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Taper of the Appendix and Lymphoid Distribution in the Zimbabwean Adult Male Population: A Cadaveric Study

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Abstract

Objective: To determine the relationship between lymphoid distribution and taper of the vermiform appendix in the adult Zimbabwean male population.

Methods:- A cross-sectional descriptive study was carried out in the Anatomy Department University of Zimbabwe, College of Health Sciences, Harare from October 2021 to March 2022. A total of 15 male cadavers from the Department of Anatomy at the University of Zimbabwe were used. The length of the appendix, luminal diameter, external diameter and wall thickness were measured using a vernier calliper at three segmental levels, i.e. the base, mid part and the tip of the appendix. IBM SPSS version 23 was used to calculate the means and standard deviations. To determine the lymphoid distribution, histological sections of the appendix were prepared and viewed using a light microscope.

Results: Appendix length ranged from 4.52cm to 15cm with an average length and standard deviation of 8.43± 2.45cm. The average luminal diameter with standard deviation at the base, mid-part, and tip was found to be 0.53± 0.22cm, 0.39± 0.21cm and 0.36±0.17cm, respectively. The average external diameter with standard deviation at the base, mid-part and tip was measured as 0.74± 0.18cm, 0.61± 0.16cm and 0.55± 0.15cm, respectively. The average wall thickness with standard deviation at the base, mid-point and tip was noted to be 0.21± 0.14cm, 0.25± 0.14cm and 0.20± 0.17cm, respectively.

Conclusion: It was found that a strong relationship exists among the lymphoid tissue aggregations, luminal diameter and wall thickness of the adult male Zimbabwean inhabitants. The luminal diameter was observed to decrease in cadavers having an increase in wall thickness or hypertrophy of the lymphoid tissue. Moreover, there was a reduction in the number and size of lymphoid follicles along the length of the appendix.

Keywords: Luminal diameter, Lymphoid follicle, vermiform appendix.

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1. Introduction

The anatomy of the vermiform appendix shows differences in its dimensions and microscopic features which can potentially predispose certain individuals to appendicitis1. Acute appendicitis is the most known abdominal urgency that poses a lifespan risk of approximately 8.6% in males and 6.7% in females, hence remains a major health problem to the population.[2] Although most of the time its causes are unknown,[3] some authors postulate that it is caused by blockage of the appendiceal lumen.[4] In such a case, luminal narrowing would increase the chances of blockage.[5] However; it remains unclear what is the real cause of luminal narrowing; whether it is mucosal thickening, lymphoid tissue aggregations, or other factors.[6]

The vermiform appendix is a blind-ended diverticulum of the caecum which has masses of lymphoid tissue.[7] It emerges from the posteromedial base of the caecum inferior to the ileocecal junction during the sixth week of fetal development.[8] In the lamina propria, the appendix bears lymphoid nodules which initially appear about two weeks after birth.[9] It is depicted that the appendix was of great importance in immune defence due to the abundance of lymphoid tissue.[10] The lymphoid tissue is organized in the form of follicles and has been considered as part of the mucosa-associated lymphatic tissue.[11] Lymphoid follicles of the vermiform appendix ranged by their number, diameter, and location in different human beings.[12] In about one-third of the specimen, it was seen that fecolith is a specific cause of appendicitis whereas, in the remaining two-thirds, the blockage was assumed to be a

result of swelling of individual lymphoid follicles in response to inflammation.[13]

Taper is the gradual reduction of thickness in an elongated object and the appendix is tapered from its base to tip.[14] It was also illustrated that the luminal diameter did not show uniformity along the length of the appendix.[15] It is demonstrated by previous research that the luminal diameter of the appendix was almost equated at the base and mid-part, and smallest at the tip.[16] The luminal diameter decreased when either the mucosal thickness or the lymphoid follicle diameter increased in size, hence creating non-uniformity along the length of the appendix.[17] Appendix has a short triangular mesentery known as meso-appendix which is attached to the caecum and the proximal part of the appendix, which could be one of the reasons for taper.[18] It is, however, not clear whether the tapering is due to changes in mucosal thickness and lymphoid follicle distribution or other anatomical features that may compromise the blood supply to the appendix thereby predisposing the individuals to appendicitis.[19] Acute appendicitis is known to sometimes occur as a result of appendiceal blockage due to narrowing of the lumen 20; however, in the Zimbabwean population, it was not clear which part of the appendix was most susceptible to blockage. There was a dearth of literature concerning the causes of luminal narrowing, be it mucosal thickening, lymphoid tissue aggregations, taper, or any other factor. Therefore, the current study was designed to investigate the tapering of the appendix and the distribution of lymphoid follicles in adult male Zimbabwean cadavers.

2. Materials & Methods

The study was conducted in the Department of Anatomy, University of Zimbabwe College of Health Sciences Harare, Zimbabwe. It was a descriptive cross-sectional study. The duration of the study was six months from October 2021 to March 2022. Fifteen black adult male Zimbabwean cadavers between the age group of 25 to 45 years were taken for the current research. Non-probability convenient sampling technique was used. Approval to experiment was taken from the Joint Research Ethics Committee of the University of Zimbabwe. The abdominal wall of the 15 embalmed human cadavers was dissected and the peritoneal cavity was opened to expose the viscera. The ascending colon, caecum and appendix were identified within the abdominal cavity. Each appendix was labelled and its length was measured by using the digital vernier calliper. The external diameter of each appendix was recorded in centimetres at its base, mid-point and tip. Each appendix was detached at its base and its luminal diameter (without opening) was measured at the base, mid-point and tip. The wall thickness was calculated by subtracting the luminal diameter from the external diameter. Each appendix was fixed in a 10% formalin solution. The sections of 5µm thickness were obtained at the base, mid-point and tip by using the rotary microtome. The slides were prepared and stained with hematoxylin and eosin stains. The examination by light microscope was done under 4X and 10X magnifications. IBM-SPSS version 23 was used for data analysis. Means, standard deviations and ranges were calculated.

3. Results

It was determined that the length of the appendix varies between 4.52cm to 15cm while the average length and standard deviation were calculated as 8.43±2.45cm. The average luminal diameter with standard deviation at the base, mid-part, and tip was found to be 0.53±0.22cm, 0.39±0.21cm and 0.36±0.17cm, respectively. The average external diameter with standard deviation at the base, mid-part and tip was 0.74±0.18cm, 0.61±0.16cm and 0.55±0.15cm, respectively. The average wall

thickness with standard deviation at the base, mid-point and tip was 0.21±0.14cm, 0.25±0.14cm and 0.20±0.17cm, respectively.

Microscopically it was observed that there was a reduction in the size and number of lymphoid tissue along the length of the appendix. The lymphoid follicles were more concentrated and extensive at the base and mid part while less extensive at the tip. Hence, there was a reduction in the wall thickness and external diameter which resulted in the tapering of the appendix in the adult black male population.

Table 1: Mean values of Luminal Diameter, External Diameter and Wall Thickness of the Vermiform Appendix

App	Luminal Dia			External Dia			Wall Thickness		
	Base	Mid	Tip	Base	Mid	Tip	Base	Mid	Tip
App 1	0.66	0.69	0.35	0.87	0.75	0.55	0.21	0.14	0.22
App 2	0.32	0.38	0.30	0.87	0.81	0.71	0.55	0.57	0.41
App 3	0.31	0.10	0.12	0.44	0.47	0.51	0.13	0.37	0.41
App 4	0.51	0.24	0.65	0.78	0.59	0.75	0.27	0.35	0.10
App 5	0.81	0.39	0.38	0.91	0.69	0.49	0.10	0.30	0.11
App 6	0.20	0.19	0.13	0.55	0.43	0.75	0.35	0.36	0.62
App 7	0.35	0.28	0.26	0.55	0.44	0.59	0.20	0.14	0.33
App 8	0.90	0.70	0.61	1.10	0.89	0.71	0.20	0.19	0.10
App 9	0.61	0.30	0.30	0.72	0.46	0.40	0.11	0.16	0.10
App 10	0.43	0.34	0.47	0.50	0.52	0.51	0.07	0.18	0.04
App 11	0.33	0.22	0.22	0.76	0.59	0.44	0.43	0.37	0.22
App 12	0.80	0.72	0.56	0.89	0.80	0.62	0.09	0.08	0.06
App 13	0.76	0.70	0.54	0.81	0.77	0.62	0.05	0.07	0.08
App 14	0.54	0.36	0.22	0.74	0.52	0.30	0.20	0.26	0.80
App 15	0.38	0.30	0.22	0.59	0.45	0.30	0.21	0.15	0.08
Min	0.20	0.10	0.12	0.44	0.43	0.30	0.05	0.07	0.04
Max	0.90	0.72	0.65	1.10	0.89	0.75	0.55	0.57	0.80
Mean	0.53	0.39	0.36	0.74	0.61	0.55	0.21	0.25	0.25
SD	0.22	0.21	0.17	0.18	0.16	0.15	0.14	0.14	0.23

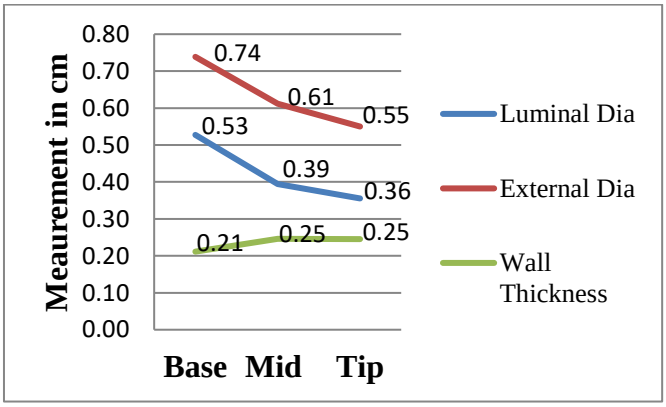

Figure 1: Comparison of Luminal Dia, External Dia and Wall Thickness at the Base, Middle and Tip of Appendix

4. Discussion

In adult male Zimbabwean, the length of the vermiform appendix is 8.43cm on average which ranges from 4.52cm to 15cm and a standard deviation of 2.45cm. Hence, the average length is longer as compared to other populations where the average length is 5.42cm.[22] It was illustrated by a previous study that the inflammation of the long appendix resulted in the damage of surrounding organs within the abdominal cavity.[23] Moreover, the harmful effects of the long-inflamed appendix on the neighbouring structures were also dependent upon its position.[24]

The average luminal diameter of the vermiform appendix at the base, mid-part, and tip was found to be 0.53cm, 0.39cm, and 0.36cm, respectively. These results are from the previous experiment in which it was manifested that the luminal diameter was non-uniform along the length of the appendix.[25] In the current study, such a trend was not seen in specimens number 1, 2 and 4. In specimen number 1 and 2 the luminal diameter was maximum at the mid-part. On the other hand in

specimen number 4, the luminal diameter was maximum at the tip region of the vermiform appendix. The reduction in the luminal diameter can be seen either due to an increase in the wall thickness or because of hypertrophy of lymphoid follicles.[26]

The average external diameter at the base, mid part and tip was 0.74cm, 0.61cm and 0.55cm, respectively (Table 1)(Fig 1). The reduction of the external diameter of the appendix from base to tip is due to a decrease in the number and size of lymphoid follicles. The wall thickness of the appendix is mainly dependent upon the external diameter.[27] Consequently, the reduction in the wall thickness from the base towards the tip caused the tapering of the appendix. The wall thickness at the base is compromised due to increased luminal diameter while at the mid-point and tip it is increased due to reduction of luminal diameter28. The current study has shown that the wall thickness was 0.21cm at the base while it was maximum at the mid part (0.26cm) and minimum at the tip (0.20cm).

In the present study the lymphoid follicles were found extensive at base and mid part while they were less extensive at the tip. Moreover, it was determined that the lymphoid follicles traversed the mucosa and sub-mucosa at the base and mid part while at the tip they only traversed the mucosa. The external diameter decreased from base to tip due to the reduction in size and number of the lymphoid follicles along the length of appendix. Hence, a marked decrease in the wall thickness as well as the tapering of the appendix. The lymphoid tissue in the vermiform appendix also diminished from the base towards the tip and consequently accounted for its taper as well. The diameter of the lymphoid follicles was calculated to be 94.40mm at the base, 92.60mm at the mid-part and 90.90mm at the tip which showed a significant reduction in the size of the lymphoid follicles along the length of the appendix.

5. Conclusion

The lymphoid follicles and wall thickness contribute to the tapering of the vermiform appendix in the adult male Zimbabwean population. The lymphoid follicles are relatively more extensive at the base and mid-region than at the tip of the appendix. The mean external diameter decreases from base to tip which is the same trend as seen in other communities and hence causes tapering of the appendix.

CONFLICTS OF INTEREST- None

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Contributions:

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M.K, M.G, T.M - Critical Review
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