The Histological Observations on the Large Intestine of the Goose (Anser anser) during the Pre- and Post-Hatching Periods

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ABSTRACT. The development of the cecum and colon in the goose was investigated during the period from the 15th to 28th day of the incubation and from 1 to 30 days of age after hatching by light microscopy. By day 15 of the incubation, in the cecum and colon, the lumen was surrounded by pseudostratified epithelium. The previllous ridges appeared at 15th and 17th days of the incubation in the colon and ceca, respectively. At the base of previllous ridges, the epithelium changed into a simple prismathic epithelium at 15th and 17th days of the incubation in the colon and cecum, respectively. The villi appeared at the 21st days of the incubation. The crypts and goblet cells appeared on the first day after hatching. In the pre-hatching period, the lamina muscularis mucosa was present only in the colon. The submucosa consisted of loosely aggregated connective tissue in the pre-hatching period. In the post-hatching period, it consisted of a very thin layer of connective tissue. Its presence was only obvious where the cells of the submucosal nerve plexus or occasional large blood vessels considerably increased its thickness. The nerve plexus corresponding to the Auerbach’s plexus of the mammalian intestine and submucosal nerve plexus appeared by 15th days of the incubation. From the 15th to 28th day of incubation, the tunica muscularis consisted of circular smooth muscle cells in the ceca. On the 28th day of the incubation a thinner longitudinal muscle layer added to the circular muscle layer. In the colon there was an outer longitudinal and a thicker circular muscle layer. The avian cecum has been classified into five histological types: (I) Intestinal long ceca that are histologically similar to the small intestine, (II) Glanduler long and well-developed ceca with an abundance of glandular cells, (III) Lymphoid-small ceca with many lymphocytes, (IV) Vestigial-small ceca, often embedded in the intestinal wall, with little or no lumen, and (V) Absent [5, 14]. The ceca of ducks and geese are intestinal types [10]. The intestinal types of ceca in birds are paired, blind-ended tubes [2, 11–13, 15] and are usually fingerlike in shape, looking much like simple lateral extensions of the intestine, but some are complex in structure. The colo-rectum or colon is the terminal part of the intestine, passing between ileo-cecal junction and the cloaca [11].

The purpose of the present study was to study the development of the cecum and colon in the goose (Anser anser) and exhibit the histological changes that occur in the tunica mucosa, muscularis and serosa during the pre- and post-hatching periods.

MATERIALS AND METHODS

In the study, 30 geese embryos on the 15th, 17th, 21st, 26th and 28th days of incubation and 25 young geese (gosling) aging, 1, 5, 10, 21 and 30 days were used as the materials. For each day, five embryos and gosling were observed. Animals were killed by decapitation and segments of the proximal cecum and colon (or colo-rectum) were removed. Tissue samples for light microscopic observations were fixed in Bouin’s and Formol alcohol fixative solutions, dehydrated, embedded in paraplast and cut at 5 µm transversal sections. Sections were stained with Crossmon’s connective tissue stain for general observations [6]. The combined Alcian blue (pH: 2,5)-PAS technique was used to determine the goblet cells [1].

RESULTS

Prenatal stage: The intestinal wall is composed of the tunica mucosa, muscularis and subserous stratum.

1. The tunica mucosa

Epithelium: On the 15th day of incubation (Figs. 1a, b), the lumen of colon had a starred shape due to the appearance of the previllous ridges, while the lumen of cecum was angular. The lumen of colon was lined by a pseudostratified epithelium in the intervillus region, except at the base of previllous ridges, where a simple prismathic epithelium was seen. The luminal surface of the cecum showed a pseudostratified epithelium. The epithelial cells of the cecum and colon showed an intense mitotic activity (Figs. 1c, d).

On the 17th day of incubation (Fig. 2), the first previllous ridges had begun to appear in the cecum. The epithelium of cecum was similar to that of colon. The simple prismathic epithelial cells had oval nuclei situated near the cell base. One or more, dense nucleoli were found spherical in shape.

The villi were already formed in the ceca and colon on the 21st day of incubation and they were lined by a bathyprismatic epithelium (Figs. 3a, b).

On the 26th day of the incubation, no appreciable differ-
ences from the morphological aspects observed in the previous days were seen in the ceca and colon. However, the thickness of intestinal wall and the number of villi were increased.

On the 28th day of incubation (Figs. 4a, b), the villi were completely formed in the mucosa of colon and ceca. Generally, the villi were the finger-like, which have a peaked, domed or swollen point.

With the Alcian blue (pH: 2.5)-PAS the secretory materials of the epithelial cells stained purple, blue or bluish-purple. The blue staining secretory materials were grosser. The secretory material containing the epithelial cells didn’t appear as a typical goblet cell with the Crossmon’s stain, although these cells were described as goblet cell-anlage due to stain blue with Alcian blue (pH: 2.5)-PAS.

Lamina propria and tela submucosa: On the 15th day of incubation, the lamina propria was characterized by a relatively compact connective tissue. The border between the epithelium and lamina propria was characterized by the presence of a circular basement membrane. Beneath of the lamina propria was present at a relatively loose connective tissue. This is described as tela submucosa. Within the tela submucosa of colon and ceca, the nerve plexus and blood vessels were observed. The tunica mucosa of colon and cecum protruded into the lumen on the 21st and 28th day of incubation, respectively (Figs. 3a, 4a). The folds showed a well developed mesenchymal axis. These areas of protruding mucosa of colon were supported by the muscle bundles, which became as under from circular muscle layer (tunica muscularis). These muscle bundles were oriented circularly.
or longitudinally or obliquely and the connective tissue were seen among them (Fig. 3b, 4b).

Lamina muscularis mucosa: The lamina muscularis mucosa was formed only in colon on the 28th day of incubation, and consisted of longitudinal muscle fibers.

2. Tunica muscularis

From the 15th to 28th day of incubation, the muscle layer consisted of a circular and a longitudinal muscle layer in the colon. The muscle layer of mucosal folds of the colon consisted of a longitudinal- on the outer single circular- in the middle and an oblique-muscle layer in the inner. The oblique muscle layer presented clear-cut muscle fascicle and connective tissue septa. In the other portion of the colon, instead of the oblique muscle layer, there was a longitudinal muscle layer which was described as lamina muscularis mucosa. The outer longitudinal muscle layer made up discrete bundles of muscle cells ( fascicles), while the circular muscle layer had a compact structure with little evidence of fascicles and only few intramusculer septa of connective tissue. Between the longitudinal and circular muscles was a narrow connective tissue layer containing many large blood vessels and well developed nerve plexus. Between the fascicles of the outer longitudinal muscle was also found the nerve plexus.

From the 15th to the 26th day of incubation, the tunica muscularis of cecum oriented circularly, but on the 28th day of incubation it consists of an outer longitudinal and an inner circular muscle layer. The muscle fibers of longitudinal layer were not prominent (vaguely).

3. Subserous stratum

From the 15th to the 28th day of incubation, the subserous stratum was characterized by a loose mesenchyme, and large blood vessels and nerve plexus were within the subserous stratum.

Postnatal stage: On the first day after hatching a progressive increase in the number, thickness and height of intestinal villi of large intestine was observed. At this stage, the goblet cells and the crypts appeared for the first time in the cecum and colon. Many blood vessels were notable within the lamina propria. The lamina muscularis mucosa appeared under the lamina propria in the cecum and colon and consisted of circular muscle fibers. It was seen that the muscle fibers passed inward from the lamina muscularis mucosa to the corium of each villus. The nerve plexus was observed under
the lamina muscularis mucosa in colon and ceca. The tela submucosa was indistinct in the colon, while in the ceca it was only obvious where within the portion of folds the cells of the submucosal nerve plexus or an occasional large blood vessel considerably increase its thickness (Fig. 5). In the colon, the tunica muscularis had the same morphological characteristics as those observed on the pre-hatching period.

When the intestine of gosling from 5th to 30th days of age was examined, it was observed that the number of goblet cells, villi and crypts and the height of villi were increased by progress of age. The goblet cells were seen particularly numerous and mainly placed in the epithelium lining the crypts and the lateral surface and base of intestinal villi. The size of goblet cells was greater in the epithelium lining of the villi than that of the crypts (Fig. 6). On the 30th day after hatching, a remarkable increase in the thickness of the tunica mucosa was observed. The thickness of the muscle layer also progressively increased from the first day to 30th day after hatching. The other components of the intestine wall had the same morphological characteristics as those observed on the first day after hatching.

DISCUSSION

In the present study, on the 15th day of the incubation, the luminal surface of the cecum and colon bounded by pseudostratified epithelium was found. The feature of the epithelium was similar to the chicken reported elsewhere [3, 4, 9]. In the goose embryos, the appearance of the previllous ridges and the change of epithelium into a simple prismatic epithelium were on 15th and 17th days of the incubation in the colon and ceca, respectively. These findings were similar to the observation of Gheri et al. [9], but were different from the reports of Bryk and Gheri [3] and Chiarugi [4]. Therefore, it is suggested that the mucosal development of the cecum may be later than that of colon in the goose embryos and the mucosal developments of cecum and colon were slower than the development of these intestine in chicken [3, 4]. In the chicken, it was noted that the epithelial maturation occurred before the formation of previllous ridges [8]. In this study the previllous ridges were formed at the same time with the differentiation of the epithelium in the ceca in goose embryos.

In chicken [4, 12], the typical goblet cells appeared in the pre-hatching period, while in the goose, they were absent from 15th to 28th day of the incubation and appeared at the first day after hatching. The incubation period of the goose was 30th days. In the present study had investigated from 15th to 28th day of incubation. Therefore, it was suggested that the goblet cells may be formed during the last two days of incubation.

Previous studies have reported that the lamina propria was characterised by a loose mesenchyme in the thick embryo at about the 8th day of the incubation in the large intestine [3, 4, 8, 9]. In the present study, it was determined that the lamina propria was characterised by relatively compact mesenchyme and under the lamina propria, a relatively loose mesenchyme which is described as tela submucosa was present. It has been reported that in chicken [4, 9], the crypts appeared in all segments of large intestine during the...
pre-hatching period. By contrast, in this study the crypts were first observed at the first day after hatching. In geese, it was concluded that the submucosa was found in the prenatal stage and disappeared at the first day after hatching as a result of the formation of crypts. Furthermore, it was determined that the lamina muscularis mucosa appeared for the first time at the 28th day of incubation in colon, while in cecum it was identified at the first day after hatching. The feature of musculature of colon and cecum is in agreement with that observed in the fowl [11]. In the goose embryos, all portion of intestine Auerbach’s plexus and Meissner’s plexus appeared at the 15th days of incubation. The detailed information about the appearance of this plexus in intestine of birds was not present in literature.

These results indicated that the mucosal maturation begins at an earlier stage in the colon than in the cecum.

REFERENCES