

## Research Article

# Histological observations and its variations in appendix at different stages of life

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### ABSTRACT

**Background:** It was reported that the appendix is a tough soldier against infection, especially in people who have been exposed to some types of radiation. Early in a child's life the appendix is relatively larger than it is in an adult which creates confusion. Hence, it is need to explore the histological details at different stages of life before the functional details.

**Methods:** The present study was conducted after an institutional ethical clearance. Fifty six human appendices were collected for histological study. The fixed specimens were subjected to the process of paraffinisation and processed for staining with routine haematoxylin and eosin methods, Gamori's methenamine silver method and AB – PAS staining method using standard procedures.

**Results:** Histological features during the foetal period and first decade lumen of appendix appeared large and three cornered or irregular with comparatively thin wall, in second and third decades lumen became very narrow to almost occluded, in the fourth and fifth decades lumen appeared wide as the wall thinned out. In the sixth decade appendix almost appeared oval in shape and the lumen was almost obliterated in seventh and eighth decades.

**Conclusions:** The thickness of the mucosa kept increasing in the second decade onwards and in the later decades both lymphatic tissues and crypts were markedly reduced and by eighth decade these features were not present at all.

**Keywords:** Histology, Appendix, Developmental variations, Decades of life

### INTRODUCTION

The word appendix originates from Latin word 'having on' and it is called vermiform shaped appendix because it looks like a three inch earthworm. Many years ago organs such as appendix and tonsils were thought to be useless 'leftovers' of evolution. These parts were called vestigial organs. The word 'vestigial' means a trace or a mark left by something. It was thought that these organs were marks or footprints evolution.<sup>1</sup> A continuous study of vermiform appendix was in progress since 1924. And as a result, the opinions on the vermiform appendix changed.

In recent years, doctors have observed that the appendix is a tough soldier against infection, especially in people

who have been exposed to some types of radiation.<sup>2</sup> Inside the appendix is lymphoid tissue which helps produce white blood cells that fight disease. Also, early in a child's life the appendix is relatively larger than it is in adults. It is during these early stages of life that the appendix appears to play an even bigger role in guarding the body from infection.<sup>3</sup>

The appendix also happens to feed into the caecum at the beginning of the large intestine. The large intestine is the home to many types of bacteria (*E. coli* being the most common). These bacteria are not all "bad" and may play an important role in our digestion processes. However, bacteria populations can get out of control sometimes, and that's when the lymphatics of the appendix may be

important. In effect, the appendix may help to regulate the population of bacteria in our gut.<sup>4</sup>

Its structure is made of the some tough fibrous outer covering as protects the entire alimentary canal. There is a layer of muscular tissue under the outer covering and further a layer of lymphoid tissue. The lymphoid tissue can produce antibodies to fight infection. The function of the appendix, which is performed by this lymphoid tissue, is to neutralize the irritating waste material generated in the body or the organic poisons introduced through the skin or membranes.

The general conclusion is that the human appendix at least in children has the characteristics of a well-developed lymphoid organ, suggesting that it has important immunological functions. Now, the scientists declare that it is not a useless organ; for the time being the knowledge of functions/usefulness of some of the organs is limited.<sup>5,6</sup> Hence, it is need to explore the histological details at different stages of life before the functional details. Therefore, the present study was aimed at analysing the histological features in relation to the various age groups.

## METHODS

The present study was conducted after an institutional ethical clearance. Fifty six human appendices were collected for histological study from bodies brought for post-mortem examinations to the mortuary of Calicut Medical College. Forty four foetal specimens were obtained from labour room of Calicut Medical College. The specimens were grouped according to age ranging from still born to eighty seven years.

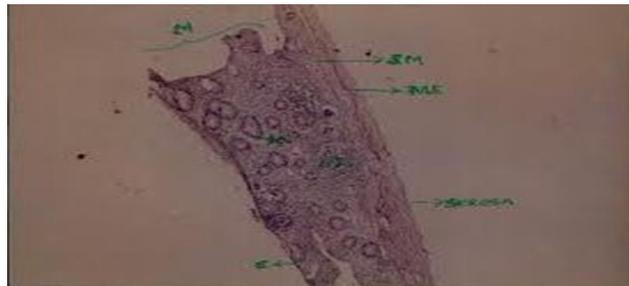
After removing the appendices, they were transferred to the fixative solution – 10% formalin. The fixed specimens were subjected to the process of paraffinisation and processed for staining with routine haematoxylin and eosin methods, Gamori's Methenamine Silver Method and AB – PAS Staining Method using standard procedures.

## RESULTS

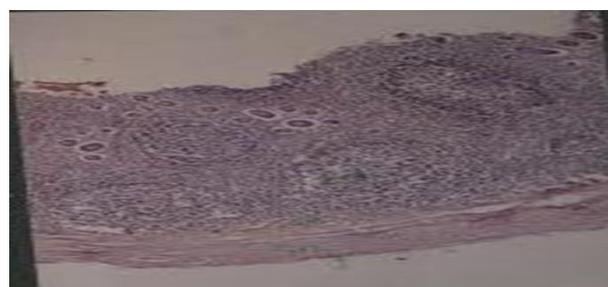
Histological features during the foetal period and first decade lumen of appendix appeared large and three cornered or irregular with comparatively thin wall (Figure 1 and 2). In second and third decades lumen became very narrow to almost occluded probably due to abundance of lymphoid tissue with prominent follicles projecting into the lumen (Figure 3 and 4).

In the fourth and fifth decades lumen appeared wide as the wall thinned out (Figure 5 and 6). During sixth decade appendix almost appeared oval in shape and in the later part of this decade presence of connective tissue were noticed within the lumen (Figure 7). The lumen was

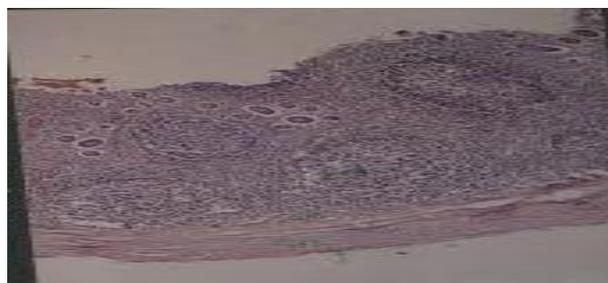
almost obliterated in seventh and eighth decades (Figure 8 and 9).



**Figure 1: Histological observations of appendix during the foetal stage (H&E staining, 400x magnification).**



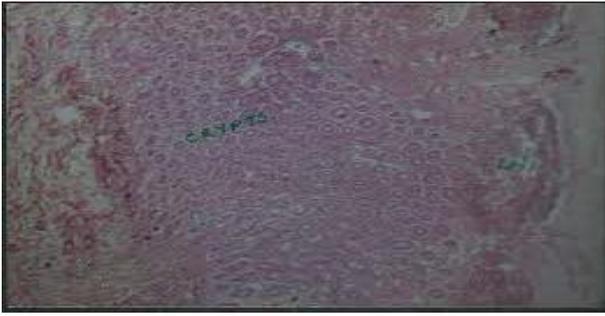
**Figure 2: Histological observations of appendix during the first decade of life (H&E staining, 400x magnification).**



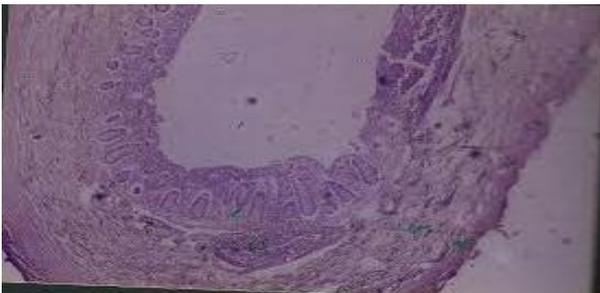
**Figure 3: Histological observations of appendix during the second decade of life (H&E staining, 400x magnification).**



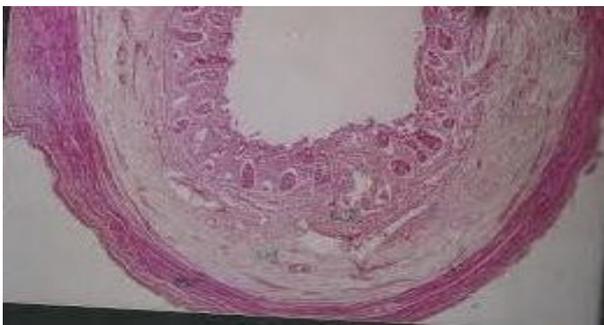
**Figure 4: Histological observations of appendix during the third decade of life (H&E staining, 400x magnification).**



**Figure 5: Histological observations of appendix during the fourth decade of life (H&E staining, 400x magnification).**



**Figure 6: Histological observations of appendix during the fifth decade of life (H&E staining, 400x magnification).**



**Figure 7: Histological observations of appendix during the sixth decade of life (H&E staining, 400x magnification).**



**Figure 8: Histological observations of appendix during the seventh decade of life (H&E staining, 400x magnification).**



**Figure 9: Histological observations of appendix during the eighth decade of life (H&E staining, 400x magnification).**

## DISCUSSION

The present study illustrates the histological observations and its variations in appendix at different stages of life. Arthur W. Ham reported that microscopically the lumen of the appendix may become obliterated by connective tissue in advancing years replacing its mucous membrane as well as filling its lumen.<sup>7</sup>

The lining epithelium of appendix was found to be of simple columnar type, even though in some of them, it was seen as an incomplete lining. Goblet cells could be demonstrated among the columnar cells. Leeson & Leeson mentioned the surface epithelium of appendix being composed of columnar striate and bordered cells mainly with only a few goblet cells.<sup>8</sup> According to Ham, the lining epithelium of appendix is simple columnar like that of large intestine.<sup>7</sup>

The main mass of mucosa was formed by lymphatic tissue present in the lamina propria. As early as 30 weeks, lymphoid tissue could be demonstrated in the lamina propria of appendix, but lymphatic follicles or nodules appeared only towards the end of first decade. Appendices of second and third decades showed abundance of lymphatic tissue in the lamina propria to the extent of occlusion of the lumen. Prominent lymphatic follicles with germinal centres were present in them.<sup>9</sup> Mild extensions of lymphatic infiltration into the submucosa at places by breaking the muscularis mucosa were also evident.

In the fourth decade, abundance of crypts of Lieberkuhn was seen and the number of lymphatic nodules was less compared to the previous decade. By fifth decade, both crypts and lymphatic tissue in the mucosa were very much reduced. In the sixth seventh and eighth decades only diffuse lymphatic infiltration was present in the lamina propria and it was comparatively less in amount and no nodular arrangement could be demonstrated. This could be indication of gradual atrophy. Muscularis mucosa was only poorly represented, often broken by the large lymph nodules of second and third decades.<sup>10</sup>

Windle WF found that lymphatic follicles often breaking up the muscularis mucosa penetrate into the submucosa, may form a complete ring around the lumen. The lumen may be partly or completely obliterated. Occasionally the mucosa is replaced by fibrous connective tissue.<sup>11</sup> Bailey reported that the mucous membrane of appendix is with a simple columnar epithelium with a striated apical border. It continues into the glands or crypts of Lieberkuhn where the border gradually becomes thinner.<sup>12</sup> The glands frequently have many goblet cells, some paneth cells and a number of argentaffin cells. In the embryo, the mucosal surface is lined with villi, but these disappear early in life. The lumen is often thrown into deep pocketed folds and in many adults is nearly or completely obliterated. The most characteristic histological feature of the appendix is the lymphoid tissue. Not only the lamina propria infiltrated with lymphocytes, but also a complete ring of solitary lymphoid nodules often conspicuously occupies it. These closely reassemble the follicles, which surround the crypts of the palatine tonsils.

In the present study, the lymphatic follicles were not seen in any of the foetal sections. Arey LB reported that the lamina propria of appendix contains closely spaced solitary lymph nodules except in old age and the crypts of Lieberkuhn decrease in number and length in middle age and later.<sup>13</sup> The observations of the present study fully agree with the previous reports.

Gardner stated that the wall of appendix contains large collections of lymphoid tissue which become active and enlarged if the appendix becomes inflamed. The crypts of Lieberkuhn (simple tubular glands) showed a decrease in number after fifth decade onwards. They were lined with columnar and goblet cells in almost all age groups.<sup>14</sup> Crypts above the nodules were poorly developed as evident from some of the photographs taken.

Cruickshank B, Dodds and Gardner reported that lymphoid follicles are present in the lamina propria of appendix amounting in places to a complete layer surrounding the lumen. In Children germinal centres are often seen and the muscular mucosa is poorly developed and may be incomplete.<sup>15,16</sup> Ribbert reported that the lumen to have become obliterated in one half the subjects over 50 years of age.<sup>17</sup> The process of obliteration seems to be a fibrotic one and it begins at the tip and proceeds towards the base. Prior to fibrosis the originally abundant lymphoid tissue of the organ has begun to decrease in amount.

## CONCLUSION

Microscopically, the mucosa of the foetal appendix showed diffused lymphatic infiltration and this changed to nodular appearance by the end of the first decade. The thickness of the mucosa kept increasing in the second decade with the appearance of more lymphatic nodules and the same features carried over to third decade also. By this time, the lumen was almost occluded due to the

presence of abundance of lymphatic tissue. By fourth decade the crypts of Lieberkuhn showed its predominance and in the later decades both lymphatic tissues and crypts were markedly reduced and by eighth decade these features were not present at all.

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