



EVALUATION OF VARIATION IN ABDOMINAL AORTIC DIAMETER IN WESTERN UP PATIENTS USING CT ABDOMEN.

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Abstract

Objectives - The aim of this study was to evaluate the variation of abdominal aortic diameter at L3 and T12 level in western UP population using CT abdomen, and to study the variation in abdominal aortic diameter with age and sex.

Materials and Methods - In this study 131 both males and females were included with age 18 to 72. The patients without CVD (cardiovascular disease) and AAA (abdominal aortic aneurysm) underwent abdominal CT scans were recruited for this study. Routine protocol was used for abdomen CT scanning, the diameter of abdominal aorta measure in axial slice at the L3 level and T12 level in transverse and AP manner. Pearson correlation and t- test perform to evaluate correlation between aortic diameter, age and gender.

Results -The mean and S.D. of transverse and AP diameter of abdominal aorta at L3 level in male patients were found as 15.0 ± 1.9 mm and 14.0 ± 1.7 mm respectively, while it found in female patients as 13.2 ± 1.6 mm and 13.0 ± 1.6 mm respectively. At T12 level it were analysed as 20.8 ± 2.8 mm and 20.9 ± 2.9 mm respectively while in female patients it found as 18.9 ± 2.6 mm 18.4 ± 2.5 mm.

The mean and S.D. of the whole patients was 40.2 ± 15.0 years. The mean \pm S.D. of transverse and AP diameter at L3 level were analysed as 14.2 ± 2.0 mm and 14.0 ± 1.9 mm respectively while at T12 level were analysed as 19.9 ± 2.9 mm and 19.8 ± 3.0 mm respectively.

Conclusion - We observed in our study abdominal aortic diameter at L-3 and T-12 level in both planes transverse and AP significant correlate with age and gender. Male patients have aortic diameter greater than female patients. Abdominal aortic diameter increase with the age.

Keywords: CT (computed tomography), AAD (Abdominal Aortic Diameter), AAA (Abdominal aortic aneurysm), Abdominal Aorta

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INTRODUCTION

The diagnosis of abdominal aortic aneurysm (AAA) can be evaluate by help of normal abdominal aortic diameter. There is an inefficient of the data on the abdominal aortic diameter according to which evaluate and management of abdominal aortic aneurysm of UP western population.

The abdominal aortic diameter in western country population larger than the Indian population due to different geographical regions therefore treatment protocols for intervention are likely to be different¹.

Aorta means major artery in the body. Aorta in human body is divided into two parts thoracic aorta and abdominal aorta. Thoracic aorta is classified as ascending aorta, arch of aorta, and descending thoracic aorta. Descending thoracic aorta continues to downward as abdominal aorta. Abdominal aorta is a major artery in abdominal cavity. It carries oxygenated blood from the heart through thoracic aorta to the abdominal cavity organs. It supplies oxygenated blood to the abdominal cavity organs as well as lower extremities. Abdominal aorta starts from an endpoint of descending thoracic aorta at the level of T12 vertebrae. It enters in abdominal cavity through diaphragm at T12 level. Abdominal aorta end just above pelvis and it is divided into two arteries, at the level of L4 namely, left and right iliac arteries each one for the lower extremity^{2,3,4}.

Aneurysm

Aneurism is a pathological condition in which lumen wall of the arteries of the body becomes weak and causes a large internal diameter of the arteries. Patients with aneurysm do not show any symptoms it is not dangerous until it reaches a severe stage, in some severe cases arteries can rupture and may lead death of the patient.

According to CDC (Centers of Disease Control) 25000 death per year in the United State (U.S) by an aortic aneurism. Smoking and high blood pressure are risk factors that can cause an aortic aneurism. The types of aneurism are as follow-

1. Abdominal aortic aneurism (AAA)
2. Cerebral aneurism
3. Thoracic aortic aneurism⁵

1. Abdominal aortic aneurism (AAA)

Abdominal aorta is a major artery in abdominal cavity that supplies the oxygenated blood for abdominal cavity organs as well as lower limb and pelvic region. In abdominal aortic aneurism, abdominal aorta walls become weak and increase internal diameter of lumen. Abdominal aortic

aneurism most commonly occurs in older patients. There are some risk factors for abdominal aortic aneurism which are high cholesterol, high blood pressure, smoking, emphysema, and obesity. The rupture of aorta is a medical emergency condition during this condition 80% of patients die.

Abdominal aorta aneurism (AAA) risk factors not only old age, smoking, hypertension, and high blood pressure, it also dependent on higher plasma low-density lipoprotein (LDL)⁶.

CT (Computed tomography)

The basic principle of computed tomography (CT) is, the internal structure of an object can be reconstructed from multiple projections of an object.

G.N.Hounsefield was a physicist at the British Institute of Radiology. He announced a new imaging technology in 1972. This new imaging technique was known as computerized axial transverse scanning (CAT). The basic physics behind this technique was a pencil an x-ray beam from different angles transmitted through an object and transmitted x-rays detect by a detector. The data, detected by a detector, is processed in a computer and displays a cross-sectional image of internal structure.

Nowadays computerized axial transverse (CAT) is known as computed tomography. The first CT scanner is known as the original EMI scanner. EMI scanner was used only for head scanning. A physicist from 1972 to the present time has done various changes and advancements in CT machines from one generation to next generation. There are seven generations they indicate their advancement than previous generation.

At present time third-generation CT scanners are most common use in hospitals. This CT scanner is also known as a 'rotate-rotate' fan-beam geometry scanner. These scanners used 700-900 detectors in an array opposite to the x-ray source fan-beam cover detector array. Continuous rotation of both x-ray tube and detector around the patient was made possible by using slip-ring technology. Spiral or helical CT scanning is also made possible by using slip ring technique. Entire organs in the body can be scanned in one breath-hold by using a spiral scanner.

Volume data scan by spiral scanning image display in a 2D or 3D manner by processing the data which detect by a detector. The computed tomography (CT) technique has an advantage over the conventional x-ray. It produces slice by slice 2D and 3D images of internal structure of the body. It

can be detected complicated bone fractures which not detected by x-ray modalities⁷.

The priority of our study to evaluate normal abdominal aortic (AA) diameter by using computed tomography (CT) in the UP western population. We measured abdominal aortic diameter at L3 and T12 level according to age and gender.

MATERIALS AND METHODS

Multi slice Computed tomography scanner (MSCT) is used for this study. The model name of the modality is Philips ingenuity core 128 slice. The patients who underwent for abdominal scan are included in this study.

This study was conducted on 131 patients who underwent an abdomen CT scan in the Teerthanker Mahaveer Hospital and Research Center Delhi Road Moradabad Uttar Pradesh, India. Patients with abdominal aortic aneurism (AAA), cardiac disorder, and vascular disease were excluded from the study. Both male and female patients were included in this study ages between 18 to 72 years. Written consent was filled in by the patients before the scan. The anteroposterior (AP) and transverse diameter of abdominal aorta was measured at the T12 and L3 vertebral levels by using the software available in the CT console.



Figure 1- Measurement of transverse and AP diameter of abdominal aorta at the L-3 level

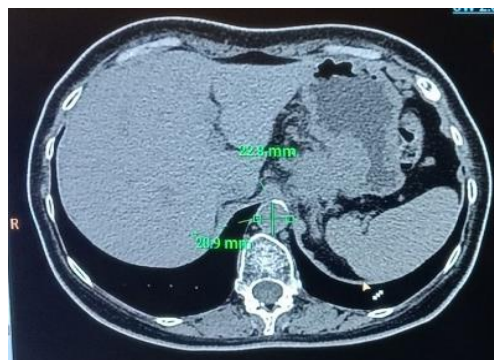


Figure 2- Measurement of transverse and AP diameter of abdominal aorta at the T-12 level.

RESULTS

Statistical analysis-The data were recorded and analysed with Microsoft excel and SPSS softw are (SPSS Inc; Chicago, IL), version 26.0. For analysis data, different tests were performed on the data, that are one-way ANOVA, independent “t” test, Pearson correlation, and S.D. were performed.

The total sample size in this study was 131 (n = 131) patients in male patients 72 (55%) and female patients were 59 (45%). Patients were categorized according to their age. Five age groups were created in this study they are 18-28, 29-39, 40-50, 51-61, and 62-72. Table -1 and figure-1 shows age group distribution according to their frequency and percentage of the patients shows age group distribution according to their frequency and percentage of the patients.

Table-1

(n = 131)		Frequency	%
Gender	Male	72	55
	Female	59	45
Age	18-28	38	29
	29-39	25	19.1
	40-50	31	23.7
	51-61	28	21.4
	62-72	9	6.9

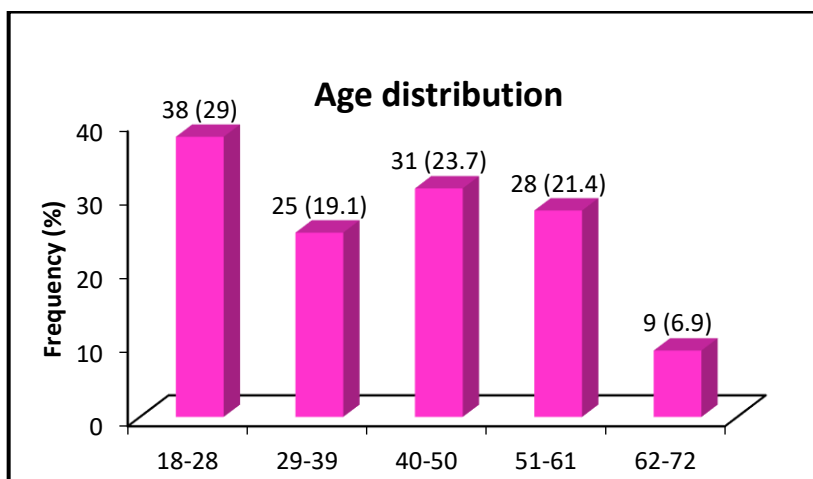


Figure- 1 shows age group distribution according to their frequency and percentage of the patients.

The table -2 shows mean and S.D. of transverse and AP diameter of abdominal aorta at L3 level in male patients were found as 15.0 ± 1.9 mm and 14.0 ± 1.7 mm respectively, while it found in female patients as 13.2 ± 1.6 mm and 13.0 ± 1.6 mm respectively. At T12 level it were analysed as 20.8 ± 2.8 mm and 20.9 ± 2.9 mm respectively while in female patients it found as 18.9 ± 2.6 mm 18.4 ± 2.5 mm.

The mean and S.D. of the whole patients was 40.2 ± 15.0 years. The mean \pm S.D. of transverse and AP diameter at L3 level were analysed as 14.2 ± 2.0 mm and 14.0 ± 1.9 mm respectively while at T12 level were analysed as 19.9 ± 2.9 mm and 19.8 ± 3.0 mm respectively.

Table – 2

		Mean (mm)	S.D. (mm)
Age		40.2	15.0
L-3 level diameter	Transverse	14.2	2.0
	AP diameter	14.0	1.9
T-12 level diameter	Transverse	19.9	2.9
	AP diameter	19.8	3.0

Table -3 and Figure – 2 shows distribution mean and S.D. of abdominal aorta transverse and AP diameter at L-3 and T-12 level according to gender, the Independent sample “t” test was used to compare diameter of abdominal aorta in NCCT

patient according to gender. There was a difference ($p < 0.05$) in mean diameter of abdominal aorta between male and female patients.

The comparison means and standard deviation (S.D.) of abdominal aorta diameter at the levels L-3 and T-12 level between males and females were analysed and mentioned in upper table 5:3. The mean transverse and AP diameter of abdominal aorta at the L-3 level in male patients were found as 15.0mm and 14.0mm respectively while it was found in female patients as 13.2mm and 13.0mm respectively. The S.D. of abdominal aorta diameter in transverse and AP planes at L-3 level in male patients 1.9 and 1.7 respectively while in female patients it found as 1.6 and 1.6.

At the T-12 level mean of the transverse and AP diameter of abdominal aorta in male patients were analysed as 20.8mm and 20.9mm respectively while in female patients it was found as 18.9 and 18.4 respectively. S.D. of abdominal aorta diameter in both planes transverse and AP at T-12 level in male patients was analysed as 2.8 and 2.9 respectively while in female patients it was analysed as 2.6 and 2.5 respectively. Figure 5:4 mentioned below shows a graphical representation of the mean and S.D. of abdominal aorta (transverse and AP) diameter at L-3 and T-12 levels according to gender.

Table – 3

		Male		Female		"t"	p value
		Mean	S.D.	Mean	S.D.		
L-3 level diameter	Transverse	15.0	1.9	13.2	1.6	5.61	< 0.001*
	AP diameter	14.8	1.7	13.0	1.6	6.474	< 0.001*
T-12 level diameter	Transverse	20.8	2.8	18.9	2.6	4.033	< 0.001*
	AP diameter	20.9	2.9	18.4	2.5	5.144	< 0.001*

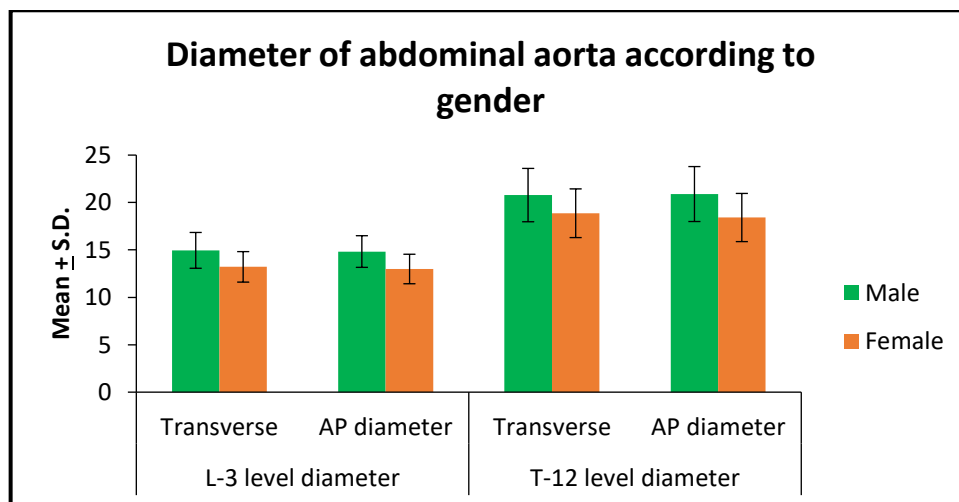


Figure – 2 shows distribution mean and S.D. of abdominal aorta transverse and AP diameter at L-3 and T-12 level according to gender.

DISCUSSION

In our study we include total 131 patients who underwent for abdominal CT scan. The male patients in this study were 72 (55%) and female patients were 59 (45%). Age criteria of patients was 18-72 years. Abdominal aorta diameter were measured in transverse and AP planes at the L-3 and T-12 vertebrae level.

For analysis data different test were performed on the data they are one way ANOVA, independent “t” test, pearson correlation and S.D.

In our study, the mean transverse and AP diameter of abdominal aorta at the level L-3 was 14.2 ± 2.0 mm and 14.0 ± 1.9 mm respectively. At T-12 level transverse and AP diameter mean of the total patient's abdominal aorta was 19.9 ± 2.9 mm and 19.8 ± 3.0 mm. Transverse and AP diameter mean of the abdominal aorta at the L-3 level in male patients was 15.0 ± 1.9 mm and 14.8 ± 1.7 mm respectively, while in female patients was 13.2 ± 1.6 mm and 13.0 ± 1.6 mm respectively. At T-12 level transverse and AP diameter mean of the abdominal aorta in male patients was 20.8 ± 2.8 mm and 20.9 ± 2.9 mm respectively, while in female patients it found as 18.9 ± 2.6 mm and 18.4 ± 2.5 mm.

In comparison of abdominal aorta diameter according to different age groups of the patients. We found that diameter of abdominal aorta increase with age. Therefore we conceive that age and abdominal aorta diameter have linear correlation among themselves. In this study lowest age group (18-28) of the patient have transverse and AP mean diameter at the L-3 level is 13.0 ± 1.5 mm and 12.9 ± 1.5 mm respectively while highest age group (62-72) have mean transverse and AP diameter 16.5 ± 2.6 mm and 15.9 ± 1.8 mm. At T-12 level lowest age group mean transverse and AP diameter 17.8 ± 2.4 mm and 18.1 ± 3.1 mm respectively, while in highest age group it found as 23.4 ± 2.8 mm and 22.8 ± 2.9 mm respectively.

A study conducted in south Indian population by A Jasper et al, they measured abdominal aortic diameter of 142 patients who underwent for CT scan. The mean of the abdominal aortic diameter at T-12 level in male patients were found as 19 ± 2.3 mm and in female patients it found as 17.1 ± 2.3 mm. At the L-3 level mean diameter of the abdominal aorta in male patients was 13.8 ± 1.9 mm while in female patients it was 12.0 ± 1.6 mm. According to their study abdominal aortic diameter increase with the age. Therefor significant

correlation between age and diameter of abdominal aorta¹.

A study conducted in university of California, San Diego by Matthew A. Allison et al, they conducted their study in total 504 patients in which 41% female and 59% male patients. Age criteria of the patient was 25-87 years. They analysed, mean of the of the abdominal aortic diameter at the level L-3 level was 21.3 ± 2.9 mm, 19.3 ± 2.5 mm was analysed at the L-1 level and abdominal aortic diameter mean where it bifurcate at level L-4 was 18.6 ± 2.2 . They analysed aortic diameter according to gender at three levels, they found mean diameter in male patients were 22.6, 20.5 and 19.6 mm respectively while in female patient were 19.3, 17.5, and 17.0 respectively. Their study prove that three aortic diameter location significantly different between male and female patients. Male patients have greater aortic diameter at three location than female patients. They found in their study aortic diameter at three level also significantly correlate with the age⁸.

Dominic Fleischmann concluded in their study abdominal aortic diameter significantly effected by sex and body surface area. Age effects AA diameter according anatomical position which range from 0.14mm/y (P < .0001) proximally to 0.03mm/y (P = .013)⁹.

A study done by Bello Omuya Usman et al, they found in their study the mean supra renal aortic diameter (SAD) $17.9 (\pm 2.5)$ mm, in which male has mean SAD 18.8mm while female SAD was 16.9mm.. In this study AA diameter measured by using 3.5 MHZ grayscale curvilinear transducer of the Mindray DC-6 diagnostic ultrasound unit¹⁰.

Bjorn Sonesson et al ultrasonic study on “Infrarenal aortic diameter in the healthy person” states that AA diameter increases throughout the life in both men and women. Their study concluded is infrarenal aortic diameter correlate with age, sex and body surface area, males have larger diameter than female¹¹.

Ravi Kumar et al study on “Normal Aortic Diameter on Multi Detector Computed Tomography In Nepalese Population Of Eastern Nepal” reveals that both inner and outer diameter of aorta significantly increase with age of the patients and male have larger diameter than female. In this study they found no positive correlation between BMI and inner and outer diameter of abdominal aortic diameter. Their study also states

that Mongolian have higher aortic diameter than Aryan¹². The factors affect the abdominal aortic diameter are age, gender, height and BMI^{13,14,15,16}. The diameter of abdominal aorta increase from normal range increase risk of cardiovascular disease, the normal range of infrarenal aortic diameter from 19 to 21 mm in male and 16 to 18 mm female^{13,17,18}.

CONCLUSION

We observed in our study abdominal aortic diameter at L-3 and T-12 level in both planes transverse and AP correlate with age and gender. Male patients of western UP population have aortic diameter greater than female patients. Abdominal aortic diameter increase with the age, we found out in our study highest age group (62-72) have greater abdominal aortic diameter while lowest age group (18-28) have lesser abdominal aortic diameter. So we concluded abdominal aortic diameter have significantly correlation with age and sex.

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