



Age related changes of vermiform appendix (Histomorphometric study)

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ABSTRACT

Background: Many researches and studies were performed to investigate many aspects of the vermiform appendix. Many variations were observed at the different regions, among that, the focus was made on the lymphoid number and diameter, wall thickness, and luminal diameter.

Objective: The aim of this work was to a finding of histomorphometry features of the adult vermiform appendix for different sex and age groups.

Materials & methods: Fifty cadavers were included and divided into five age groups; A(20-29), B(30-39), C(40-49), D(50-59), and E(60-70)years. Ten cadavers were included for each age group. The inclusion criteria of the cadavers were brain stroke, built injuries, sudden death, car accident, and angina pectorals. The exclusion was with gangrenous, grossly inflammation and perforated appendices cadavers. Total length was measured from the base to the tip, as well as the diameter using a digital vernier caliper. Histological slides were made using H&E for counting the number and diameter of lymphoid follicles.

Results: Wall thickness and luminal diameter decreased from the base towards the tip. Luminal diameter decreased from the base towards the tip. Luminal diameters increased with age group increase. The number of follicles decreased from the base towards the tip and decreased also with increasing age groups. The number and diameter of lymphoid follicles are more in males than in females. Wall thickness decreased with increasing age groups.

Conclusion: Histomorphometric changes of the vermiform appendix were obvious along with the Wall thickness; Number and diameter of lymphoid follicles. Male and females have shown clear differences with increasing age groups.

INTRODUCTION

Vermiform appendix varies in length from 2-20cm (Gupta *et al.*, 2012). Many changes in the structure of this organ may occur with aging among that good thickness, shortening, and atrophy of the muscular coat(Eliseev,1979). Lymphoid involution was observed in many studies(Eliseev,1979; Shcherbakov,1980). In the past vermiform appendix was considered as unimportant part, but then after, they found that it is not a useless part in humans (Zahid, 2004).

The vermiform appendix may be important when the bacterial population becomes an outbreak sometimes (Elias & Hulst 1967). And because of lymphatic follicle number decreasing with advances of age, the appendix weight also decreases and the area will be replaced by connective tissues (Rahman, *et al.*, 2008). At different ages, the lumen has various shape and size, because of the changes of lymphatic follicles number, as well as the number of mucosal glands also varied (Bakar *et al.*, 2016). This study aimed to diagnose the age and sex-related changes of the wall thickness, lumen diameter, number of lymphoid follicles and its diameter for male and female histomorphometrically.

MATERIALS AND METHOD

Fifty cadavers were selected after obtaining permission from the police station and the institution of forensic medicine. Cadavers were divided into five age groups (in years). Groups; A(20-29), B(30-39), C(40-49), D(50-59), and E(60-70). Each group contained 10 cadavers (6 males and 4 females). Inclusion criteria of cadavers were built injuries, brain stroke, car accident, angina pectoralis, and sudden death. Cadavers with grossly inflammatory, perforated appendices and gangrenous were totally excluded from the study. Histological slides were prepared from the base, middle, and the tip of the appendix and stained with Haematoxyline and eosin (H&E) for the measurements of the wall thickness, luminal diameter, number and diameter of lymphoid follicles. These measurements were applied to both males and females.

RESULTS AND DISCUSSION

Wall Thickness:

Wall thickness has shown a trend of decreasing from base towards the tip. These results go with the result of (Keerti, *et al.*, 2016), who mentioned that, the average mucosa-serosa, wall thickness showed a

gradual decrease from the base towards the tip. The present work clarifies that the male has thicker wall than female. Also wall thickness decreased with increasing age groups. Table (1) and Figures (1 & 2) show these results. (Rahman & Karim 2019) have also stated that, the average wall thickness was high in age group (0-20), and was gradually decreased through the age groups (21-30) years, followed by the age groups (31-40) and (41-50), and the lowest value was with the age group above fifty years.

Luminal Diameter:

In this work, the luminal diameter was decreasing from the base towards the tip. The luminal diameter was increased with increasing age groups. The luminal diameter of the vermiform appendix was slightly larger in females than in males for all age groups, an exception was with the age group 20-29 years (Table-2 and Figures 3 & 4). Gupta and his team (Gupta, *et al.*, 2012) stated that other factors as wall thickness, amount of lymphoid follicles, age group, or the normality of organ process must have a good role in luminal diameter determination. Their explanation conforms with the result of the present work. The present result also showed that the lumen diameter in females was larger than in males.

Number and Diameter of Lymphoid Follicles:

The number of lymphoid follicles was decreased started from the base towards the tip. The number of follicles is more in males than in females. The results of the present work proved that the number of lymphoid follicles decreased with increasing age groups (Table-3 and figure-5 & 6). The highest number of lymphoid follicles in the age group up to 20 years, and the lowest was in the age group (56-70) years (Rehman, *et al.*, 2008; Borley, 2006). Again the results of present work come close to the study of Niazi, *et al.* (Niazi, *et al.*,

2013), who reported the highest lymphoid follicles number was in the age group(16-30)years, and the lowest was for the age group(46-74)years. Also, the study of Rehman, et.al (Rehman, *et al.*, 2008) obtained similar results with the results of the present work in that, the diameter of lymphoid follicles was high in the age group up to 20years and low for the age group of (56-70)years (Gupta, *et al.*, 2012; Rehman, *et al.*, 2008).

The diameter of the lymphoid follicles was slightly higher in males than in females. And the diameter of these follicles is decreasing with increasing age groups (Table-4 and figure-7&8). Diameter's comparison of follicles of age(20-29)years in males with that of the age group(60-70) is twice, and the same was with females. It was reported that the lymphatic follicles in the appendix with age progress migrating towards the lymphatic system and this was clearly detected in the lymph node and spleen(Aminova, *et al.*, 2013). So this can explain the decrease and disappearance of the lymphatic

nodules with age progress and then deposition of connective tissues in the area.

In general, the lining epithelium of the vermiform appendix is of the type simple columnar with some goblet cells similar to that of the large intestine(Ham, *et al.*,1999). Abundance crypts of Lieberkuhn (glands) are present. With the aging process, the number of lymphatic follicles and crypts become reduced in the mucosa. This decrease can be related to the process of glandular atrophy. The appendicular glands (simple tubular) are also decreased in the age of fifties and onward. Two types of crypts Lieberkuhn were demonstrated in the mucosal lamina propria, one is short and the second one is long. This was also reported by George (George, *et al.*,2016). Finally, more works are required to be done to understand and clarify more variables and the cytoarchitecturic structure about the lymphoid follicles.

Table (1): Wall thickness of vermiform appendix in human male and female at(base, middle, and tip) in all groups.

Sex group	Base Wall thickness (mm)		Middle Wall thickness (mm)		Tip Wall thickness (mm)	
	Male	Female	Male	Female	Male	Female
A	2.39±0.42 A	2.33±0.31 A	2.21±0.47 A	2.16±0.34 A	2.01±0.28 A	1.96±0.18 A
B	2.33±0.37 A	2.24±0.45 A	2.18±0.51 A	2.09±0.42 A	2.08±0.32 A	1.99±0.34 A
C	2.16±0.53 AB	2.08±0.52 AB	2.01±0.39 A	1.92±0.25 AB	1.89±0.41 A	1.76±0.24 AB
D	1.71±0.24 B	1.62±0.29 B	1.35±0.16 B	1.50±0.33 B	1.36±0.21 B	1.42±0.32 B
E	1.02±0.41 C	0.94±0.32 C	1.18±0.23 B	1.16±0.28 B	0.81±0.32 C	0.70±0.15 B

The different capital letters refer to significant differences between different ages at ($P \leq 0.05$).

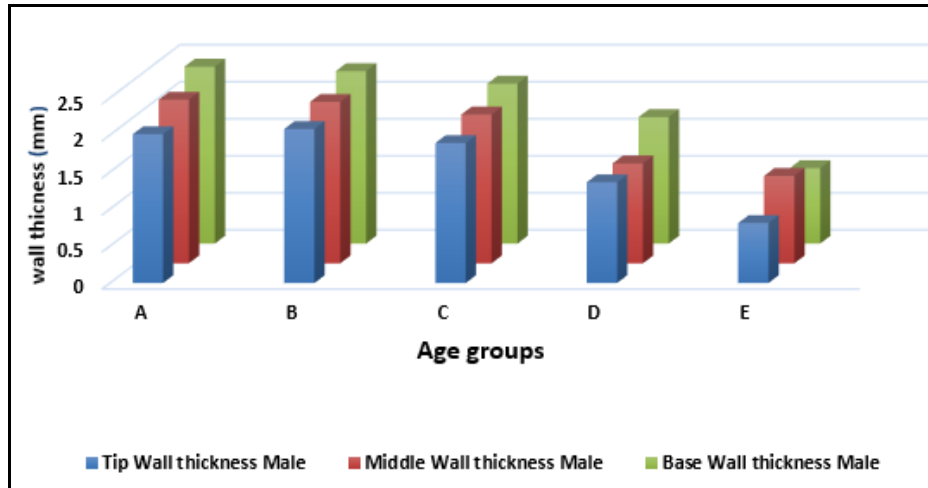


Fig.1: wall thickness of vermiform appendix at(base, middle and tip) in human in male in all groups.

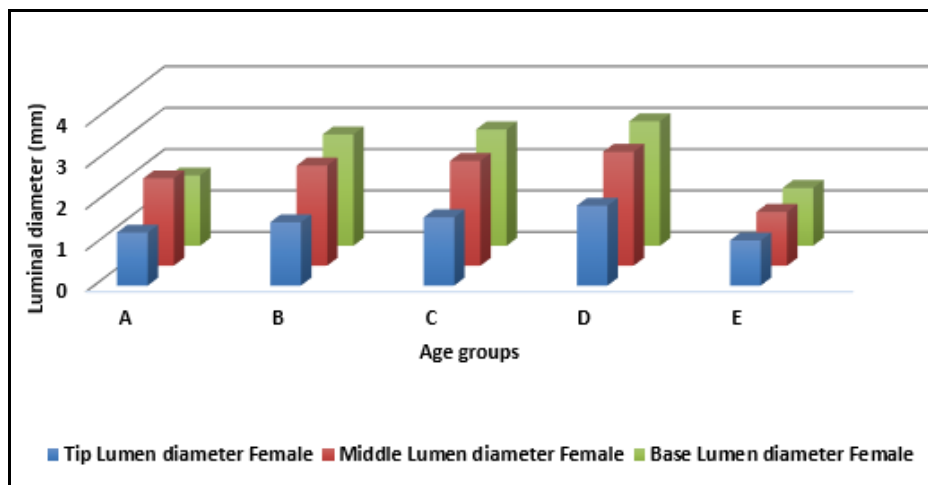


Fig.2: Luminal diameter of vermiform appendix at(base, middle and tip) in females in all groups.

Table 2: Lumen diameter of vermiform appendix in human male and female at (base, middle, and tip).

Sex group	Base Lumen diameter (mm)		Middle Lumen diameter (mm)		Tip Lumen diameter (mm)	
	Male	Female	Male	Female	Male	Female
A	1.83±0.64 AB	1.70±0.59 B	1.89±0.64 AB	2.11±0.76 AB	1.12±0.53	1.28±0.45
B	2.69±1.03 A	2.80±1.01 A	2.42±0.79 AB	2.65±1.05 A	1.53±0.54	1.63±0.56
C	2.81±0.70 A	2.93±0.63 A	2.53±0.48 A	2.71±1.08 A	1.65±0.69	1.79±0.58
D	3.01±0.62 A	3.34±1.02 A	2.75±0.58 A	2.90±0.82 A	1.93±0.72	2.04±0.47
E	1.40±0.39 B	1.51±0.45 B	1.30±0.27 B	1.37±0.39 B	1.09±0.28	1.13±0.34

The different capital letters refer to significant differences between different ages at ($P \leq 0.05$).

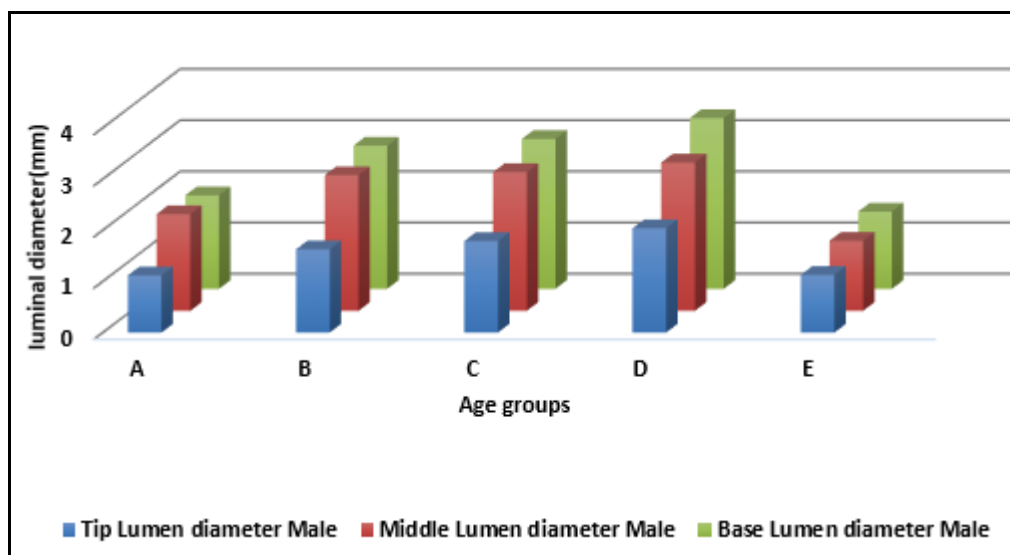


Fig.3: Luminal diameter of vermiform appendix at (base, middle, and tip) in males in all groups.

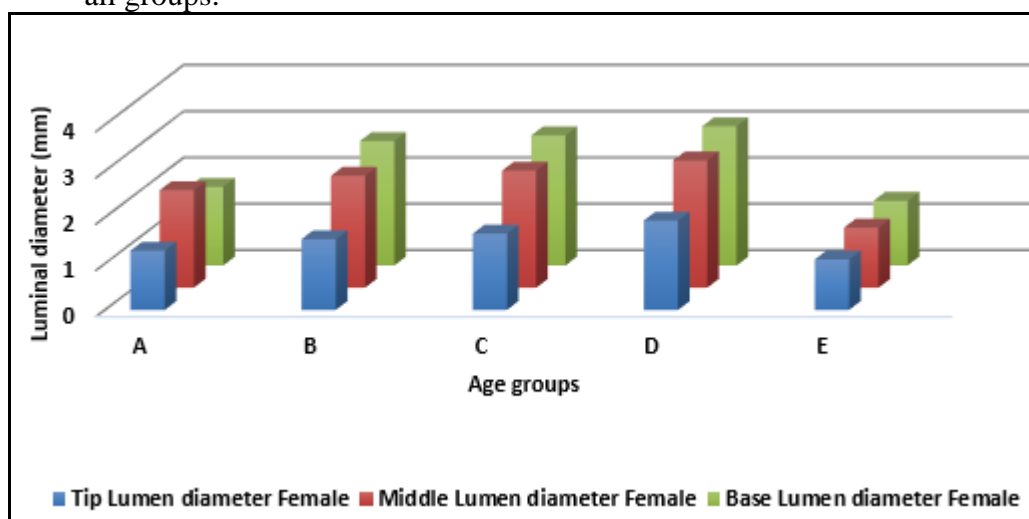


Fig.4: Luminal diameter of vermiform appendix at (base, middle, and tip) in females in all groups.

Table 3: Number of lymphoid follicles of vermiform appendix in both males and females in different regions (base, middle and tip).

Sex Group	Base number of LF		Middle number of LF		Tip number of LF	
	Male	Female	Male	Female	Male	Female
A	7.80±1.10 A	7.20±0.84 A	7.00±0.71 A	6.60±0.55 A	5.80±0.84 A	5.40±0.90 A
B	7.40±1.52 A	6.80±1.30 A	6.40±1.14 A	5.80±0.45 A	5.40±1.14 AB	4.80±0.84 B
C	5.20±0.84 B	4.40±0.55 B	4.20±1.30 B	3.40±1.14 B	3.20±0.84 B	2.40±0.55 C
D	3.00±0.71 C	2.40±0.89 C	1.80±0.55 C	1.40±0.89 C	1.60±0.55 C	1.20±0.84 CD
E	1.2±0.84 D	1.00±0.71 C	0.80±0.84 C	0.60±0.55 C	0.40±0.55 C	0.20±0.55 D

The different capital letters refer to significant differences between different ages at ($P \leq 0.05$).

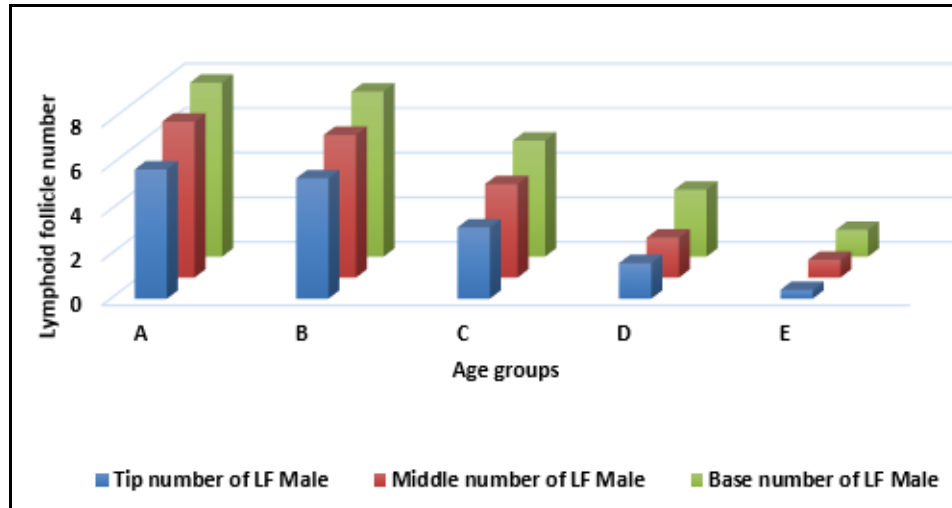


Fig.5: Lymphoid follicle number of vermiform appendix at (base, middle, and tip) in males in all groups.

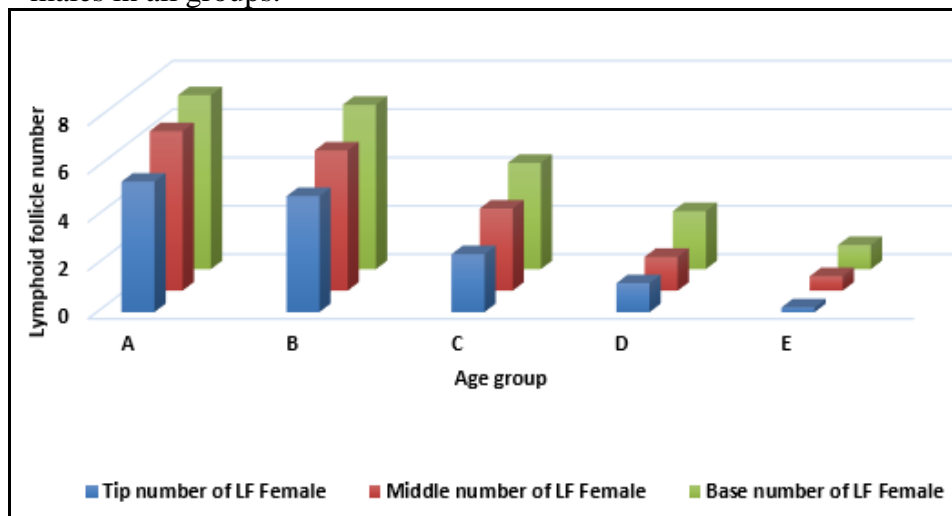


Fig.6: Lymphoid follicle number of vermiform appendix at (base, middle, and tip) in females in all groups.

Table 4: Diameter of lymphoid follicle of vermiform appendix in both males and females in different regions (base, middle, and tip).

Age \ Sex	Base diameter LF (mm)		Middle diameter LF (mm)		Tip diameter LF (mm)	
	Male	Female	Male	Female	Male	Female
A	0.45±0.07 A	0.43±0.11 A	0.38±0.10 A	0.37±0.08 A	0.35±0.04 A	0.33±0.03 A
B	0.40±0.06 AB	0.39±0.04 AB	0.35±0.06 AB	0.33±0.04 AB	0.33±0.06 AB	0.31±0.04 AB
C	0.36±0.03 BC	0.34±0.05 BC	0.32±0.05 BC	0.30±0.02 BC	0.29±0.05 AB	0.29±0.03 AB
D	0.32±0.05 C	0.29±0.03 C	0.28±0.07 CD	0.27±0.04 C	0.27±0.06 BC	0.25±0.05 B
E	0.23±0.04 D	0.20±0.02 D	0.23±0.03 D	0.22±0.02 D	0.20±0.03 C	0.16±0.02 C

The different capital letters refer to significant differences between different ages at ($P \leq 0.05$).

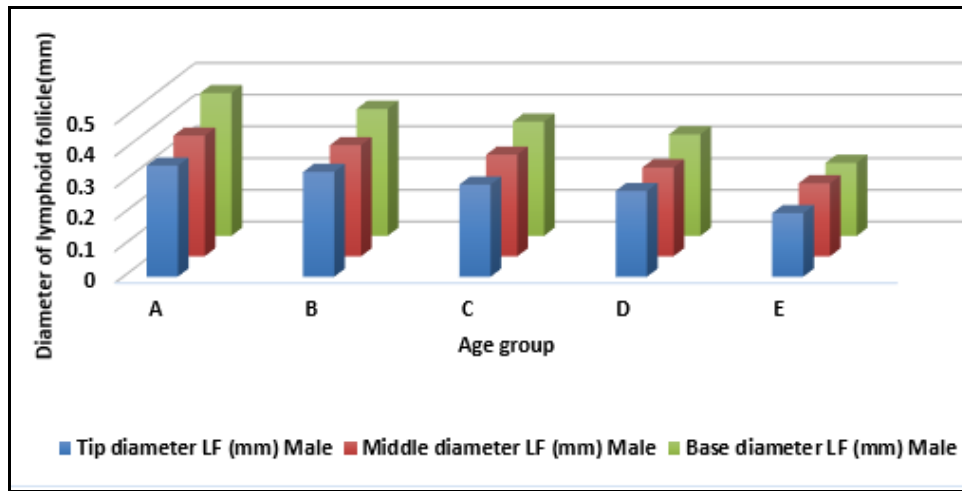


Fig.7: Diameter of lymphoid follicle of vermiform appendix at(base, middle, and tip) in males in all groups.

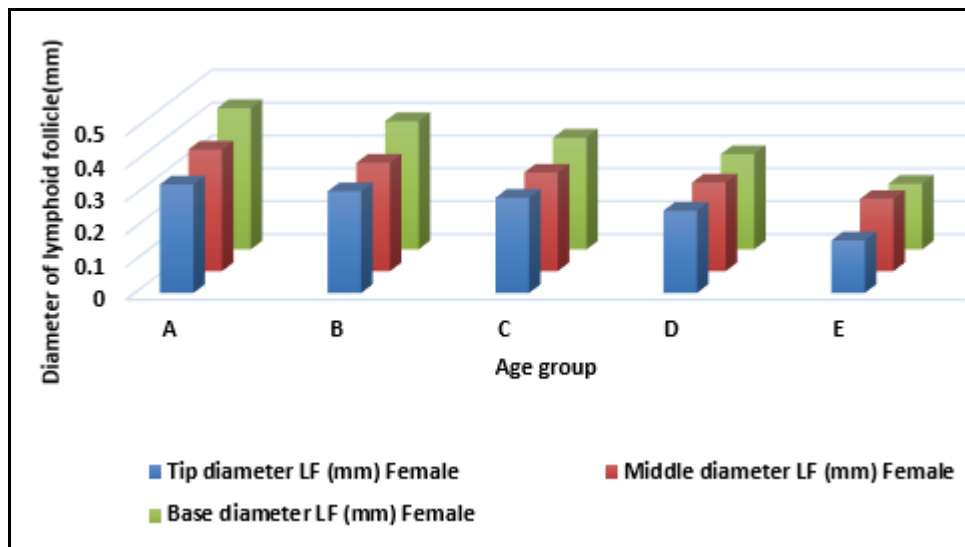


Fig.8:Diameter of lymphoid follicle of vermiform appendix at(base, middle, and tip) in females in all groups.

Conclusion

It can be concluded that the decrease in lymphatic follicles number and diameter are obvious. And this decrease can be explained by the migration of the lymphatic follicles. Wall thickness decrease and lumen diameter increase with age progress

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