Assessment of abdominal aortic diameter by computed tomography

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ABSTRACT

Introduction: The aim of this study was to assess the diameters of abdominal aorta of normal Nepalese people by using computed tomography (CT) scans of Abdomen and to correlate the diameters with the patient's age and gender. CT measurements of abdominal aorta are useful in age estimation and in clinical procedures. **Methods:** This retrospective study was performed in the Department of Radiology and Imaging, Gandaki Medical College, Nepal during the period of four months from December 2023 to April 2024. Data of total 100 patients are collected who underwent CT abdomen or CT Intra Venous Urography (IVU) of which 49 were males and 51 were females. Age and gender were noted, diameters of abdominal aorta were measured at the suprarenal and infrarenal level i.e. at T12 and L3 vertebral levels in Cannon Prime SP Aquilion with 160 slice CT scanner system. **Results:** The mean diameters of the suprarenal and infrarenal abdominal aortas measured at T12 and L3 vertebral levels were 18.98±3.45 mm and 15.19±2.46 mm in men and 18.53±2.79 mm and 14.34±1.92 mm in women respectively. The ratio of the infrarenal to suprarenal abdominal aortic diameters was 0.80±0.06 in men and was 0.77±0.06 in women. **Conclusions:** This study concluded that the diameter of abdominal aorta increased with increase in age and vice versa. Also, there was no significant difference in suprarenal and infrarenal abdominal aortic diameter between male and female.

Keywords: Abdominal aortic diameter, computed tomography, contrast-enhanced.

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Submitted: November 25, 2024
Accepted: May 23, 2025

To cite: Singh S, Sharma BR, Thapa M, Khatri N, Sunar E, Kafle S. Assessment of abdominal aortic diameter by computed tomography. JGMC-Nepal. 2025;18(1):60-4.

DOI: 10.3126/jgmc-n.v18i1.72004

INTRODUCTION

Arteries are complex organ because of their bifurcation and subdivisions at different levels in the body.[1] Aorta is the largest known blood vessel in humans. Structurally, aorta is a big tube and its size is directly equivalent to person's height and weight.[2] It is a continuation of descending thoracic aorta at T12 posterior to the median arcuate ligament and diaphragmatic crura.[3] Within the abdomen, the descending aorta branches into the two common iliac arteries that provide blood to the pelvis and, eventually, the lower legs.[4,5] The normal diameter of abdominal aorta is expected to be <3cm, but with time the size of the aorta varies. If increase in diameter of abdominal aorta exceeds 50%, this results in the presence of ectasia which further turns into the formation of aneurysm. Abdominal aorta aneurysms are not harmful as long as there are no complications because symptoms are not produced by enlargement in diameter alone unless over expansion occurs. The rate of aneurysm rupture increases with age.

The studies earlier have used ultrasound because of its practical and economic reasons.[6] Contrast Enhanced Computed Tomography

(CECT) is used for screening of early changes in size of abdominal aorta and has become an important pre-operative imaging technique well as less operator dependent and more objective.[7-9] CT has various tools and techniques to measure the size of arteries.[10-12] While in the present study, 2D axial sections were taken to measure the variation in size of the abdominal aorta.

METHODS

A retrospective cross-sectional study was conducted at Department of Radiology and Imaging, Gandaki Medical College Teaching Hospital & Research Center, Pokhara using purposive sampling technique from the period of December 2023 to April 2024 after getting the approval from the Institutional Review Committee (Ref. No. 19/080/081-F). CT-Scan cases that were conducted over last six to eight months duration were included in the study.

The study population consisted 100 patients consisting 49 males and 51 females, age ranging from four years to 80 years. Purposive sampling technique (Total Enumeration Technique) was carried out, since there are very few studies with the defined prevalence among Nepalese people, we referred to other previous papers conducted in other Asian countries and they had sample sizes approximately 100.[11,15] All patients referred for the contrast enhanced CT abdomen and IVU in the Department of Radiology were reviewed for study. Any Patients with atherosclerotic plaque seen between T10-L5 levels, technical adequacy like motion artifact, motion blurring, position errors, etc. or any retroperitoneal tumors, metastatic renal cell carcinoma, large abdominal masses distorting the aorta were not included in the study. Scans were performed on Cannon Prime SP Aquilion 160 slice CT scanner with normal department protocol under standard guidelines, patient preparation, procedure and technical adequacy in coronal and axial plane. Contrast scans were acquired after an antecubital intravenous injection. The scan range was from diaphragm to pelvic cavity. The diameters of aorta were measured at supra supra-renal and infra-renal abdominal aorta at T12 and L3 vertebral levels perpendicular to the axis of blood flow in the aorta. (Figure1A and 1B). All images were reconstructed and analyzed. Performa was made to collect the measured values.

Statistical analyses were carried out with the help of Statistical Package for the Social Sciences (SPSS) version 24.0 and Microsoft Excel 2010. The mean, standard deviation, and correlation between transverse diameters of suprarenal and infrarenal abdominal aorta were calculated through descriptive statistics analyses. The values were compared between different age groups, and gender and the results were expressed in tables.

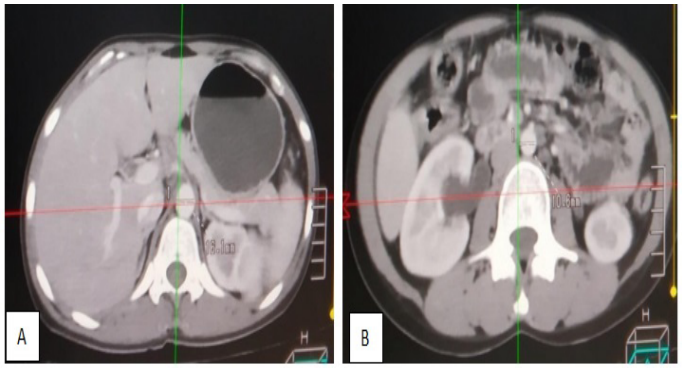

Figure 1

A: Axial images showing the transverse abdominal aortic diameter measurement at T12 vertebral level.

B: Axial images showing the transverse abdominal aortic diameter measurement at L3 vertebral level

RESULTS

The study population comprised of 100 patients, 49 males and 51 female with age ranging from 4 years to 82 years. Patient's age, gender, transverse abdominal aortic diameters at T12 and L3 vertebral levels and L3 level to T12 level ratio were recorded. The mean values of abdominal aortic diameters at T12 and L3 vertebral levels were 18.75±3.12 mm and 14.76±2.23 mm respectively. (Table 1) The mean aortic diameter increases as the age increases. (Table 2) Mean abdominal aortic diameter at both T12 and L3 vertebral level was observed to be larger in male (18.98±3.45 mm and 15.19±2.46 mm) than compared to female (18.53±2.79 mm and 14.34±1.92 mm) respectively (Table 3).

Correlation analysis of different variables was done with age. The results are presented in Table 4. There was significant high positive correlation of abdominal aortic diameter at T12 with age ($r=0.722$, $p< 0.01$) at 0.01 level of significance. There was significant average positive correlation of abdominal aortic diameter at L3 with age ($r =0.659$, $p<0.01$) at 0.01 level of significance.

Independent sample T-test was performed to check whether there is significant difference in the mean abdominal aortic diameter at T12 and L3 between males and females. There was no significant difference of abdominal aortic diameter at T12 level ($T (98)=0.721$, $P=0.472$) and at L3 level ($T(98)=1.918$, $P=0.058$) between males and females. (Table 5)

Table 1: Maximum, Minimum, mean and standard deviations of abdominal aortic diameter measured at T12 and L3 vertebral level (measured in mm)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Diameter of abdominal aorta at T12	100	7.90	26.20	18.7590	3.12914
Diameter of abdominal aorta at L3	100	6.80	21.30	14.7600	2.23693

Table 2: Mean abdominal aortic diameters at T12 and L3 vertebral levels according to age group (measured in mm)

Age groups	Mean diameter of abdominal aorta at T12	Mean diameter of abdominal aorta at L3
Less than 20	13.83±2.74	11.13±2.06
20-29	16.55±1.94	13.80±1.34
30-39	18.45±1.95	14.61±1.86
40-49	18.68±1.57	14.62±0.86
50-59	19.46±1.98	15.30±1.56
60-69	20.37±2.29	15.87±1.69
70 and above	22.15±2.75	16.82±1.93
Mean Value	18.75±3.12	14.76±2.23

Table 3: Mean abdominal aortic diameters in males and females at T12 and L3 vertebral levels

Variables	Male Mean Diameter	Female Mean Diameter
Diameter of abdominal aorta at T12	18.98±3.45	18.53±2.79
Diameter of abdominal aorta at L3	15.19±2.46	14.34±1.92

Table 4: Correlation and p-value of aortic diameter at T12 and L3 level with age of different groups

		Diameter of abdominal aorta at T12	Diameter of abdominal aorta at L3
Age	Pearson Correlation	0.722**	0.659 **
	Sig.(2-tailed)	<0.001	<0.001

**Correlation is significant at the 0.01 level (2-tailed)

Table 5: Independent sample t-test between male and female

		t-test	Df	Sig. (2-tailed)	Mean Difference
Diameter of abdominal aorta at T12	Equal variances Assumed	0.721	98	0.472	0.45254
	Equal variances not assumed	0.718	92.296	0.474	0.45254
Diameter of abdominal aorta at L3	Equal variances Assumed	1.918	98	0.058	0.84674
	Equal variances not assumed	1.908	90.903	0.059	0.84674

DISCUSSION

The objectives of this study were to assess the diameter of abdominal aorta at suprarenal and infrarenal levels (i.e, at T12 and L3 vertebral levels) and to correlate with the patient's age and gender. The subjects were undergoing CT scans of the abdomen for other indications and were not subjected to additional ionizing radiation for the purpose of this study. The data collected were statistically interpreted with some statistical tools and the results were observed.

Sharma et al.[1] studied the variation in the size of abdominal aorta by taking 130 patients concluded that there was a variation in the size of abdominal aorta with age which is similar with conclusion of our study. Studies conducted by Lucarelli et al.,[9] Bootpheaw et al.,[13] Albager et al.,[14] Jasper et al.[15] concluded that the mean aortic diameters increases with increasing age in both suprarenal and infrarenal aorta in both genders which was also the conclusion of this study.

In this study, the mean aortic diameter of the suprarenal abdominal aorta in men was 18.98±3.45 mm and in women was 18.53±2.79 mm and the infrarenal diameter was 15.19±2.46 mm in men and 14.34±1.92 mm in women. In our study mean aortic diameter was found to be slightly larger at all levels in both genders except in men at suprarenal diameter. Men were found to have larger diameters than age matched women which support the conclusion of this study.

Previous studies[9,13-15] also revealed that there was a significant difference in suprarenal and infrarenal abdominal aortic diameters between men and women as $p<0.05$. This differs with conclusion of our study in which there was no significant difference in suprarenal and infrarenal abdominal aortic diameter between men and women ($p>0.05$).

In a study done for Turkish population by Sariosmanoglu et al.[16] which demonstrated aortic diameters in 596 patients, mean subdiaphragmatic aortic diameter was 18±3 mm in females and 19±4 mm in males. At the bifurcation level, the mean aortic diameter was 15±3 mm in females and 16±4 mm in males. The observed abdominal aortic diameters in our study were less than that obtained in the various studies available in the western population. The variance in diameter may due to variable attributes of the patients like height, weight and body mass index.

However, it can be concluded that there was an increase in mean aortic diameters in both men and women in both suprarenal and infrarenal aorta with increase in age.

Despite the adequate sample size, it was still small for generalization of the study as it may not be representative of the varying ethnic and racial groups in our country. We measured patient's parameter manually and the value may not be consistent. In addition, the measured diameters may not be considered true as the patients were referred having certain clinical condition which warrants the need

of the abdomen CT scan. We measured the diameter of the abdominal aorta of different patients so the level of the site of measurement might not be the same in all cases.

The sample size is not adequate to generalize the result and required the measurement with large sample size. Further studies for measurement of abdominal aortic diameter with larger sample size are recommended for more accuracy in results. Further descriptive analytic studies are needed using other imaging modalities as MRI to confirm these results.

CONCLUSIONS

There was statistically significant correlation of the suprarenal and infrarenal abdominal aortic diameter with patient's age. But there was no significant difference of suprarenal and infrarenal abdominal aortic diameter between male and female.

CONFLICTS OF INTEREST: None declared

SOURCE OF FUNDING: None

AUTHORS' CONTRIBUTIONS

SS designed the study, collected the data and did the manuscript writing, checked the referencing and editing of the study. BRS and NK did data analysis, analyzed the results, MT collected the reference articles; SK defined the intellectual content, ES helped in collection of data.

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