

Segmental Representation of Intimal Thickness in Ascending Aorta as Early Clinical Marker of Aging

Kavita Pahuja¹, Amardeep Bissa^{*2}.

¹ Associate Professor, Department of Anatomy, SP Medical College, Bikaner, Rajasthan, India.

^{*2} Assistant Professor, Department of Anatomy, SMIMER Medical College, Surat, Gujarat, India.

ABSTRACT

Background: Intimal thickness is the innermost layer of aorta; play a vital role in development of atherosclerotic changes. It may vary in the different parts of the aorta and may increase with age.

Methods: 120 aortas of adult human forensic bodies were taken. Histological slides were formed and the thickness of different segments of aorta were measured microscopically. Data were statically analyzed using ANOVA, p test methods.

Results and Discussion: There is no significant difference of Intimal thickness in different segments of ascending aorta though it significantly increase with age may be due to accumulation of medial SMCs into intima. Results agree with previous workers.

Conclusion: No significant difference between different segments of ascending aorta and it increase with age showing the aging aorta and early sign of atherosclerotic changes.

KEY WORDS: Aging, Intimal thickness, Age Groups, Smooth Muscle Cells, Medial thickness.

Corresponding Author: Dr Amardeep Bissa, PhD (Medical) in Anatomy, Assistant Professor, SMIMER Medical College, Surat, Gujarat, India. **E-Mail:** amardeepbissa@gmail.com

Access this Article online	Journal Information
Quick Response code 	International Journal of Anatomy and Research ISSN (E) 2321-4287 ISSN (P) 2321-8967 https://www.ijmhr.org/ijar.htm DOI-Prefix: https://dx.doi.org/10.16965/ijar
	Article Information
	Received: 17 Feb 2021 Peer Review: 18 Feb 2021 Revised: None
	Accepted: 15 Mar 2021 Published (O): 15 Apr 2021 Published (P): 05 Jun 2021

DOI: 10.16965/ijar.2021.116

INTRODUCTION

Aging is a complex phenomenon which impacts general capacities and structure of an organ, bringing about dynamic changes in organ dysfunction [1,2]. Age is a notable significant danger factor for different issues, particularly in cardiovascular diseases (CVD). CVD are expanding overall [1,3]. The pervasiveness of CVD increases with age and for the most part influences the older age group [4]. The aorta is the great artery which sustains all the pressures exerted by heart and throw the blood to entire body. At microscopic level, the blood vessel wall is made up of three layers which named the tunica intima, tunica media,

and tunica adventitia from the inner to outer side. The alterations of the human aorta with age generally happen including the structural and functional properties of wall. Numerous examinations into age related changes in the aorta have been done and it was discovered that the effect can be on the width, length, and thickness including the tissue organization inside the aortic wall. As respects the thickness of the aortic wall, there are age-related structural changes in the tunica intima and media. Studies have demonstrated that these two layers expands gradually with age [5-8]. Histology of the aortic wall likewise changed with aging. Collagen, elastin, and smooth

muscle cells are the significant tissues in the blood vessel divider. The synthesis of these tissues had changed in both amount and their association in every tunica of the aortic wall [9]. So, we carried out this study to understand the effects of aging on intimal thickness in different segments of ascending aorta. Knowledge of the intimal changes in different segments of the aorta is also important for future clinical therapies pertaining to aortic diseases.

MATERIALS AND METHODS

Our targeted population was confined to Surat city area of south Gujarat. As our study was based on the post mortem cases, we designed it as direct analytic observational method. We used randomized sampling method as it maximize statistical power, especially in subgroup analyses, minimize selection bias and minimize allocation bias. We included all the adult subjects available during our study period in the department of Forensic Medicine of SMIMER Medical College without any Gender biasing. Subjects with cardiovascular disease, any known chronic disease, with 90% and above burn or with extreme train crushed injuries, were excluded from the study. After satisfying with inclusion and exclusion criteria total 120 samples from 120 subjects were procured. The number of the subjects were decided after studying the average autopsies performed per day. Out of 120 cases 32 cases were of Females and 88 cases were of Males. Subjects were grouped in three groups: Age Group I which includes the cases of age from 19 to 44 years, Age Group II which includes the cases of age from 45 to 64 years and Age Group III which includes the cases of age from 65 and above years. Routine histological procedure which include tissue processing, microtomy, staining and mounting were performed. We use Haematoxylin and eosin as staining dyes. We used binocular microscope with adjustable eye piece for microscopy. It has 4X, 10X, 40X and 100X objective pieces (Fig.1). Images of stained sections were digitalized using a High Resolution USB color camera on a Labomed PixelPro upright microscope. These images were delivered to PixelPro™ software and stored as JPEG

files. Once captured, the images were transferred to ImageJ software for analysis and quantification of histological features. Histological features of each sample site were recorded in Microsoft Office Excel 2007. Data were statistically analyzed using ANOVA test and p- value was obtained for significance.

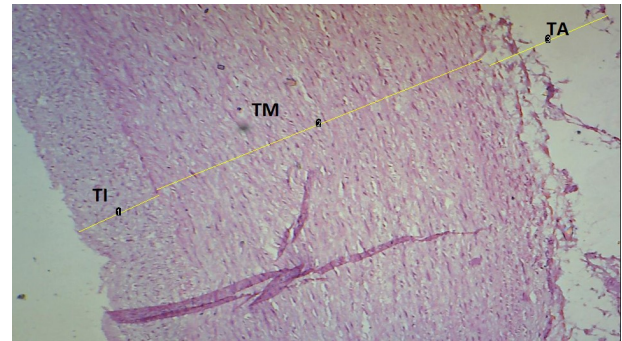


Fig. 1: Measurements of Tunica Intimal (TI), Tunica Medial (TM) and Tunica Adventitial (TA) Thickness.

RESULTS AND DISCUSSION

Intimal Thickness of proximal segment of Ascending Aorta in micron with standard deviation was 168.66 ± 73.75 in Age Group I, 218.62 ± 90.008 in Age Group II and 164.41 ± 94.784 was in Age Group III. It shows that there is a significant difference of intimal thickness in the Proximal segment of different age groups ($P < 0.01$). (Table 1)

Intimal Thickness in micron with standard deviation of middle segment of Ascending Aorta was 157.30 ± 54.167 in Age Group I, 215.71 ± 81.035 in Age Group II and 163.45 ± 92.168 . It shows that there is a significant difference of intimal thickness in the Middle segment of different age groups ($p < 0.001$). (Table 2)

Intimal Thickness of Distal Segment of Ascending Aorta with standard deviation in micron was 160.14 ± 51.536 in Age Group I, 212.31 ± 74.315 in Age Group II while 162.24 ± 69.251 in Age Group III. It shows that there is a significant difference of intimal thickness in the Distal segment of different age groups ($p < 0.001$). (Table 3)

Intimal thickness of Ascending Aorta of Age Group I which have 50 total number of samples (N) have the mean value of intimal thickness of 162.03 ± 50.74 micron. Age Group II which have 45 total number of samples (N) 215.54 ± 75.79 micron. Age Group III which have

20 total numbers of samples (N) 162.93 ± 79.97 micron. These values show very much inter group significant difference as the ANOVA test shows the p-value less than 0.001 ($p = 0.00030$) (Table 4 & Figure 2, 3)

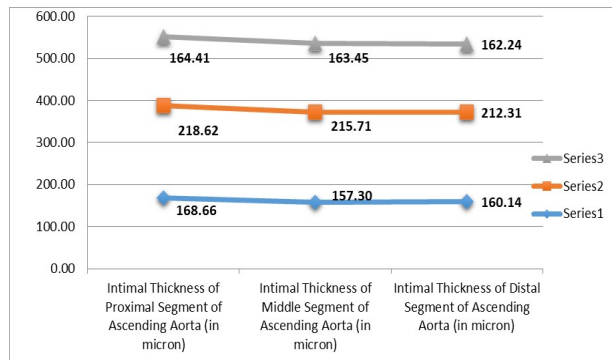


Fig. 2: Comparative Values of Intimal Thickness of Each Segment of the Ascending Aorta with Age Groups (Series 1: Age Group I, Series 2: Age Group II & Series 3: Age Group III).

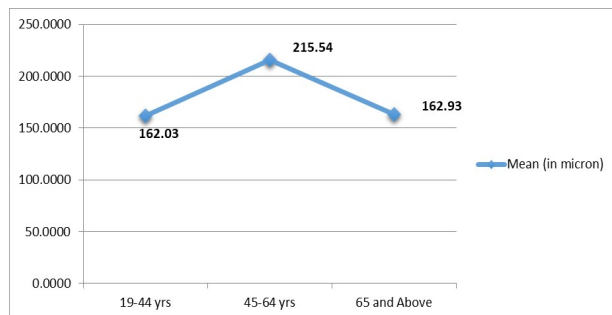


Fig. 3: Change in Mean Intimal Thickness with Aging.

The intima is the most inner and the thinnest layer of the wall of Ascending Aorta (AA). It prevents interaction, like the inflammatory, invasion and other direct attacks. The sub endothelial is the largest part of the intima is, consisting of connective tissue elements, only 20 to 40 collagen elements and elastin. This layer grows with age by proliferation. The last layer of the intima is the internal elastic membrane.

Vascular aging changes gradually from infancy but changes become more significant in middle age then deteriorate with aging [10]. These changes affect the thickness of each layer of wall and the lumen size of the aorta. Sawabe et al. [11] studied 833 autopsies with an age range of 2–94 years. They measured the internal circumference of each part of the aorta by using a hard scale and they carried out an assessment of atherosclerosis. They found a correlation between aortic circumference and age which was highest in the descending aorta

and an increase in the diameter of the descending aorta which was related to an increase in the severity of atherosclerosis.

Movat et al. [12] studied 92 human aortas by necropsy. They investigated the qualitative structure and development of the intimal thickening of the human aorta. They found that the differences of the thickness in the tunica intima were associated with age and location within the aorta. Thickness of the tunica intima and the composition of the atrial wall gradually changed from the fetus to old age. In the first to fourth decades, differences were found in the thickness in the tunica intima between the proximal and distal part of the aorta. The intima of the distal part was thicker than the proximal part of the aorta. Our study shows that mean thickness of proximal, middle and distal segments are 187, 181 and 180 which means intima of proximal part was thicker than the distal part though the difference was not significant, which contradict above statement.

Maurel et al. [13] studied the distribution of morphological appearance related-to age changes in different segments of the aorta in cadavers aged less than 50 years (20–48) and aged more than 50 years. The results showed that the aorta in those aged less than 50 years had a number of elastic fibres with less ground substance. There were decreased numbers of elastic fibres and the space between the elastic lamella was wider. With advancement of age, the tunica intima was found to be thickened with what was damage of internal elastic fibres. Degradation of elastic lamellae was found in the tunica media and elastic fibres were irregularly arranged and fragmented. Schlatmann and Becker [14] studied qualitative histological changes in relation to age in the tunica media of 100 normal aortas. They described histological features such as elastin fragmentation and fibrosis. It was found that these changes showed a correlation with age. Elastin fragmentation decreased with aging and fibrosis increased with increasing age. In the middle-aged and aged cadavers, the degeneration of the elastic fibres was in the media, internal and external elastic laminae.

Table 1: Intimal Thickness of Proximal Segment of Ascending Aorta with Age Groups.

Age Group	Mean (micron)	Std. Deviation	Range	Minimum	Maximum	Std. Error of Mean	N	% of Total N	% of Total Sum
19-44 yrs	168.66	73.757	411	55	466	10.431	50	42.70%	38.50%
45-64 yrs	218.62	90.008	322	70	392	13.418	45	38.50%	44.90%
65 and Above	164.41	94.784	372	37	409	20.208	22	18.80%	16.50%
Total	187.08	87.333	429	37	466	8.074	117	100.00%	100.00%

(ANOVA, p < 0.01)

Table 2: Intimal Thickness of Middle Segment of Ascending Aorta with Age Groups.

Age Group	Mean (micron)	Std. Deviation	Range	Minimum	Maximum	Std. Error of Mean	N	% of Total N	% of Total Sum
19-44 yrs	157.3	54.167	223	80	303	7.66	50	43.50%	37.70%
45-64 yrs	215.71	81.035	284	74	358	12.08	45	39.10%	46.60%
65 and Above	163.45	92.168	332	47	379	20.609	20	17.40%	15.70%
Total	181.23	77.378	332	47	379	7.216	115	100.00%	100.00%

(ANOVA, p < 0.001)

Table 3: Intimal Thickness of Distal Segment of Ascending Aorta with Age Groups.

Age Group	Mean (micron)	Std. Deviation	Range	Minimum	Maximum	Std. Error of Mean	N	% of Total N	% of Total Sum
19-44 yrs	160.14	51.536	212	85	297	7.288	50	43.10%	38.20%
45-64 yrs	212.31	74.315	258	87	345	11.078	45	38.80%	45.60%
65 and Above	162.24	69.251	250	46	296	15.112	21	18.10%	16.20%
Total	180.76	68.671	299	46	345	6.376	116	100.00%	100.00%

(ANOVA, < 0.001)

Table 4: Mean Intimal Thickness of Ascending Aorta of Each Group.

Age Group	N	Mean (in micron)	Std. Deviation	Minimum	Maximum	Std. Error of Mean	% of Total N	% of Total Sum
19-44 yrs	50	162.0333	50.74932	80.67	322.67	7.17704	43.50%	38.50%
45-64 yrs	45	215.5481	75.79432	81	348	11.29875	39.10%	46.10%
65 and Above	20	162.9333	79.9795	59	338.67	17.88396	17.40%	15.50%
Total	115	183.1304	71.21815	59	348	6.64113	100.00%	100.00%

(ANOVA p < 0.00 (p = 0.000309135))

Virmani R et al. [5] studied Intimal thickness increased with advancing age in all populations and was maximal in abdominal aorta than other parts of Aorta. Gupta SD et al. [15] studied about the microscopic structure of Aorta with different age groups; they observed that thickness of tunica intima was minimal during infancy and it could not be measured, where as in the age group 60 years and above thickness of tunica intima ranged between 385 and 450 μ with mean thickness of tunica intima was 417 μ. In this study 40% of study subjects belonged to 40 -60 years age. There was increase in thickness of tunica intima of aorta with age. Present study make agreement with Gupta SD as in our study the intimal thickness ranged between 59 to 348 μ with mean thickness of tunica intima was 183 μ as in our study 60% of the cases belongs to 19 to 44 years of age. It increase with age.

In our study mean intimal thickness of Age group I (19 to 44 years) was 162.033 μ, mean intimal thickness of Age group II (45 to 64 years) was 215.54 μ and mean intimal thickness of Age group III (65 years and above) was 162.933 μ. It shows that there is continuous increase in intimal thickness up to the age of 65 years there after it decreases. Mara et al. [16] studied that there was a significant increase of lipid in the intima of Aorta. They evaluated the Median value with its minimum and maximum range of thickness of tunica Intima and found it was 239.5 (139.6–364.9) μm in non-elderly and 335.2 (216.3–563.9) μm in elderly people. In present study the Mean Intimal thickness of proximal segment of ascending aorta increases (from 168.66 μ to 218.62 μ) significantly with age up to 64 years but it decreases (from 218.62 μ to 164.41 μ) significantly above 65 years of age. In present study the Mean Intimal thickness of middle

segment of ascending aorta increases (from 157.30 μ to 215.71 μ) significantly with age up to 64 years but it decreases (from 215.71 μ to 163.45 μ) significantly above 65 years of age. In present study the Mean Intimal thickness of distal segment of ascending aorta increases (from 160.14 μ to 212.31 μ) significantly with age up to 64 years but it decreases (from 212.31 μ to 162.24 μ) significantly above 65 years of age.

There is always scope of betterment of every work or research. As this study was done in South Gujarat region so these results may not be implemented for all populations. Samples need to be taken from different regions to get more generalized results.

CONCLUSION

Our study shows that mean thickness of proximal, middle and distal segments of ascending aorta are 187, 181 and 180 μ ; which means intima of proximal part was thicker than the distal part though the difference was not significant. Value of Mean Intimal thickness of Ascending Aorta of Age Group I, II and III was 162.03 \pm 50.74 μ , 215.54 \pm 75.79 μ and 162.93 \pm 79.97 μ respectively; It shows constant increase till the age of 64 years and there after it decreases. Intimal thickening is the first event in pathogenesis of atherosclerotic changes and in above study we can appreciate that intimal thickness increases with age so it may be used as an early marker of cardiovascular diseases.

Conflicts of Interests: None

REFERENCES

- [1]. Webb RC, Inscho EW. Age-related changes in the cardiovascular system. In: Aiyagari V, Gorelick PB, editors. *Clinical Hypertension and Vascular Diseases: Hypertension in the Elderly*. Totowa, NJ: Humana Press; 2005. pp. 11–21.
- [2]. Karavidas A, Lazaros G, Tsiachris D, Pyrgakis V. Aging and the cardiovascular system. *Hellenic J Cardiol* 2010;51:421–7.
- [3]. Fleg JL. Alterations in cardiovascular structure and function with advancing age. *Am J Cardiol* 1986;57:33–44.
- [4]. Redheuil A, Yu WC, Mousseaux E, Harouni AA, Kachenoura N, Wu CO, *et al.* Age-related changes in aortic arch geometry: relationship with proximal aortic function and left ventricular mass and remodeling. *J Am Coll Cardiol* 2011;58:1262–70.
- [5]. Virmani R, Avolio AP, Mergner WJ, Robinowitz M, Herderick EE, Cornhill JF, *et al.* Effect of aging on aortic morphology in populations with high and low prevalence of hypertension and atherosclerosis: Comparison between occidental and Chinese communities. *Am J Pathol* 1991;139:1119–29.
- [6]. Nagai Y, Metter EJ, Earley CJ, Kemper MK, Becker LC, Lakatta EG, *et al.* Increased carotid artery intimal-medial thickness in asymptomatic older subjects with exercise-induced myocardial ischemia. *Circulation* 1998;98:1504–9.
- [7]. Laurent S. Defining vascular aging and cardiovascular risk. *J Hypertens* 2012;30:S3–S8.
- [8]. Collins JA, Munoz JV, Patel TR, Loukas M, Tubbs RS. The anatomy of the aging aorta. *Clin Anat* 2014;27:463–6.
- [9]. Cheuk BL, Cheng SW. Expression of integrin $\alpha 5\beta 1$ and the relationship to collagen and elastin content in human suprarenal and infrarenal aortas. *Vasc Endovascular Surg* 2005;39:245–51.
- [10]. Greenwald SE. Ageing of the conduit arteries. *J Pathol* 2007;211:157–72.
- [11]. Sawabe M, Hamamatsu A, Chida K, Mieno MN, Ozawa T. Age is a major pathobiological determinant of aortic dilatation: a large autopsy study of community deaths. *J Atheroscler Thromb* 2011;18:157–65.
- [12]. Movat HZ, More RH, Haust MD. The diffuse intimal thickening of the human aorta with aging. *Am J Pathol* 1958;34:1023–31.
- [13]. Maurel E, Shuttleworth CA, Bouissou H. Interstitial collagens and ageing in human aorta. *Virchows Arch A Pathol Anat Histopathol* 1987;410:383–90.
- [14]. Schlatmann TJ, Becker AE. Histologic changes in the normal aging aorta: implications for dissecting aortic aneurysm. *Am J Cardiol* 1977;39:13–20.
- [15]. Gupta SD, Gupta SK, Pal DK, Sarawagi R, Gupta P. Microscopic study of aorta in relation of different age groups: an observational study. *Int J Biol Med Res* 2011;2:398-403.
- [16]. Mara LDFF, Douglas MSN, Joao PHR, Ana PE, Livia FO, Luciana SR, *et al.* Correlation of lifetime progress of atherosclerosis and morphologic markers of severity in humans: new tools for a more sensitive evaluation. *Clinics* 2012;67(9):1071-5.

How to cite this article:

Kavita Pahuja, Amardeep Bissa. Segmental Representation of Intimal Thickness in Ascending Aorta as Early Clinical Marker of Aging. *Int J Anat Res* 2021;9(2.1):7955-7959. DOI: 10.16965/ijar.2021.116