

A Study of Variations in Human Ascending Aortic Fold

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ABSTRACT

Objective: To study the variations in gross appearance of ascending aortic fold, and relationship of vertical height of middle of fold to vertical height of heart and to the mean width of the fold.

Study Design: This was a cross sectional study.

Place and Duration of Study: Department of anatomy, Rawalpindi Medical College, Rawalpindi, from Jan 2010 to Dec 2010.

Materials and Methods: The present study was carried out on 24 hearts obtained from the dissection room of Rawalpindi Medical College, Rawalpindi. All the cases cadavers available during the study period were included in the study. The ascending aorta was studied with respect to its length and presence of fold in each of the specimens. The direction of the fold was noted for the classic oblique form and other variations.

Results: The fold was present in all the specimens. It was oblique in 13 cases, horizontal in 6, oval in 2, vertical oblique in 2 and vertical horizontal in 1 individual. The vertical height of middle of fold was inversely proportional to vertical height of the heart and directly proportional to the mean width of the fold.

Conclusion: The present study provided new dimension and observation that the vertical height of the middle of fold and vertical height of heart are inversely proportional to each other. Vertical height of the middle of fold and mean width of the fold are directly proportional to each other.

Keywords: *Ascending Aortic fold, Vertical height of heart, Mean width of aortic fold.*

Introduction

The ascending aortic fold was described for the first time by Rindfleisch (1984) as a fibrofatty epicardial fold, semilunar in shape, 1 to 3 cm long, 2 to 5 mm wide and directed obliquely across the middle of anterior surface of ascending aorta. He concluded that the fold enhanced the elasticity of visceral pericardium.¹ Epicardium is the visceral layer of pericardium. Ascending aorta is enclosed in a sheath of serous pericardium. Serous pericardium has parietal and visceral layer. Parietal layer lines the fibrous pericardium.^{2,3} Accessory thyroid tissue was detected by Swarts and Thompson (1911) in sub-epicardial preaortic fat.⁴

The term of periaortic fat pads was used by Gross (1921) for the ascending aortic fold. He observed that these fat pads increase with age and myocardial pathology. He concluded that this progressive deposition

of fat was the result of collateral enlargement of blood vessels in the fat pads to lessen the effect of coronary insufficiency.⁵ It was demonstrated by Woodruff that opening of vasa vasorum of aorta was present beneath the fat pads.⁶ Vasa vasorum are contained in adventitia of large arteries.^{7,8} It was reported by David J. Davis (1927) that ascending aortic fold was constant in location, form and size. He suggested the name of periaortic fat bodies for the fold.⁹ Epicardial fat pad was another name used by Robertson (1930) for the ascending aortic fold. He was of the opinion that the fold carried an arterial network to the vasa vasorum of aorta and a site of anastomosis between the coronary arteries.¹⁰ The fold was found by Parke and Michels (1966) in adults, children and fetuses and was called by them as aortic ridge. They proposed that it relieves pressure and friction between aorta and right auricle.¹¹ A relatively recent study was carried out by G.T Lebona (1993) in South Africa. He proposed the name of ascending aortic fold. The fold has not been mentioned in the recent textbooks of anatomy. He observed that apart from classic oblique form other

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varieties of ascending aortic fold also exist.^{12,13} Different views were given about the structure of ascending aortic fold. The knowledge about the fold was limited. Moreover no more studies could be found to confirm or refute the work done by G.T Lebona, which needs to be studied and explored more. This inspired me to work for this difficult task and to conduct the present study.

Materials and Methods

This was cross sectional study carried out in Rawalpindi Medical College from Jan 2010 to Dec 2010.

All the cadavers dissected during this period were used for this study. For the data collection a structured questionnaire was developed mentioning the important variables about Length, width, position, type's and shapes/axis of fold etc. Data was analyzed by using Microsoft Excel and Statistical package for social sciences version 17. Mean and standard deviation were calculated; cross tabs were done and mentioned in tables and graphs.

The material consisted of 24 hearts obtained from the dissection hall of Rawalpindi Medical College, Rawalpindi.

Obese adult, putrefied and macerated specimens, gross pathological findings like aortic aneurysms, myocardial infarction and congenital anomalies were not included. The ascending aorta was studied with respect to its length and presence of fold in each of the specimens. The direction of the fold was noted for the classic oblique form and other variations. Mean width of the fold was calculated by taking the average of maximum and minimum width in each of the specimens. The vertical height of the middle of fold was measured from middle of its upper border to its lower border. Vertical height of the heart was measured from middle of the upper border of fold to the inferior border of heart. Height of the fold as

percentage of height of heart was also calculated in each of the specimen. A comparison of the vertical height of the heart and vertical height of the fold was made in each of the specimen. Similarly a comparison of mean width and vertical height of the middle of the fold was made.

Results

The ascending aortic fold was present in all the 24 specimens. It was obliquely oriented in 13 specimens as shown in figure 1. Horizontal variety was present in 6 specimens as shown in figure 2. The fold was oval in 2 hearts as shown in figure 3. In remaining 3 specimens combination of axis was observed. It was vertical oblique in 2 specimens as shown in figure 4. Vertical horizontal form was seen in only 1 heart as shown in figure 5. The frequency of variations of ascending aortic fold is shown in table 1. Length of ascending aorta ranged between 4.40 to 5.40 cm. The mean length of ascending aorta came out to be 4.90cm as shown in table 1. The mean width of the fold ranged between 0.19 cm and 1.07 cm. The mean of the mean width was 0.41 cm with SD of 0.17 as shown in table 1. The vertical height of the middle of fold ranged between 0.21 cm to 0.82 cm, with mean value of 0.39 and SD of 0.14 as shown in table 1. The vertical height of the heart ranged between 7.80 cm and 9.82 cm with mean value of 8.66 cm and SD of 0.62 as shown in table 1. Height of the fold as percentage of height of the heart ranged from 2.23% to 8.81% with mean of 4.61% as shown in figure 6 and table 1. The vertical height of the fold decreased as the height of the heart increased as shown in figure 7. The vertical heights of the middle of fold and mean width of fold generally remained in the similar ranges as shown in figure 8.

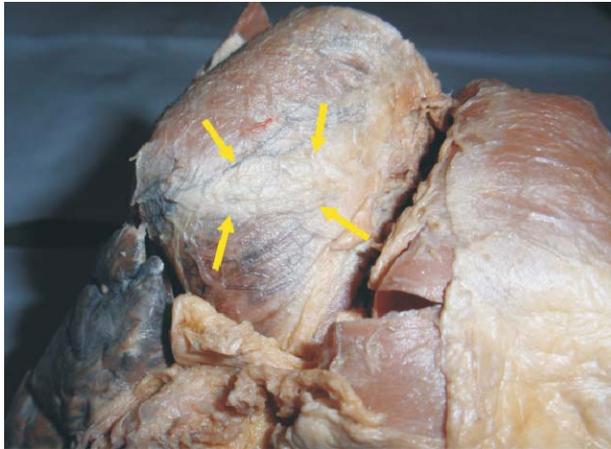


Figure 1: Anterior aspect of ascending aorta showing oblique type of ascending aortic fold (yellow arrows).

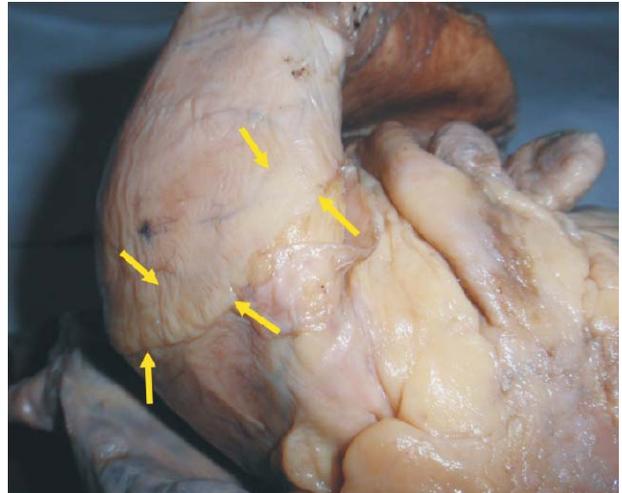


Figure 4: Anterior aspect of ascending aorta showing vertical oblique type of ascending aortic fold (yellow arrows).



Figure 2: Anterior aspect of ascending aorta showing horizontal type of ascending aortic fold (yellow arrows).

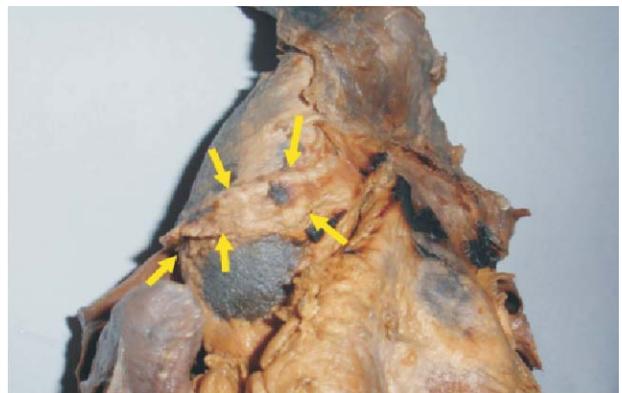


Figure 5: Anterior aspect of ascending aorta showing vertical horizontal type of ascending aortic fold (yellow arrows)

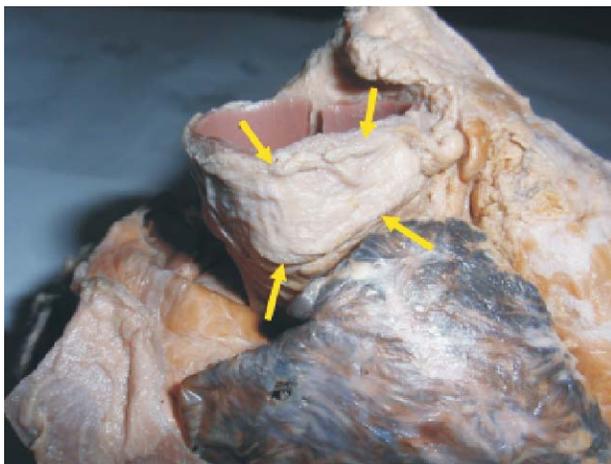


Figure 3: Anterior aspect of ascending aorta showing oval type of ascending aortic fold (yellow arrows).

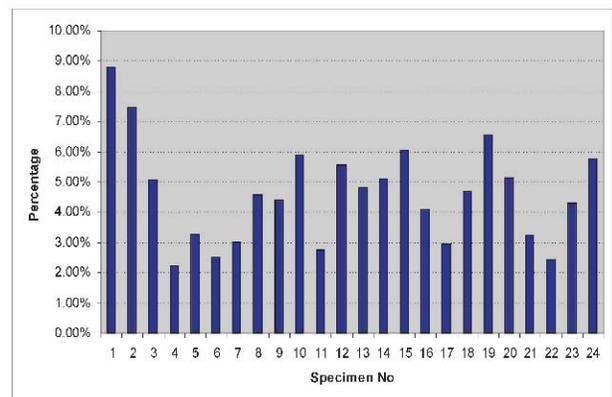


Figure 6: The height of the fold as percentage of height of the heart.

Table I: Gross parameters of ascending aortic fold

Specimen No	Inclination of the aortic fold	Max Width (cm)	Min Width (cm)	Mean Width (cm)	Vertical Height of middle of the fold (cm)	Vertical Height from middle of the fold to inferior border of heart (cm)	Height of Fold as percentage of Height of the Heart	length of the fold (cm)	Length of Ascending Aorta (cm)
1	Vertical Oblique	1.3	0.83	1.07	0.82	9.31	8.81%	3	5.3
2	Oval	0.62	0.34	0.48	0.6	8.05	7.45%	2.2	4.8
3	Oblique	0.45	0.25	0.35	0.4	7.9	5.06%	3.51	4.8
4	Vertical Oblique	0.25	0.13	0.19	0.21	9.41	2.23%	4	4.9
5	Horizontal	0.6	0.27	0.44	0.32	9.82	3.26%	1.71	5.1
6	Vertical Horizontal	0.5	0.16	0.33	0.21	8.42	2.49%	5	4.7
7	Oblique	0.55	0.18	0.37	0.27	8.95	3.02%	2.7	5
8	Oblique	0.42	0.23	0.33	0.37	8.1	4.57%	3.3	5.1
9	Oblique	0.7	0.28	0.49	0.4	9.1	4.40%	4.2	5.2
10	Horizontal	0.35	0.19	0.27	0.47	8	5.88%	3.7	4.7
11	Horizontal	0.52	0.17	0.35	0.26	9.5	2.74%	2.8	4.4
12	Oblique	0.29	0.14	0.22	0.44	7.9	5.57%	2.1	4.9
13	Oblique	0.58	0.31	0.45	0.41	8.5	4.82%	2.6	4.5
14	Horizontal	0.71	0.37	0.54	0.42	8.2	5.12%	3.1	5.1
15	Oval	0.59	0.22	0.41	0.51	8.4	6.07%	2.5	5
16	Oblique	0.61	0.24	0.43	0.35	8.6	4.07%	3	5.2
17	Oblique	0.32	0.2	0.26	0.27	9.1	2.97%	2.3	4.5
18	Horizontal	0.8	0.39	0.60	0.43	9.2	4.67%	2.7	5.4
19	Oblique	0.61	0.33	0.47	0.55	8.4	6.55%	2.3	5
20	Oblique	0.44	0.26	0.35	0.41	7.95	5.16%	2.6	4.8
21	Horizontal	0.58	0.3	0.44	0.31	9.6	3.23%	1.9	4.7
22	Oblique	0.26	0.15	0.21	0.22	9.1	2.42%	2.5	4.9
23	Oblique	0.51	0.18	0.35	0.37	8.6	4.30%	2.8	4.6
24	Oblique	0.47	0.29	0.38	0.45	7.8	5.77%	1.9	4.9
Mean		0.54	0.27	0.41	0.39	8.66	4.61%	2.85	4.90
SD		0.22	0.14	0.17	0.14	0.62		0.79	0.26

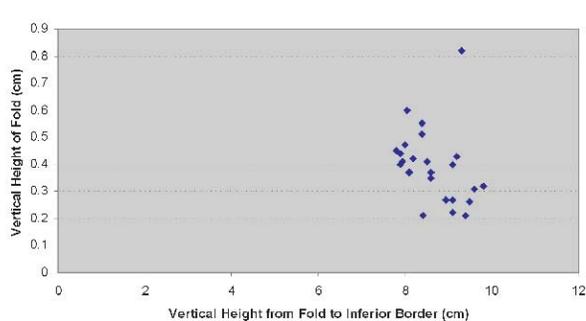


Figure 7: Scatter graph showing the comparison of vertical height of the fold and the vertical height of the heart.

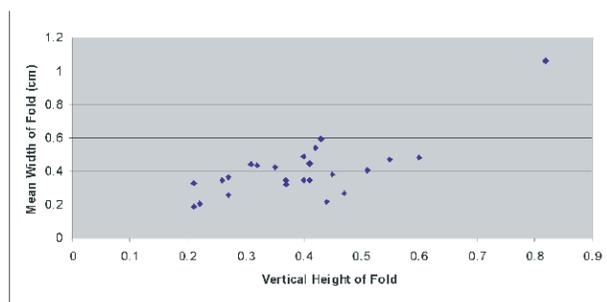


Figure 8: Scatter graph showing the comparison of vertical height of middle of fold and its mean width.

Discussion

The present study has shown that the ascending aortic fold is a constant feature and confirmed the findings of previous workers.^{1,9,11,12} During the present study mean length of aorta (4.90cm) was approximately the same as given in literature.¹⁴ Earlier the literature identified only oblique semilunar form of the ascending aortic fold. Later on, it was reported by G.T Lebona that a wide variation in gross anatomy of fold exists.^{12,13} He observed classic oblique form in 51 out of 90 specimens. Horizontal form was seen in 17, vertical form in 5 and oval in 2 hearts. In the remaining 15 hearts the fold was seen in the form of a combined axial pattern. It was horizontal-oblique in 4, vertical-oblique in 6, vertical-horizontal in 3, vertical-horizontal-oblique in 1 and oval-oblique in 1. The present study has confirmed that variations are present in the gross anatomy of

ascending aortic fold. Classic oblique form was present in 13 out of 24 hearts. It was oval in 2 hearts and horizontal in 6 hearts. The remaining 3 hearts showed a combination of axis. The fold was vertical-oblique in 2 and vertical-horizontal in 1 of the hearts. However the variations noted in the present study were not as wide as seen by G.T Lebona in Black South Africans. Thus the present study is the first to agree with the work of G.T Lebona. During the present study it was found that height of the fold as percentage of the height of heart ranged from 2.23% to 8.81% with mean value of 4.61%. A trend was noted that as the vertical height of heart increase there was no increase in vertical height of middle of fold, rather it decreased. To our knowledge no such study has been carried out before this.

The present study provides new dimension and observation that the vertical height of the middle of fold and mean width of the fold are directly proportional to each other.

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