



## STUDY OF THE COMPUTED TOMOGRAPHY MEASUREMENT OF DIAMETER OF ABDOMINAL AORTA IN NEPALESE

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### ABSTRACT

**Background:** The diameter of abdominal aorta (DAA) has its own importance in human body in diagnosing several abdominal aortic diseases. Its size is the diagnostic parameter for the abdominal aortic aneurysm which is the localized dilation of the abdominal aorta. **Methods:** The DAA of Nepalese was measured according to age and sex at three different levels, just superior to the celiac axis, at renal pedicle level and just superior to bifurcation by using Computerized Tomography (CT) scan. Also the DAA of the normal people was compared to those having hypertension, alcohol consumption and smoking habit. **Study Sample:** Altogether, 125 patients were included who came to Tribhuvan University Teaching Hospital (TUTH), Maharajgunj, Kathmandu, Nepal for abdominal CT scan. Among them 100 are normal population and 25 are the victim of hypertension, alcohol consumption and smoking habit. **Results:** The findings revealed that the DAA in most of the observed patients is less than the aneurysm limit i.e. smaller than 30mm except in one male patient of age 72 years. **Conclusion:** It is concluded that the diameter of abdominal aorta increases with ages and is pronounced more in Nepalese male population than in female. It is also higher in patients of both sexes having hypertension and smoking habit.

**KEYWORDS:** bifurcation, celiac axis, CT scan, DAA, renal pedicle level.

### INTRODUCTION

Aorta, the complex blood vessel, arises from the left ventricle of the lower chamber of the heart and supplies oxygenated blood to the other arteries and ultimately throughout the body. It curves at the back and reaches the abdomen through the diaphragm and terminates at the iliac bifurcation at the level of the fourth lumbar vertebra.<sup>[1-3]</sup> Abdominal aorta, the largest and most important artery found in abdominal cavity, is the continuation of thoracic aorta. It begins at the diaphragm and goes down through the left side of the inferior vena cava parallel to the anterior segment of the vertebral column and the posterior wall of the abdomen. As the abdominal aorta goes down, it divides into smaller arteries at other parts of the abdomen. Thus the diameter of abdominal aorta (DAA) goes on decreasing from

the top to the bottom. It is clinically estimated that the normal diameter of the abdominal aorta is regarded to be less than 30mm. However, the normal diameter explicitly depends upon age, gender, size of the body and the anatomy of the affected aorta.<sup>[4-6]</sup>

DAA is the principal parameter to the diagnosis of Abdominal Aortic Aneurysm (AAA) which is the localized dilation or enlargement of the abdominal aorta by more than 50 percent (greater than 30mm) of the normal diameter. The dilation of abdominal aorta is more common in hypertension as well as smoking and alcohol consumption in higher age.<sup>[7-9]</sup>

Without causing symptoms, such dilation often causes pain in the abdomen or back and in the legs. The pain in the former is

due to the extra pressure on the nearby tissues and the pain in the latter is due to the disturbance in the normal flow of the blood. Sometimes it leads to pulsating sensations in the abdomen and pain in the chest, lower back, or scrotum in male.<sup>[10]</sup> As the abdominal aorta supplies oxygenated blood to different organs in the abdominal area, pelvis and legs it is the most important artery in the human circulatory system and its malfunctioning leads to the failure of multiple organs.<sup>[11]</sup> The measurement of the diameter of abdominal aorta is also useful in diagnosing several other abdominal aortic diseases such as atherosclerosis which generally coexists with AAA.<sup>[12]</sup> Atherosclerosis is the condition in which the wall of an artery becomes thick and hard due to the formation of plaque (cholesterol, fatty substances, cellular waste, etc.) inside the artery.<sup>[13]</sup>

The size of the abdominal aorta varies with age, sex, hypertension, alcohol consumption and smoking habit. According to the epidemiological studies, AAA is the most common factor for the increasing rate of mortality due to the rupturing of the abdominal aorta.<sup>[14, 15]</sup> Having considered the increasing prevalence of aortic aneurysm, the study of the size of the aortic diameter is also very important in the context of Nepalese.

#### Objective of the study:

1. To study the diameter of abdominal aorta at three different levels viz: just superior to celiac axis, at renal pedicle level and just above the bifurcation in normal male and female patients.
2. To compare the diameter of abdominal aorta of normal patients with those having hypertension, alcohol consumption and smoking habit.

## PATIENTS AND METHODS

**Patients:** The study has been done in Tribhuvan University Teaching Hospital (TUTH), Maharajgunj, Kathmandu, which encompassed the patients attending in radiology department of TUTH for taking Computerized Tomography (CT) scan of the abdomen. The NeuViz 16 Multi-Slice CT Scanner System

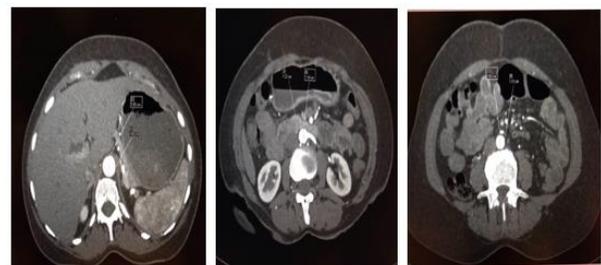
which features a continuously rotating X-ray tube and detector array was used during the study purpose. The sample size of 100 normal population (50 males and 50 females) and 25 (including both sexes) with history of hypertension, alcohol consumption and smoking habits were considered for the study purpose.

**Inclusion criteria:** Individuals aged 11-80 years of either sex were included in this study. The study includes the normal patients and the patients with hypertension, alcohol consumption and smoking habit.

**Exclusion criteria:** The patients with severe disease of abdominal organs (liver, stomach etc.) together with the pregnant women were excluded. The study also excluded those patients with symptomatic and inflammatory AAA followed by complicated coronary artery disease, dyslipidemia, respiratory disease, cerebrovascular disease, claudication, diabetes mellitus, etc.

**Preparation of patients:** Patients were advised to drink sufficient amount of water two or three hours before scanning with empty stomach so that the urinary bladder will be full and the internal organs can be examined perfectly.<sup>[16, 17]</sup> The clinical examination of all the patients was performed by nurses and physicians like age, weight and blood pressure prior to CT scan.

**Measurement of abdominal aorta:** The scanned picture were analyzed by the computer and the diameter of abdominal aorta was measured at just superior to celiac axis, at renal pedicle level and just above the bifurcation by Anteroposterior Position (APP) and Transverse Position (TVP). The CT scan of DAA just superior to celiac axis, at renal pedicle level and just above the bifurcation during the measurement are shown in fig. a, b and c respectively from left to right.



**Fig: CT scan of DAA of a normal female patient of age 35 years, a) just superior to celiac axis, b) at renal pedicle level and c) just above the bifurcation (starting from left)**

**Ethical Consideration**

During the study all ethical consideration was maintained and precaution was taken to provide a safety and right of all the patients. Verbal consent was taken from respondent and the purpose of data collection was explained prior to carry out interview to the respondents. However no written consent was taken from the patients. Confidentiality and privacy was maintained for each of the patients. The duration of the study was about one year and the design of the study was purely experimental.

**STATISTICAL ANALYSIS**

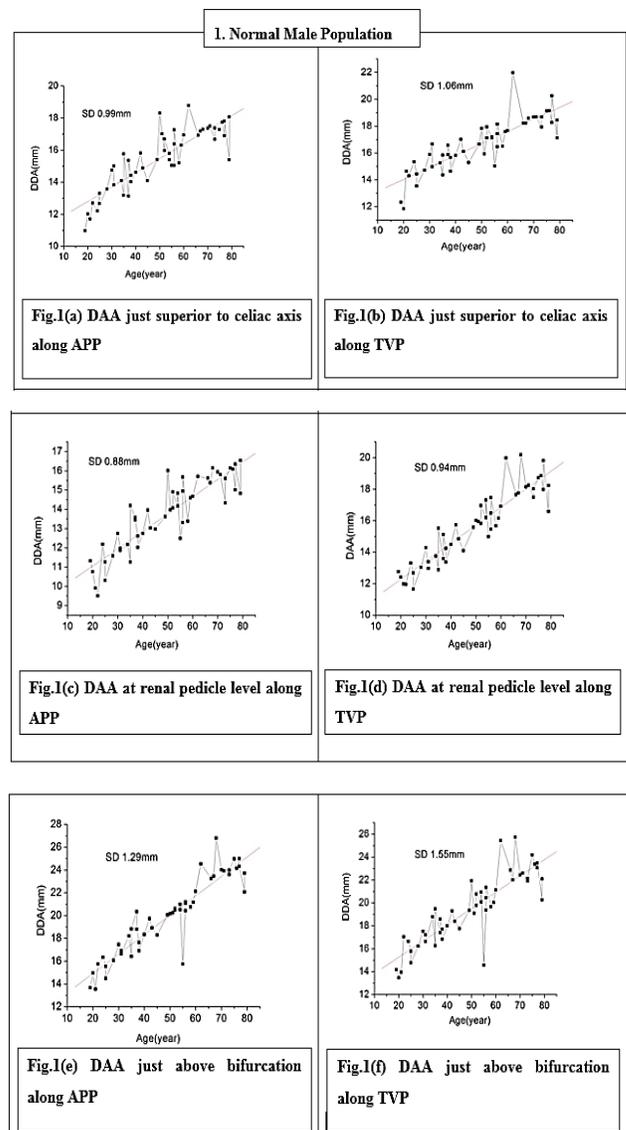
The observed data were classified on the basis of age, sex and history of the patient like hypertension, alcohol consumption and smoking habit and analyzed using different statistical tools. All the values were calculated as mean (Standard Deviation).

**RESULTS**

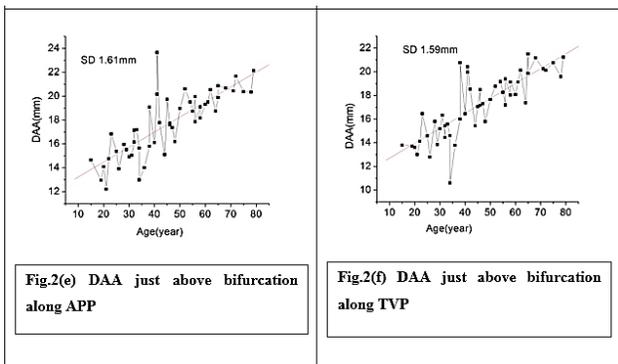
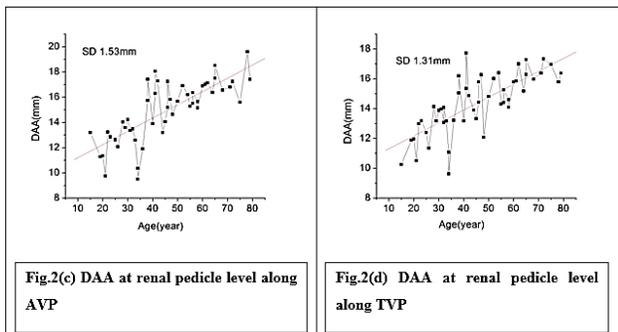
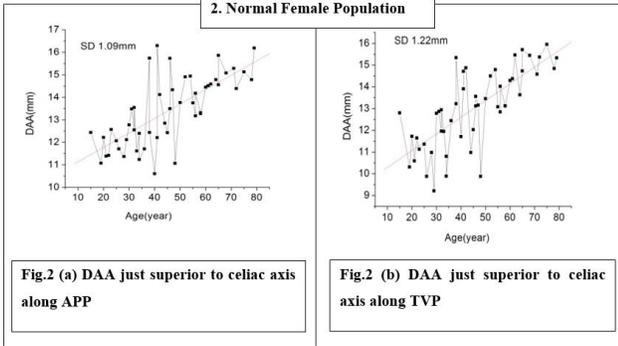
DAA of the Nepalese of age group 11-80 years was studied by dividing normal population according to their age and gender and compared to those people having hypertension, alcohol consumption and smoking habit. Also the study was carried out on the aorta of three different regions: superior to celiac axis, renal pedicle level, above bifurcation along APP and TVP. The diameter of abdominal aorta of Nepalese varied with age and sex of the people.

The average diameter of abdominal aorta, mean and Standard Deviation (S.D.) along APP and TVP of age group 11-80 is found to be 19.44 (S.D. 3.01) mm and 19.94 (S.D. 3.36) mm at just superior to celiac axis, 15.66 (S.D. 2.28) mm and 16.66 (S.D. 1.94) mm at renal pedicle level, 13.71 (S.D. 1.86) mm and 15.42 (S.D. 1.90) mm at just above bifurcation for 50 normal male population as shown in fig 1(a)-1(f). Similarly it is 17.16 (S.D. 2.66) mm and 17.66 (S.D. 2.67) mm at just superior to celiac axis, 14.36 (S.D. 1.96) mm and 14.90 (S.D. 2.34) mm at renal pedicle level, 13.00 (S.D. 1.78) mm and 13.40 (S.D. 1.54)mm just above the bifurcation for 50 normal female population as shown in fig 2(a)-2(f). It is found that the average DAA is 18.30 (S.D. 3.06) mm and 18.80 (S.D. 3.23) mm at just superior to

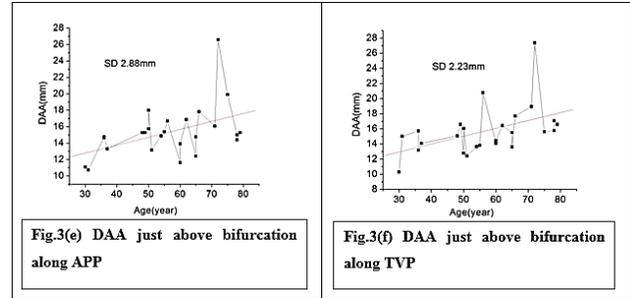
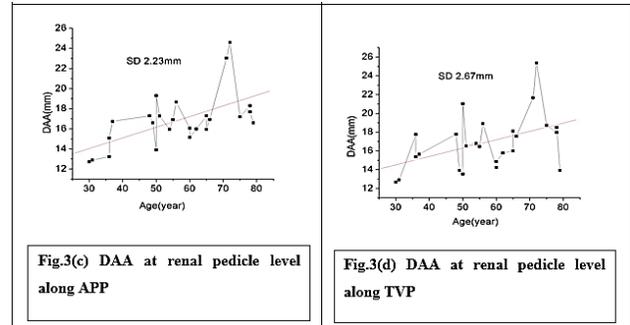
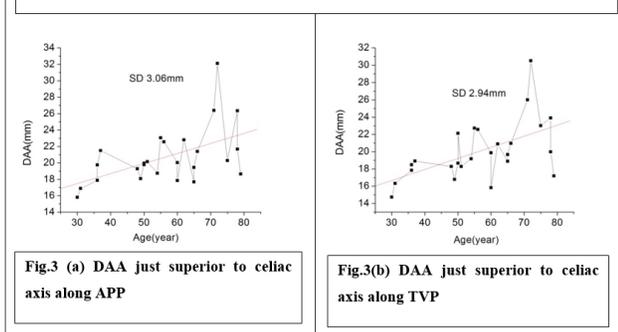
celiac region axis, 15.00 (S.D. 2.22) mm and 15.78(S.D. 2.32) mm at renal pedicle level and 13.36 (S.D. 1.84) mm and 14.41 (S.D. 2.00) mm just above the bifurcation for 100normal population including male and female. Also the average DAA is 20.06 (S.D. 3.45) mm and 20.72 (S.D. 3.50) mm at just superior to celiac axis, 16.88 (S.D. 2.93) mm and 16.84(S.D. 2.70) mm at renal pedicle level, 15.34 (S.D. 3.16) mm and 15.70 (S.D. 3.26) mm at just above the bifurcation for the population having history of hypertension, drinking and smoking habit for both sexes as shown in fig 3(a)-3(f). The detailed result of the measurement of DAA in three different regions is presented in the line graph below.



**2. Normal Female Population**



**3. For the Patients with History of Hypertension, Drinking Alcohol and Smoking Habit**



**DISCUSSION**

The study comprises detailed screening of the DAA in normal Nepalese and the risk factors associated with the asymptomatic AAA in smokers, alcoholic and hypertensive individuals using CT. DAA and its dilation due to the thickening of wall and aneurysmal changes in tissue can be detected by Computerized Tomography (CT), Ultrasonography (USG) and Magnetic Resonance Imaging (MRI). Among them CT scan is the most reliable radiographic technique for this purpose although its most of the features are similar with the USG and MRI.<sup>[18]</sup> CT is superior in the assessment of DAA, aortic aneurysm related to renal arteries, wall calcification and luminal thrombus as it provides all the essential anatomic information at reduced cost, morbidity and radiation vulnerability.<sup>[19]</sup> CT is more accurate and sensitive to identify the inflammatory components related with AAA within a short examination time.<sup>[20, 21]</sup> The three dimensional reconstruction of CT images further help in the careful planning of surgery.<sup>[22]</sup>

The increasing order of DAA, averaged in both APP and TVP, was found just above the bifurcation, at renal pedicle level and just superior to celiac axis in the sample population. About 46% of the normal male and 16% of the normal female patients have DAA greater than 20mm at just superior to celiac axis. 32% of

the patients with hypertension, alcohol consumption and smoking habit were found with both hypertension and smoking habit. Among them 75% have DAA greater than 20mm at just superior to celiac axis. The diameter of abdominal aorta at just superior to celiac axis along APP and TVP were found to be 30.52mm and 32.10mm respectively in a male of age 72 years having both hypertension and smoking habit which were beyond the aneurysm limit (greater than 30mm). This shows that hypertension and smoking have direct impact on the dilation of DAA especially in celiac axis in Nepalese. This fact is also correlated with the study of Xi Li et al (2013) that hypertension and smoking are causative factors for AAA in Asian. None of the patients were found with inflammatory AAA which requires surgical treatment if the aortic size of aneurysm exceeds 60mm.<sup>[23]</sup>

The study shows that increase in diameter of abdominal aorta is more pronounced in men than in women of Nepal. Also, the diameter increases with the increase in age and is found more in the people of age greater than 50 years. There was no significant dilation of DAA in only alcoholic patients but the risk of enlarged diameter increases together with hypertension and smoking. In this study, the blood pressure, greater than or equal to 140/90 mmHg is diagnosed as hypertension according to the guidelines of the seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.<sup>[9, 22, 24]</sup>

AAA is an important cause of death in old age. These deaths can be prevented only by prompt recognition and treatment of AAA. Care should be taken with an aortic aneurysm to prevent rupture that occurs when the aortic wall stress increases abnormally. As the prevalence of abdominal aortic aneurysm is found to be 1-4% in the population over the age of 50 years and the average mortality rate from ruptured abdominal aortic aneurysm is 85-95%. The authors recommend that persons over the age of 50 years should undergo careful abdominal screening aimed at detecting AAA in every two or three years as a part of the periodic health examination.<sup>[19, 25, 26]</sup> We further recommend that obese older men at high risk for AAA followed by hypertension

should have regular screening with abdominal CT irrespective of physical examination.

The study was carried out on the sample size of 125 only. Although the radiographic study, CT used for the sample study was reliable in itself the study does not represent picturesque information about the difference and variability of CT with USG and MRI. The sample includes only the DAA associated with asymptomatic and non-inflammatory AAA. These are the limitations of the study.

## CONCLUSION

According to the graph presented above it can be concluded that almost the DAA of all the observed population is less than the aneurysm limit except in a person having hypertension and smoking habit. Thus hypertension and smoking are the risk factors for the increased diameter of abdominal aorta in Nepalese.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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