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A morphometric CT- scan study of abdominal aorta

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***Abstract*---**Background: The aorta consists of an ascending segment, a transverse segment or arch, and a descending segment consisting of descending thoracic aorta and descending abdominal aorta. Material and methods: The study group included 52 patients including 32 males and 20 females of age ranging between 6 yrs to 65yrs. The patients underwent computed tomographic aortic angiographic scan for various indications, at 64-slice CT center of the Department of Radio diagnosis. Results: In the present study, we found that the diameter at the level of T12 ranged from 10mm to 28.3 mm with a mean value of 17.77± 3.48 mm. Conclusion: The knowledge of the diameters of abdominal aorta at various levels can help in effective diagnostic tool in a case of abdominal aortic aneurysm and also for the endovascular treatment of abdominal aortic aneurysm by vascular endograft implantation. Such more type of study required more region wise.

***Keywords*---**abdominal aorta, CT abdominal, morphometric**.**

Introduction

The aorta is the trunk of the arterial tree which conveys oxygenated blood to the body. It begins at the aortic annulus which is the base of the left ventricle. Passing up and right for about 5cm.it arches upwards, backwards and to the left over the left pulmonary hilum and then descends in the thorax at first left of the vertebral column, then gradually inclining towards the midline, to enter the abdomen via the diaphragm's aortic hiatus. It descends in front of the vertebral

column and ends on the body of the fourth lumbar vertebra, commonly a little to the left of the middle line, by dividing into the two common iliac arteries[1].

The aorta consists of an ascending segment, a transverse segment or arch, and a descending segment consisting of descending thoracic aorta and descending abdominal aorta. The abdominal portion of aorta is the segment of aorta which pierces the diaphragm at the level of twelfth thoracic vertebra, and terminates at the level of fourth lumbar vertebra by dividing into right and left common iliac arteries[2].

Material & Method

The present study was a prospective study. The patients for the study were recruited from April 2012 to July 2013. The study group included 52 patients including 32 males and 20 females of age ranging between 6 yrs to 65yrs. The patients underwent computed tomographic aortic angiographic scan for various indications, at 64-slice CT center of the Department of Radio diagnosis. Written informed consent from the patient was obtained. Computed tomographic angiographic images taken were reviewed for normal anatomy of abdominal aorta, their variants and anomalies.

Inclusion Criterias

- Patients (male or female) of any age group.
- Informed consent of the patient.
- No history or clinical sign of renal disease.

Exclusion Criterias

- Renal insufficiency (High urea/creatinine level).
- Allergy to contrast agent.
- Contraindication to radiation exposure (e.g. pregnancy).
- Distortion of anatomy of abdominal aorta due to any pathology.

Pre-procedure precautions-he patients were enquired, to rule out presence of any drug allergy, in order to avoid the occurrence of any untoward anaphylactic reaction during the procedure.

- They were asked to come empty stomach.
- They were advised to drink only water just prior to the procedure.
- Blood urea and creatinine levels were evaluated prior to procedure.

CT Angiography Protocol

CT Angiography was performed on 64-slice multidetector spiral CT scanner (BRILLIANCE CT, Philips medical system, Nederland, B.V.5684 PC Best, TheNederlands) (Fig1). This machine is installed in 64-slice CT scan centre of Department of Radiodiagnosis, K.G. Medical University UP, Lucknow.

The following parameter were Observed

a) Level of bifurcation of abdominal aorta-the vertebral level of bifurcation of abdominal aorta was observed in volume rendered as well as axial MIP images.
b) Angle of bifurcation of abdominal aorta- the angle between the two common iliac arteries is measured in volume rendered images.
c) Transverse diameter of abdominal aorta at various levels- the diameter of abdominal aorta was measured with the help of electronic calipers in axial MIP images.

Statistical Analysis: Statistical analysis was performed by using computer based software, Statistical Package for Social Science (SPSS). Mean values of parameters were compared to determine.

Observation & Result

The present study was carried out at The Department of Anatomy, King George's Medical University(UP), Lucknow with an aim to observe the normal anatomy, morphometry and variations in number.

Variation In The Level Of Bifurcation Of Abdominal Aorta

Table 2: Overall, agewise and gender wise distribution of subjects according to level of bifurcation

SN	Level of bifurcation	Overall (n=52)		Gender				Age groups							
				Male (n=32)		Female (n=20)		I (n=4)		II (n=4)		III (n=37)		IV (n=7)	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1.	L3 Middle	3	5.8	1	5.0	2	6.3	0	0.0	0	0.0	2	5.4	1	14.3
2.	L3 Lower	2	3.8	0	0.0	2	6.3	1	25.0	0	0.0	1	2.7	0	0.0
3.	Disc between L3/L4	12	23.1	2	10.0	10	31.3	0	0.0	0	0.0	9	24.3	3	42.9
4.	L4 Upper	15	28.8	7	35.0	8	25.0	1	25.0	2	50.0	10	27.0	2	28.6
5.	L4 Middle	8	15.4	2	10.0	6	18.8	2	50.0	1	25.0	3	8.1	2	28.6
6.	L4 Lower	7	13.5	5	25.0	2	6.3	0	0.0	0	0.0	7	18.9	0	0.0
7.	Disc between L4/L5	4	7.7	3	15.0	1	3.1	0	0.0	0	0.0	4	10.8	0	0.0
8.	L5 Upper	1	1.9	0	0.0	1	3.1	0	0.0	1	25.0	0	0.0	0	0.0
Significance of difference				χ^2=10.826 (df=7); p=0.146				χ^2=31.30 (df=21); p=0.069							

L4-Upper margin was the most common location for bifurcation while L5-upper margin (n=15; 28.8%) and L3 upper margin were the least common locations (n=1; 1.9%). The modal distributions were most common at L3-L4 (n=12; 23.1%) and L4-upper margin (n=15; 28.8%). Irrespective of the gender, L4, lower, middle and upper margin were the most common location of bifurcation, thus showing no statistically significant difference between two genders (p=0.146). L4-middle and L4-upper margins were most common locations irrespective of the age group. Statistically, association between age and location of bifurcation was not significant (p=0.069).

Variation In The Angle At Bifurcation Of Abdominal Aorta

Table 3: Angle at bifurcation and its association with gender and age

SN	Variable	n	Mean	SD	Min	Max	95% CI (Normative range)		Significance of difference ("p" value)
							Lower limit	Upper limit	
1.	Overall	52	47.53	12.02	21	71.2	44.18	50.88	-
Age									
2.	I	4	52.00	11.42	44	68.9	33.83	70.17	0.562
3.	II	4	52.30	8.45	40.9	61.1	38.86	65.74	
4.	III	37	47.36	12.42	21	71.2	43.22	51.50	
5.	IV	7	43.17	12.34	29.1	59.4	31.76	54.58	
Gender									
7.	Male	32	46.13	10.50	29	69.8	42.35	49.92	0.294
8.	Female	20	49.77	14.12	21	71.2	43.15	56.38	

Fig. 3: Angle at bifurcation and its association with gender and age

Angle at bifurcation ranged from 21 to 71.2^{o} with a mean value of 47.53±12.02^{o}. Among different age groups maximum mean value was observed for age group 13-18 years (52.30±8.45) and minimum for age group >50 years (43.17±12.34^{o}). However, on comparing the data statistically across different age groups, the difference in angle at bifurcation was not significant statistically (p=0.562). On gender wise comparison, mean angle at bifurcation was observed to be higher in females as compared to males yet the difference was not significant statistically (p=0.294). the normative range for angle at bifurcation can be based on 95% CI of entire sample *i.e.* 44.18 to 50.88^{o}.

Variation In The Diameter Of Aorta At Various Levels

At T12 vertebral level

Table 4: Diameter at T12 level(in mm) and its association with gender and age

SN	Variable	n	Mean	SD	Min	Max	95% CI (Normative range)		Significance of difference ("p" value)
							Lower limit	Upper limit	
1.	Overall	52	17.77	3.48	10	28.3	16.80	18.74	-
Age									
2.	I	4	11.93	1.57	10	13.4	9.42	14.43	<0.001
3.	II	4	15.75	1.80	14.3	18.3	12.89	18.61	
4.	III	37	18.10	3.19	11.8	28.3	17.03	19.16	
5.	IV	7	20.53	1.95	17.7	23	18.72	22.34	
Between Age Comparison		I vs II	I vs III	I vs IV	II vs III	II vs IV	III vs IV		
		0.259	0.001	0.000	0.426	0.055	0.192		
Gender									
6.	Male	32	18.15	3.30	11.3	25.3	16.96	19.34	0.318
7.	Female	20	17.16	3.75	10	28.3	15.40	18.91	

Fig. 4: Diameter at T12 level (in mm) and its association with gender and age

Diameter at T12 vertebral level ranged from 10mm to 28.3mm with a mean value of 17.77±3.48 mm. Among different age groups mean value ranged from 11.93±1.57 mm (<12 years) to 20.53±1.95 mm, thus showing an incremental trend with increasing age. On comparing the data statistically, it was found to be significant too (p<0.001). On exploring further, it was observed that subjects aged <12 years had significantly lower diameter as compared to those aged 19-50 and >50 years respectively. Comparison of T12 diameter between two genders revealed mean value to be higher among males as compared to females yet the difference was not significant statistically (p=0.318). The findings indicate that the normative range for overall sample can be successfully employed for both the genders. However, for different age groups, there should be a different normative range.

Variations In The Transverse Diameter Of Abdominal Aorta At Various Levels

It is important to know the normal diameter of artery throughout the body so that clinicians are able to determine when an artery becomes aneurismal. Abdominal aortic aneurysm (AAA) is a dilatation of the abdominal aorta. There are several definitions of an AAA. A diameter in more than 30 mm based on the angiographic study is the most accepted definition. There are 3 modalities for aortic diameter measurement: ultrasonography (US), computed tomography (CT), and magnetic resonance imaging(MRI). In our study, the measurement of aortic diameter was

made using 64 slice CT. The CT is less operator-dependent and more objective. In addition, CT-based measurements are not affected by gastrointestinal gas or other body features.

Discussion

In the present study, we found that the diameter at the level of T12 ranged from 10mm to 28.3 mm with a mean value of 17.77± 3.48 mm. it is similar with Joh et al[2], who stated that the mean diameter at the level of suprarenal aorta(level of aorta just above the origin of renal artery) was 21.4 mm. The findings are also comparable with those ofUres et al[3], who reported that the greatest diameter at T_{11}-T_{12} was 27 mm and also with those of Sariosrranoglu et al[4], (2002) who reported the mean diameter at T_{12} to be 19.0±3.9mm.

Diameter at the level of disc between L_{1}&L_{2}

In our study we found that the diameter at L_1-L_2 level ranged from 6.4 to 25.4 mm with a mean value of 13.66 ± 3.19mm.The findings are almost similar to those of Ures et al,[3] who reported the maximum diameter at L_1-L_2 as 23 mm and also with Joh et al[2], (2013) who stated the diameter at L_1-L_2 to be 19.5 mm in their study. Diameter at the level of bifurcation. In our study diameter at bifurcation ranged from 6.5 to 20.9 mm with a mean value of 13.29± 2.33mm. Our findings are similar to those of Ures et al[3]who reported the maximum diameter at the level of bifurcation to be 21mm. Joh et al[2], in an USG study demonstrated that the mean diameter at the level of bifurcation was 18.3 mm and Sariosmanoglu et al[4], observed that the mean diameter at bifurcation level was 15.7± 3.6mm.

In the present study we found that the diameter of abdominal aorta at all the above mentioned 3 levels studied showed an increase with age. Our findings are similar to those reported in previous studies which showed that the mean diameter of abdominal aorta at all levels increases with age (Shendrik LUG[5], Ures et al[3] , Latarjet M[6]and Joh et al [2], On exploring further in our study it was found that the mean diameter of abdominal aorta at all the three levels showed a higher value among males as compared to females. These findings are similar to those of Sariosmanoglu et al[4], andJohet al[2], who reported similar findings on comparison between males and females. The study of the diameters of abdominal aorta at various levels can be an effective diagnostic tool in a case of abdominal aortic aneurysm and also for the endovascular treatment of abdominal aortic aneurysm by vascular endograft implantation.

Variation In The Angle At Bifurcation Of Abdominal Aorta

The angle of bifurcation of abdominal aorta is noted at the level where it bifurcates into the common iliac arteries. In the present study the angle at bifurcation showed a significant range from 21° to 71.2^0 with a mean value of 47.5± 1 $2.02^{0.}$ The findings of our study were similar to those of Moussallem et al[8], who reported that aortic bifurcation angle in their study ranged from (17^0-100^0) and the mean value was $47.43^{0.}$ Kajornet al[8], demonstrated the mean aortic bifurcation angle of 54^0 in their studies.

According to genderwise comparison we found that the mean aortic bifurcation angle was observed to be higher in females as compared to males. This finding is different from those of Lakchayapakarn and Siriprakarn[9] who reported an incidence of slightly higher mean aortic bifurcation angle in males (54^0) as compared to females (53^0). Kajornet al[8], also reported that the mean aortic bifurcation level was higher in males (55 ± 18^0).

Conclusion

The knowledge of the diameters of abdominal aorta at various levels can help in effective diagnostic tool in a case of abdominal aortic aneurysm and also for the endovascular treatment of abdominal aortic aneurysm by vascular endograft implantation. Such more type of study required more region wise.

Reference

1. Anson B. J. &McVay C. B. The topographical positions and the mutual relations of the visceral branches of the abdominal aorta. A study of 100 consecutive cadavers. Anat.Rec, 1936;67:1-15
2. Annalise KS, Bridger J. A cadaveric study of the anatomical variation of the origins of the celiac trunk and the superior mesenteric artery: A role in median arcuate ligament syndrome? Clin Anat. 2013 Apr 1. doi: 10.1002/ca.22243
3. Ures S, Gatto IM, Prates JC, Ures J. The transverse diameter of the abdominal part of the aorta: an anatomo-radiological study through computerized tomography. AnatAnz. 1988; 166(1-5):341-50
4. Saldarriaga B, Pinto S A, Ballesteros L E. Morphological expression of the renal artery. A direct anatomical study in a Colombian half-caste population Int. J. Morphol., 2008; 26(1):31-38
5. ShendrikIuG. X-ray anatomy of the abdominal aorta and its branches according to angiographic findings in living subjects *ArkhAnatGistolEmbriol*. 1975 Dec; 69(12):42-7
6. Latarjet M. & Ruiz-Liard A. Anatomía Humana. 2 ed. Sao Paulo, MedicinaPanamericanaEditora do BrasilLtda, 1989. V. 2. Cited by Petrella S, Rodriguez C F, Sgrott E A, Fernandes G J M, Marques S R, Prates J C. Anatomy and Variations of the Celiac Trunk. Int J. MorphoL, 2007; 25(2):249-257
7. Moussallem CD, AbouHamad I,El-Yahchouchi CA, Moussallem MD, Arnalsteen DM, Mertl P, Havet E. Relationship of the lumbar lordosis angle to the abdominal aortic bifurcation and inferior vena cava confluence levels. Clinical anatomy (New York, N.Y.) 2012; 25(7): 866-71
8. Kajorn L,SiriprakarnY. Anatomical Variations of the Position of the Aortic Bifurcation, Iliocava Junction and Iliac Veins in Relation to the Lumbar Vertebra. J Med Assoc Thai, 2008; 91(10):1564-69
9. Lakchayapakorn K, Siriprakarn Y. Anatomical variations of the position of the aortic bifurcation, iliocava junction and iliac veins in relation to the lumbar vertebra. J Med Assoc Thai, 2008; 91: 1564–1570
10. Rahma, D. Y., & Atmaja, M. H. S. (2022). Peritoneal carcinomatosis and mimicking on CT scan findings. *International Journal of Health & Medical Sciences*, *5*(1), 154-162. https://doi.org/10.21744/ijhms.v5n1.1864

11. Rinartha, K., & Suryasa, W. (2017). Comparative study for better result on query suggestion of article searching with MySQL pattern matching and Jaccard similarity. In *2017 5th International Conference on Cyber and IT Service Management (CITSM)* (pp. 1-4). IEEE.
12. Rinartha, K., Suryasa, W., & Kartika, L. G. S. (2018). Comparative Analysis of String Similarity on Dynamic Query Suggestions. In *2018 Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS)* (pp. 399-404). IEEE.