females) with a mean age of 48.6 years consecutive adults free of cardiac or aortic structural disease or arrhythmia who referred for abdominal CT scanning in the radiology department of Royal Care Hospital in Khartoum- Sudan during the period from August 2015 to May 2018. The mean internal diameters of the suprarenal and infrarenal abdominal aorta were measured at T12 and L3 vertebral levels and tabulated according to various age groups for both men and women. Pearson correlation coefficient was used to evaluate the correlation between aortic diameters, with age and gender. The results of this study revealed that the mean diameter of the suprarenal abdominal aorta, measured at T12 vertebral level was19.44±1.51 mm in women and 20.97±1.74mm in men. The mean diameters of the infrarenal abdominal aorta, measured at L3 vertebral level were 14.13±1.34 mm. in women and 17.34±1.36 mm. in men. It concluded that normal dimensions abdominal aorta by CT scan was established and correlated with age and gender which is similar to previously published studies.

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1. Introduction

Knowledge of normal abdominal aortic size in patients without vascular disease is an important criterion to diagnose abdominal aortic aneurysms (AAA). [1]

Abdominal aortic aneurysm (AAA) is a dilatation of the abdominal aorta. There are several definitions of an AAA. A diameter in excess of 30 mm based on thegiographic study is the most accepted definition.[2]Some definitions relate to the infrarenal aortic diameter to the suprarenal aortic diameter.[3]The International Society for Cardiovascular Surgery/Society for Vascular Surgery Ad Hoc Committee proposed that an AAA is defined as the maximum infrarenal aortic diameter being at least 1.5 times larger than the expected normal infrarenal aortic diameter.[4]With this standard definition, it is important to know the normal diameter of the abdominal aorta so that clinicians will be able to determine when an aorta becomes aneurysmal. The mean diameters at the level of the infrarenal aorta were 16 to 23 mm in males and 15 to 19 mm in females.[5-7] However, a practical working definition of an AAA is a transverse diameter of 3 cm or greater based on average values for normal individuals.[8] Nowadays Computed Tomography Angiography (CTA) is one of the main noninvasive medical tests that provides detailed information about the aorta and its branches, this is due tothe fact that the method is highly informative, reliable and safe. Currently, only a few published articles have devoted to the study of the infrarenal aortic size without pathology.[9] The relevance of the investigation of these indicators comes from the dependence of changes in aortic measurements on the anthropometric indicators, such as age and other risk factors for the development of aneurysms of the infrarenal aorta (IA).[10]The determination of the aneurysmal sac became used recently. The method of determining the volume of the aneurysmal expansion may play a key role in the observation of small abdominal aneurysms and follow-up of endovascular repair of abdominal aortic aneurism.[11-13]

The aim of this study was to determine normal diameters for the suprarenal and infrarenal abdominal aorta in Sudanese population of asymptomatic, low-risk adult subjects and to study the variation in aortic diameters with age and gender, Using Computed Tomography.

2. Material and Methods

The target population for this study were patients who referred for abdominal CT scanning to radiology department of Royal Care Hospital in Sudan during the period from August 2015 to May 2018, included 200 patients (108 males and 92 females) with a mean age of 48.6 years.

The machine used in this study was Toshiba CT scan machine 64 detectors model Aquilion 64 manufacture date 2009 Siemens CT scan machine Hi-Speed CT/E Dual CT Scanner model SOMATOM definition flash with 256 detector manufacture date 2011). Three options of slice thickness: 3mm, 5mm, and 10mm. Similar scan interspaces.

CT imaging protocol:

CT scans were performed on multi-channel helical scanners that allowed the retrospective reconstruction of image data into data sets of different spatial quality and image characteristics. CT acquisition parameters were based on a standard protocol, including detector collimation of 0.5-2.5 mm. The technical exposures factors that were used in this study were 120 Kv, 100 mA, 10 mm increments, 3 - 10 mm slice thickness with identical reconstruction index and a rotation time 1.5sec.

Examinations were considered acceptable if all images of the thoracic and abdominal aorta were intact and available with soft tissue window settings.

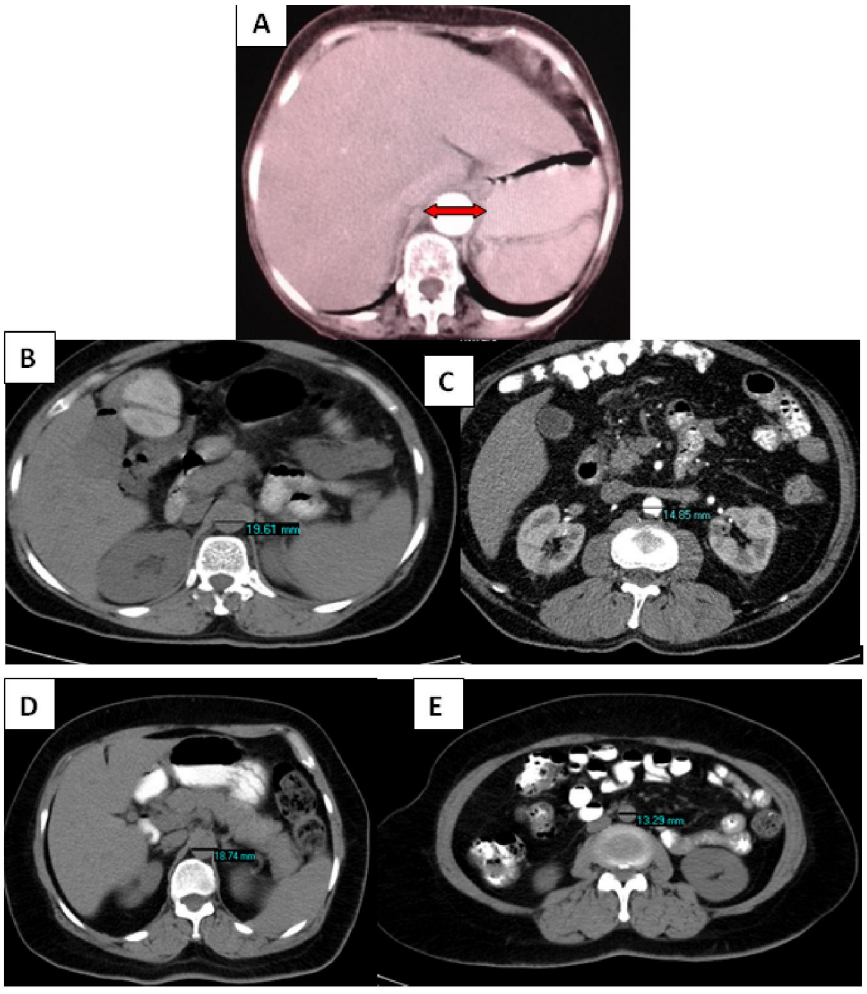

Figure 1 Axial images showing the levels of aortic diameter measurements. (A) Transverse Abdominal Aorta Measurement (B) aortic diameters measurements of 71 years old male at T12 level (C) Transverse aortic arch (D) aortic diameters measurements of 71 years old male at L 3 level (E) aortic diameters measurements of 43 years old female at T12 level (F) aortic diameters measurements of 43 years old female at L 3 level.

The scan was done started from lower chest to symphysis pubis in the most cases contrast media (Omnipaque -300 ml) to delivered into the body through the venous system by use sure start technique the dose (70-100 ml) according to patient weight and hospital polices with delay 30se-40 se, the rate of injection 2 -3- ml/ s using automatic injector machine. The technical exposures factors that were used in this study were 120 Kv, 100 mA, 10 mm increments, 3 - 10 mm slice thickness with identical reconstruction index and a rotation time 1.5sec.

All the measurements done for abdominal aorta diameters were obtained from the distant between the aorta lumens.

All images of the study were measured using transverse abdominal aorta diameters in axial CT abdominal with the contrast between two borders of the aorta at levels T12, L1, L2and L3 the method shown in figure 1(A-E).

Statistical analysis:

The data were analyzed using Excel program and SPSS version 16 for significances of tests was used. Frequency tables mean and standard deviations were presented.

3. Results

Table 1: The relationship between the mean diameters of suprarenal and infrarenal abdominal aorta and Gender

	Age groups	Male (n=108) mm	Female (n=92) mm
Suprarenal abdominal aortas (T12)	21-30	18.64 ±1.64	16.00±1.86
	31-40	19.19±1.88	17.81±1.83
	41-50	20.85±1.7	19.35 ±1.86
	51-60	21.71±2.05	20.92±1.71
	61-70	21.98± 1.93	21.33±2.06
Infrarenal abdominal aortas (L3)	21-30	14.74±2.00	12.55±1.63
	31-40	15.18±1.60	13.78±1.79
	41-50	15.88±1.91	14.40±1.66
	51-60	16.45±1.69	14,62±1.69
	61-70	16.82±1.73	14.94±1.85
p<0.01			

Table 2: Mean abdominal aortic diameters in males and females in Suprarenal and Infrarenal levels

	Male Mean diameter mm	Female Mean diameter mm
Suprarenal abdominal aortas (T12)	20.97±1.74	19.44±1.51
Infrarenal abdominal aortas (L3)	15.81±1.67	14.14±1.72

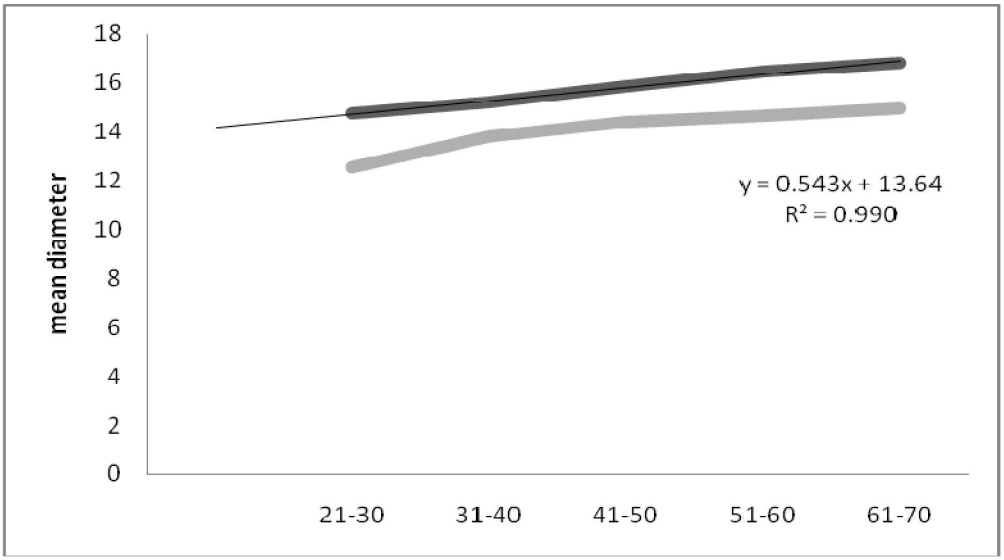

Figure 2 Line presentations of mean aortic diameter and age.

Table 3: The mean aortic diameter with age and gender

Age	Male Mean diameter mm	Female Mean diameter mm
21-30	14.74	12.55
31-40	15.18	13.78
41-50	15.88	14.40
51-60	16.45	14.62
61-70	16.82	14.94

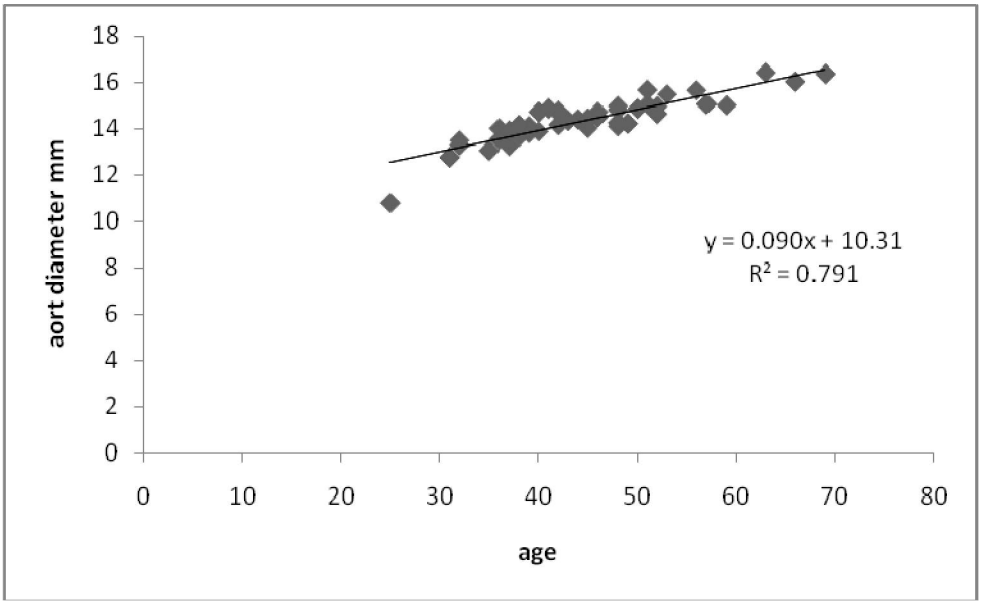

Figure 3: Scatter plot of the suprarenal aortic diameter measured at T12 levels and age in male

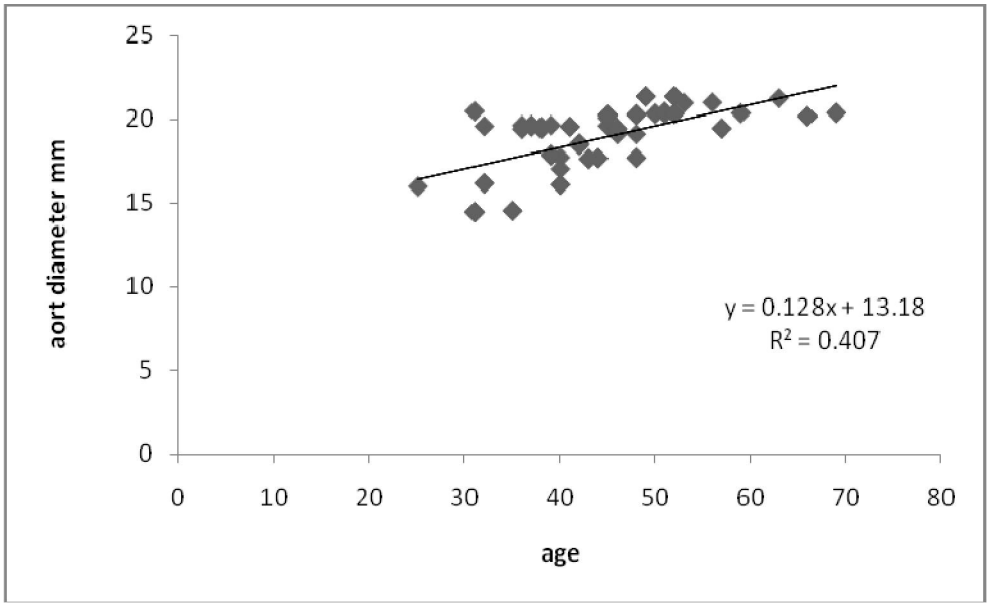

Figure 4: Scatter plot of the suprarenal aortic diameter measured at L3 levels

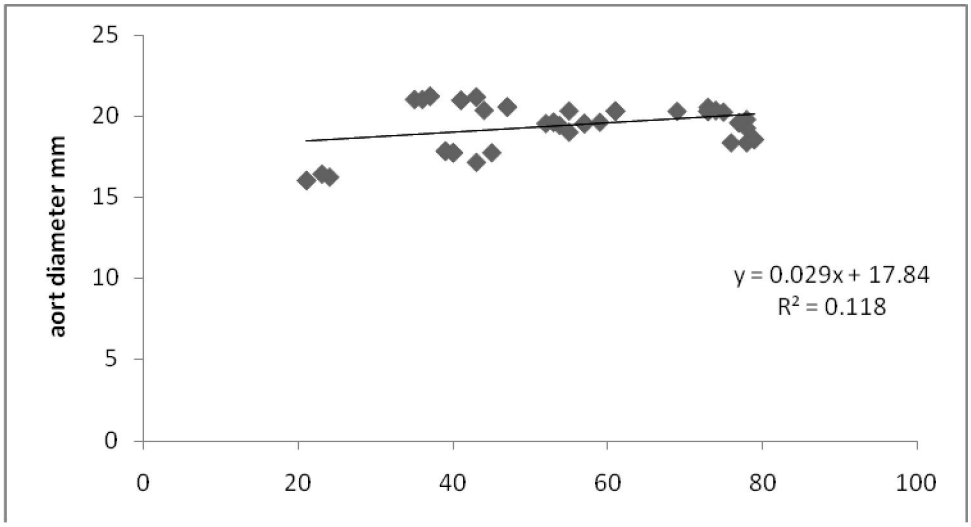

Figure 5: Scatter plot of the suprarenal aortic diameter measured at T12 levels

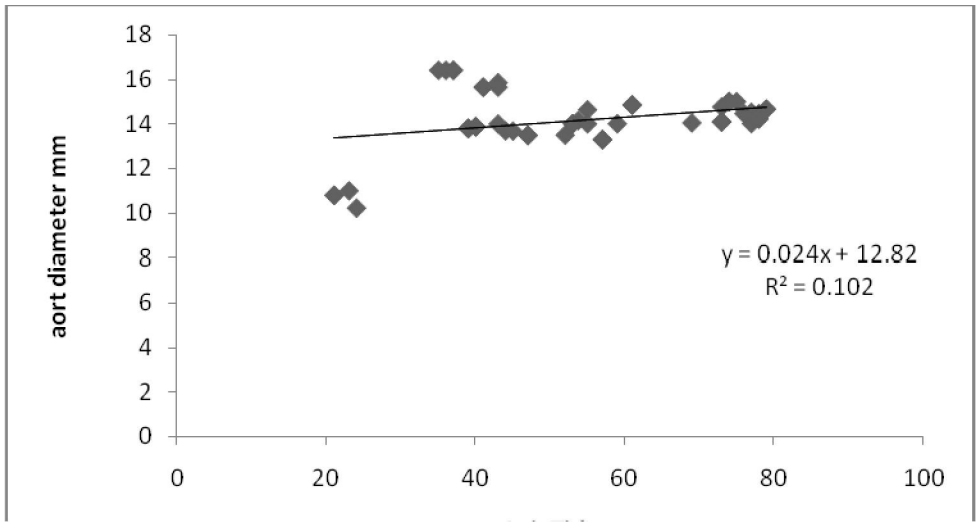

Figure 6: Scatter plot of the suprarenal aortic diameter measured at L3 levels

4. Discussions

The measurement of aortic diameters plays a key role in the clinical evaluation and management of diseases of theaorta.[14,15] Normal values for the thoracic and abdominal aorta in the population have been evaluated by a number of investigators.

This study was done using CT scan to establish normal diameters for abdominal aorta in the Sudanese population and to study the variation in aortic diameter according to age, gender, and different vertebral levels. In order to reduce confusion in terminology, aortic diameters greater than the upper limits of normal, but not meeting criteria for aneurysm, should be described as dilated.

200 patients were enrolled in the study of 92 female patients and 108 male patients between 21-90 years old. The results showed that the normal transverse abdominal aorta diameter was correlated with patient age, gender, and vertebral levels.

In this study, the mean diameter of suprarenal abdominal aortas, measured at the T12 vertebral level was 19.44±1.51mm. in Female and was 20.97±1.74mm. in Male. The mean diameters of infrarenal abdominal aortas, measured at L3 vertebral level was14.14±1.72mm. in Female and 15.81±1.67mm. in Male.

This study agree with Jasper et al study in 2014, using computed tomography to evaluate normal abdominal aortic diameters in the Indian population, who found that the mean diameter of the suprarenal abdominal aorta in men was 19.0±2.3 mm. and in women was 17.1±2.3 mm. The mean diameter of the

infrarenal abdominal aorta was 13.8±1.9 mm. in men and was 12.0±1.6 mm. in women. The mean aortic diameter of the Sudanese people was slightly larger than that of the Indian population at all levels in both genders. The mean aortic diameters had progressively increased values with increasing age in both the suprarenal and infrarenal aorta in both genders[16].

The means aortic diameter of male patients is larger than that of female patients, at all levels which is similar to the previous studies. Dilatation of the aortic root and thoracic aorta predispose patients to aortic regurgitation and aortic dissection.[17]

to the limits for aortic root diameter in relation to age and body size have been developed and widely adopted, but only limited data exist concerning reference values for diameters of more distal aortic segments.[18,19] Advances of multi detector computed tomographic (MDCT) scanners provide high spatial, temporal, and contrast resolution which, when coupled with electrocardiographic (ECG)-gating, permitted 3-dimensional (3D) assessment of cardiovascular (CV) structure and function.[20]

5. Conclusion

In conclusion, the current data establish reference values for abdominal aortic diameters and areas by CT. These data can be used as a reference for future studies attempting to identify abdominal aortic pathology by CT. The diameter of Suprarenal abdominal aortas ranged from16.00±1.86 to 21.33±2.06mm in normal Sudanese female and from18.64 ±1.64 to 21.98± 1.93 mm in normal Sudanese male. The diameter of the Infrarenal abdomemal aorta ranged from12.55±1.63 to 14.94±1.85 mm in normal female and 14.74±2.00 to 16.82±1.73 mm in normal male . Male abdominal aortas bigger than the female abdominal aortas at Suprarenal and Infrarenal levels. This study is subject to limitations of retrospective analysis, small sample size relative to the overall normal abdominal aorta population.

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