Original article

Morphological and Histological Study on Postmortem Vermiform Appendix of Adult Population in Bangladesh

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Abstract

Objective: The objective of this study was to find out the morphological and histological study on post mortem vermiform appendix of adult population in Bangladesh. Materials and method: In the present descriptive type of cross sectional study, 60 normal vermiform appendix of both sex were observed in dead bodies during routine postmortem examination due to accidental and unnatural (unclaimed) death. Length and diameter were measured with a Digital sliding (measuring types) Vernier caliper. Three pieces were taken one close to the tip, one from the middle and one from the base and were processed and examined under light microscope. The number of mucosal glands and germinal centers of lymphoid follicles present in the slide were counted. Data were processed and analyzed. Results*:* length of the vermiform appendix decreases gradually with increasing age and was highly significant ($p < 0.001$) in the present study. Statistically highly significant negative correlation between age of the cadavers(subjects)and wall thickness and diameter of the vermiform appendix ($r= -0.84$, $p < 0.001$) was found. The diameter in children is wide and the lumen is almost obliterated in the elderly. There was no statistically significant difference of length, wall thickness & diameter of the vermiform appendix between the male and female ($p > 0.05$). Conclusions: Morphological and histological study of vermiform appendix might be used to gather knowledge about the changes of appendicular features in different age groups of Bangladeshi population and would also be helpful for the anatomists, anthropologists, forensic experts, pathologists and surgeons. Further studies with a larger sample size are required for better decision.

Key words: Morphological, histological, postmortem, vermiform appendix, adult

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Introduction

The vermiform appendix is a narrow, worm shaped tube, arising from the posteromedial wall of caecum, 2 cm or less below the end of the ileum. The adjective ‘‘vermiform’’ literally means ‘‘worm like’’ and reflects the narrow, elongated shape of this organ.[1] Its opening is guarded by a semicircular fold of mucus membrane known as the valve of Gerlach.[2]

The length of the vermiform appendix varies from 2 to 20 cm with an average length of 9 cm. It is longest in childhood and gradually shrinks throughout the life. The base of vermiform appendix is fairly constant whereas the position of its apex variable. Type of vermiform appendix are retrocaecal and retrocolic, pelvic, subcaecal, preileal, postileal and paracolic. The vermiform appendix is suspended by a short triangular mesoappendix containing the appendicular nerves and vessels.[3]

Vermiform appendix shows variations in its microscopic features. For example, the number of lymphoid follicles in the mucosa/ submucosa is supposed to vary according to the amount, time and duration of exposure to antigens. Population of different region may have different number of lymphoid follicles and germinal centres. The lymphoid structure of the vermiform appendix also varies with age,[4] being well developed in the infants and children and atrophied at the old age. Lymphoid tissue first appears in the human vermiform appendix about 2 weeks after birth. The number of lymphoid follicles gradually increases to a peak of about 200, between the ages of 12 to 20 years. After 30 there is an abrupt reduction to less than half and then to a trace or total absence of lymphoid tissue after 60 years. The amount of lymphoid tissue increases throughout the puberty, remains steady for the next decade and then begins

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to decrease with age. After the age of 60, virtually no lymphoid tissue remains within the vermiform appendix and complete obliteration of the appendiceal lumen is common.[4] It may be assumed that the structural components like the number of lymphoid follicles and mucosal glands may have implications on the luminal diameter and vice versa. Again, the wall thickness may be linked to the luminal diameter as well as to external diameter of the organ.[1]

In current medical diagnosis and treatment, appendicitis has been considered as "the most common abdominal surgical emergency, affecting approximately 10 % of the population". The higher incidence of appendicitis in the young adults than in the children or elderly has been attributed to the changes in its luminal diameter with age.

Likewise, Bangladesh is a country where the majority of Bengali populations are different from the so-called White, Black and Mongoloid races. In addition, variations in the macroscopic dimensions, there are possibilities of difference in other features, especially at microscopic and molecular levels. These morphological and histological variations, are bound to have tremendous anthropologic, forensic as well as clinical implications.[1] This study was conducted to explore the possible morphological and histological variations of vermiform appendix in Bangladeshi population.

Material and method

Purposive sampling was followed considering the inclusion and exclusion criteria. In this study, 60 normal vermiform appendixes of both sex were observed in dead bodies during routine post-mortem examination due to accidental and unnatural death. Vermiform appendix of the decomposed bodies and lacerated injured cases involving appendix or its adjacent structures were excluded from the study. Before immersion in 10% normal saline solution length & diameter were measured with a Digital sliding (measuring types) Vernier caliper. Three pieces were taken one close to the tip, one from the middle and one from the base. Preserved and fixed by 10% formol saline solution, gradually dehydrated in ascending concentration of graded ethyl alcohol series, cleared in xylene, infiltrated in liquid paraffin then embedded with melted paraffin. The three segments were processed for microscopic study and several 8 mm-thick transverse sections were made from each segmental level (base, midzone and tip) using a rotatory microtome. The sections were stained with Haematoxylin & Eosin stain. After preparation, the slide was examined under light microscope. The number of mucosal glands and germinal centers of lymphoid follicles (randomly) present in the slide were counted. For measurements and counting, one good section was selected for each segmental level and these were recorded in data collection sheet. Data were processed and analyzed using computer software program SPSS (Statistical Package for Social Science) version 25.0. The data present on categorical scale were expressed as frequency and corresponding percentage, while the quantitative data were presented as mean and standard deviation (SD).Unpaired t test was used to compare the length, diameter and wall thickness of the vermiform appendix between male and female. Pearson's correlation coefficient test was used to compare the length, diameter and wall thickness of the vermiform appendix with age. p value less than 0.05 was considered as statistically significant for all tests. Prior to beginning the study approval was taken from Ethical Review Committe and institutional Review Board of rajshahi Medical College, Rajshahi.

Results

The results are shown in the following tables and figures-

Table No. 1: Distribution of the cadavers by age (n=60).

Age in years	Frequency	Percentage
≤ 25 years	21	35.00%
26-35 years	16	26.70%
36-45 years	13	21.70%
> 45 years	10	16.70%
Total	60	100.00%
±SD = 32.25±11.75 years, range = (18 – 58) yrs		

Table 1 showed the distribution of the cadavers by age. Out of 60 cadavers, it was found that 21 (35.00%) were ≤ 25 years age group, 16 (26.70%) were 26-35 years, 13 (21.70%) were 36-45 years and 10 (16.70%) were > 45 years. The mean age of the cadavers was 32.25±11.75 years.

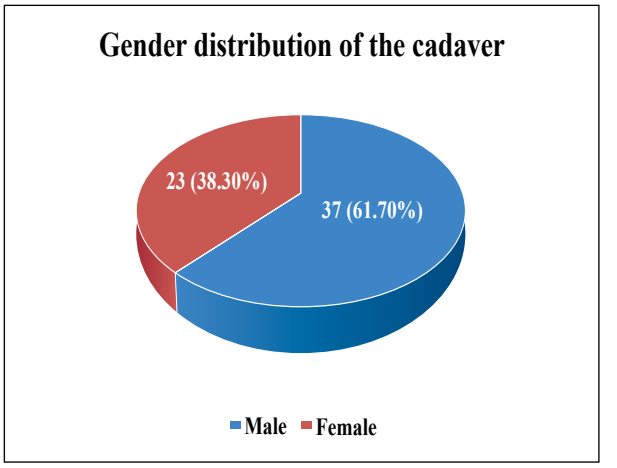

Figure No. 1: Distribution of the cadavers (subjects) by gender (n=60).

Table No. 2: Measurement of the length of the Vermiform appendix (n=60).

Variable	Median	Mode	Minimum	Maximum
Length of the vermiform appendix (cm)	7.44	6.15	2.75	13.50
Mean length of the Vermiform appendix was 7.95±3.07 cm				

Table No. 3: Measurement of the wall thickness of the vermiform appendix (n=60).

Segmental level of wall thickness	Statistical measurements			
	Median	Mode	Minimum	Maximum
At the base (mm)	2.35	2.30	1.60	2.70
At the midzone (mm)	2.15	2.15	1.35	2.50
At the tip (mm)	1.97	2.10	1.30	2.30
Overall (mm)	2.16	2.15	1.45	2.46

Table No. 4: Measurement of the diameter of the vermiform appendix (n=60).

Segmental level of lumen	Statistical measurements			
	Median	Mode	Minimum	Maximum
At the base (mm)	6.38	6.60	4.10	7.20
At the midzone (mm)	5.70	6.30	3.75	6.50
At the tip (mm)	5.20	5.20	3.40	6.10
Total (mm)	5.77	5.77	3.77	6.60

Table No. 5: Number of mucosal glands and germinal centres of lymphoid follicles present in a section of the vermiform appendix (n=60).

Variables	Statistical measurements			
	Median	Mode	Minimum	Maximum
Number of mucosal glands	76.50	33	33	159
Number of germinal centre of lymphoid follicle	8	8	2	13

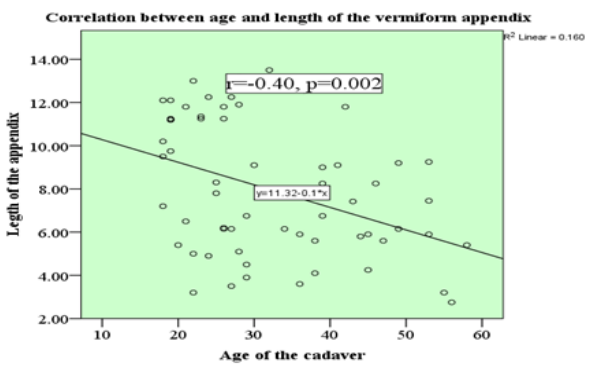

Figure No.2: Correlation between the age and length of the vermiform appendix (n=60)

There was statistically significant negative correlation between the age of the cadavers and length of the vermiform appendix (r= -0.40, p < 0.01).

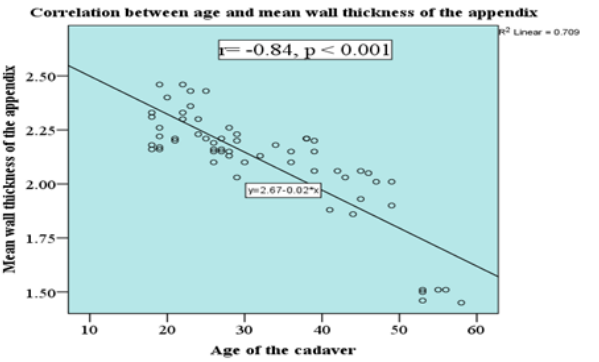

Figure No. 3: Correlation between the age of cadavers (subjects) and wall thickness of the vermiform appendix (n=60).

There was statistically highly significant negative correlation between the age of cadavers and wall thickness of the vermiform appendix (r= -0.84, p < 0.001).

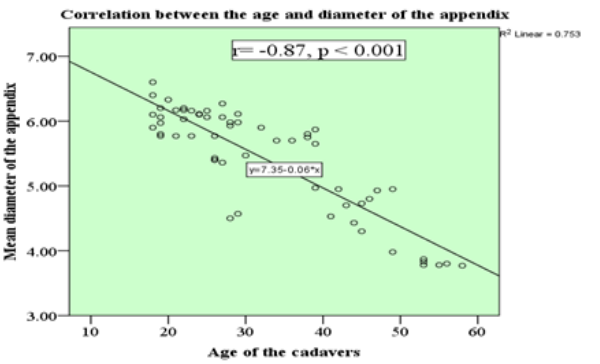

Figure No. 4: Correlation between the age and diameter of the vermiform appendix (n=60).

There was statistically highly significant negative correlation between the age of cadavers and diameter of the vermiform appendix (r= -0.87, p < 0.001).

Table No. 6: Comparison of the length of the vermiform appendix between the male and female cadavers (subjects) (n=60).

Length of the vermiform appendix	Group		t-value	p-value
	Male (n = 37)	Female (n = 23)		
mean ± SD(cm)	7.70±3.11	8.37±3.02	0.83	> 0.05
Range (cm)	3.20 to 13.50	2.75 to 12.10		

(Data were analyzed by Unpaired t-Test and were expressed as mean ± SD.)

There was no statistically significant difference of length of the vermiform appendix between the male and female cadavers ($p > 0.05$).

Table No. 7: Comparison of the mean wall thickness of the vermiform appendix between the male and female cadavers (n=60).

Wall thickness of the vermiform appendix	Group		t-value	p-value
	Male (n = 37)	Female (n = 23)		
mean ± SD(mm)	2.15±0.24	2.04±0.24	1.60	> 0.05
Range (mm)	1.45 to 2.46	1.51 to 2.43		

(Data were analyzed by Unpaired t-Test and were expressed as mean ± SD.)

There was no statistically significant difference of the wall thickness of the vermiform appendix between the male and female cadavers ($p > 0.05$).

Table 8: Comparison of the diameter of the vermiform appendix between the male and female cadavers (n=60).

Diameter of the vermiform appendix	Group		t-value	p-value
	Male (n = 37)	Female (n = 23)		
mean ± SD(mm)	5.59±0.81	5.17±0.74	1.99	> 0.05
Range (mm)	3.77 to 6.60	3.78 to 6.10		

(Data were analyzed by Unpaired t-Test and were expressed as mean ± SD.)

There was no statistically significant difference of diameter of the vermiform appendix between the male and female ($p > 0.05$).

Discussion

The anatomy of the vermiform appendix shows variations in its macroscopic dimensions and microscopic features, some of which have potentials of influencing the clinical aspects of the vermiform appendix. The aim of this study was to find out some microscopic features of vermiform appendix and evaluate the correlation between the microscopic features of the appendix and the age of the subjects and to determine whether these findings should influence the clinical implications of vermiform appendix. This study was conducted on 60 Postmortem vermiform appendixes. Statistical significance was evaluated as appropriate probability level $p < 0.05$ for all tests.

In the present study, out of 60 cadavers, the age distribution was found that 21 (35.00%) were ≤ 25 years age group, 16 (26.70%) were 26-35 years, 13 (21.70%) were 36-45 years and 10 (16.70%) were > 45 years. The mean age of the cadavers was 32.25±11.75 years. 37 (61.70%) of the cadavers were male and 23 (38.30%) were female. Length of the vermiform appendix revealed that mean length of the appendix was 7.95±3.07 cm and range was 2.75-13.50 cm. Mohammadi et al., 2017 reported that the mean length of the appendix was 8.52 cm which was nearly similar to this study.[3]

The length of the vermiform appendix ranges between 2 to 20 cm, with an average of 9 cm. Findings of this study are similar to the textbook's data, as mean length of the appendix ranged from 2.75 to 13.50 with a mean of 7.97 cm. The mean length of vermiform appendix ranges from 5.3 to 6.9 cm in western countries that was less than this study.[5] In this study mean length of vermiform appendix 8.37±3.02 in female and 7.70±3.11 in male and in a study in Germany, the mean length of the vermiform appendix was 6.3 cm in female and 7.5 cm in male[6] which was nearly similar with the study. In African studies the length of vermiform appendix varies, 7.65 cm in the Kenian population and 11.7 cm in Zambian people.[7,8,9] In Senegal, the mean length of the vermiform appendix was 10.64 cm and its diameter was 67.7 cm.[9] There are various reports on the vermiform appendix size in Asian population. In a laparoscopic study by Gupta et al., 2017 in New Delhi, the mean length of the vermiform appendix was 5.25 cm. The length of the Indian cadavers ranges between 5.9 and 10.21 and the values obtained for thickness ranges from 0.46 cm to 0.7 cm.[10,11,12] In the present study, the length and diameter of the vermiform appendixes were longer than those in Indian population (12.17 mm and 0.46 mm, respectively). The mean length of the vermiform appendix was 6.03 cm in Thailand.[13] The average length of the vermiform appendix was 6.61 cm in males and 6.06 cm in females in Gorgan[14] in Zanjan have reported that the mean length of the vermiform appendix was 9.12 cm in males and 8.03 cm in females.

In the current study, mean wall thickness at the base was 2.29±0.25 mm, at the midzone was 2.09±0.26 mm and at the apex was 1.93±0.23 mm. The mean wall thickness of the vermiform appendix was 2.11±0.25 mm. Mean diameter of the vermiform appendix at the base was 5.98±0.87 mm, at the midzone was 5.44±0.81 mm and at the apex was 4.91±0.73 mm. The mean diameter of the vermiform appendix was 5.43±0.81 mm. The present study provided a microscopic feature of the vermiform appendix and find out a correlation between the age of the subjects and some microscopic variables of the vermiform appendix.

In this study the number of mucosal glands was 81.73±31.12 in a section and number of germinal centres of lymphoid follicles was 8.02±2.72 in a section. showed that the number of mucosal glands present in a section varied between 42.33 to 130.00. But in this study the number of mucosal glands present in a section varied from 33 to 159 which was slightly different from the study findings done by. They also reported that the number of germinal centers of lymphoid follicles in a

section varied from 2.33 to 10 which was nearly similar to the present study where the number of germinal centers were 2 to 13.[1]

Many cases of acute appendicitis result from infections and also obstruction of the lumen of the vermiform appendix by lymphoid hyperplasia and the lymphoid follicles of the vermiform appendix vary with respect to their number, diameter and location in different ages.

There was statistically significant negative correlation between age of the cadavers (subjects) and length of the vermiform appendix ($r= -0.40$, $p < 0.01$)[10] also found that there was a negative correlation between the age and the length of the human vermiform appendix which was similar with these findings. Statistically highly significant negative correlation between age of the cadavers (subjects) and wall thickness of the vermiform appendix ($r= -0.84$, $p < 0.001$) was found by this study which was inconsistent with the results of who found no correlation between age and thickness of wall of appendix.

In the current study there was statistically highly significant negative correlation between age of the cadavers (subjects) and diameter of the vermiform appendix ($r= -0.87$, $p < 0.001$). also found statistically significant negative correlation between the diameter of the vermiform appendix and increasing age, the appendix becoming narrower with age. The diameter in children is wide and the lumen is almost obliterated in the elderly. Obstruction of the appendiceal lumen with subsequent secondary infection has been the most popular theory regarding the pathogenesis of acute nonspecific appendicitis.[15]

In the present study, there was no statistically significant difference of length, wall thickness & diameter of the vermiform appendix between the male and female ($p > 0.05$). Having standard data on the vermiform appendix is useful for clinicians as well as anthropologists. The findings of the present study can also provide information about morphologic variations of the vermiform appendix in Bangladeshi population. However, further studies with a larger sample size are required to make better decision.

Conclusion

Studies on the anatomy of the human vermiform appendix in specific populations have clinical implications as well as usefulness in understanding the organ. An appropriate anatomical knowledge about vermiform appendix is important for surgeons, pathologists and other physicians for proper diagnosis and management of appendicitis and carcinoma. In this study, mean length of the appendix was 7.95±3.07 cm. Wall thickness at the base was 2.29±0.25 mm, at the mid zone was 2.09±0.26 mm and at the apex was 1.93±0.23 mm. The mean wall thickness of the vermiform appendix was 2.11±0.25 mm. Mean diameter of the vermiform appendix was 5.98±0.87 mm at the base, 5.44±0.81 mm at the mid zone and 4.91±0.73 mm at the apex. The mean diameter of the vermiform appendix was 5.43±0.81 mm. The number of mucosal glands was 81.73±31.12 in a section and number of germinal centres of lymphoid follicles was 8.02±2.72 in another section. There is significant negative correlation between the age of the cadavers (subjects) and the length, diameter and wall thickness of the vermiform appendix ($p < 0.05$). But there was no statistically significant difference of length, wall thickness & diameter of the vermiform appendix between the male and female ($p > 0.05$). This histological anatomy of the appendix might be used to study appendicular features in different age groups to establish the age changes in the appendix. Thus, morphological and microscopic histological study of vermiform appendix might be used to gather knowledge about the changes of appendicular features in different age groups of Bangladeshi population. The findings of this study would also be helpful for the anatomists, anthropologists, forensic experts, pathologists and surgeons.

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