Histological Aspects of Brunner's Glands in Chinchillas *(Chinchilla lanigera)*

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Abstract:

Since their discovery, Brunner's glands have been an attractive subject of research. The study aimed to investigate the structure, the topography, and the degree of development of the Brunner's glands in chinchillas through light microscopy. Transversal fragments from the duodenum of 5 chinchilla males were histologically processed by classical paraffin technique. Brunner glands are much more developed and proportionally, they occupy at least three times more space than the Lieberkuhn glands. In many places, Brunner glands are clustered, suggesting that more than one such gland spills its secretion product through a common Lieberkuhn gland in the space between villi. We can affirm that Brunner glands, after their disposition, appearance and absence of distinct muscularis mucosae, are disposed into the thickness of the mucosa and submucosa in chinchilla (together with the Lieberkuhn glands) and not strictly in the submucosa as in other mammals.

Keywords: Brunner's glands, chinchilla, structure.

Introduction

Since their discovery by Wepfer in 1679 (Mohammadpur, 2011), the submucous duodenal glands (Brunner's glands) have been an attractive subject of research that has pursued many aspects of these particular glands. Many studies have tracked their presence, disposition, and extension in various animal species and also cell types found in their structure. Their presence in the submucosa of the duodenum is incontestable (Botros *et al*., 1990; Bloom and Fawcett, 1994; Burkitt *et al*., 2000), but there is still controversy over their location along the duodenum, because in the literature there is incomplete information in some species (Coutinho *et al*., 1996; Gartner and Hiatt, 2003).

In most mammalian species, Brunner glands are present from the gastrointestinal junction and extend over variable distances in the proximal part of the jejunum (Alogninouwa *et al*., 1996; Krause, 2000; Takehana *et al*., 2000; Verdiglione *et al*., 2002). In humans, Brunner glands are present up to the Vater ampoule (Treasure, 1978). In eutherians, the duodenal submucosal glands are located just a few millimeters away near the pyloric sphincter (Krause, 2000). Brunner glands are present in the horse on a very long distance, starting from the pyloric junction, continuing on

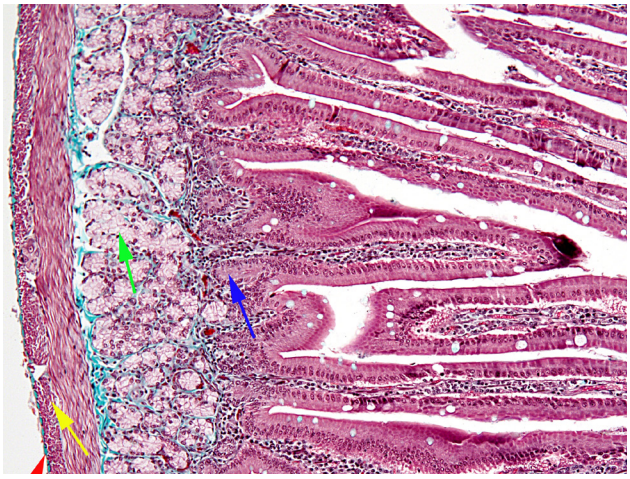

Figure 1. Duodenum; Goldner's trichrome stain; black arrow- villi; blue arrow - Lieberkuhn glands; green arrow - Brunner glands; yellow arrow – muscularis externa; red arrow - serosa

about 6 m of the length of the small intestine. They also extend into the jejunum in pig and large ruminants (Verdiglione *et al*., 2002). In rabbits, they extend over the length of the duodenum to the immediate vicinity of the jejunum. In pony, Brunner glands are present in all the length of the duodenum (Takehana *et al.,* 1989).

In the South American opossum, these glands are present only in a limited portion of the immediate vicinity of the pyloric sphincter, more precisely from the distal part of the pillar region to the proximal duodenum (Schumacher *et al*., 2004). In the guinea pig, the Brunner glands were identified along the length of the duodenum, and their density was highest in the first third, then gradually decreasing towards the terminal portion (Mohammadpur, 2011).

The duodenal submucosa glands consist of a single or two types of secretory cells, depending on the species. Thus, they are composed of mucous and serous cells in horses and rabbits (Oduor-Okelo, 1976; Pfeiffer and Dabareiner, 1992; Takehana *et al*., 1989) and only of mucous cells in white-tailed deer, moose, bison and elk (Krause, 2000). The Brunner glands in the guinea pig contain a single type of cells (mucous) also. Regarding the substances secreted by Brunner's glands, several studies have been performed that have shown they differ according to species. They can secrete neutral mucins, acid mucins, or even both types of mucins (Mohammadpur, 2011). The Brunner's glands promote cellular proliferation and differentiation and contribute to elevating the pH of the intestinal luminal contents through their secretion (Krause 2000; Akiba *et al*. 2000).

This study aimed to investigate the structure, the topography, and the degree of development of Brunner's glands in chinchillas through light microscopy techniques.

Materials and methods

In this study, the duodenal fragments were harvested from 5 clinically healthy chinchilla males, with ages between 6 months and 1 year. Animals came from a farmhouse in Sălaj County and were slaughtered by the farmer for their fur. Immediately after skinning, transversal fragments from the duodenum were harvested and fixed in Stieve solution. The samples were histologically processed by classical paraffin embedding method and the slides were stained with Goldner's trichrome method.

Results and discussions

The duodenum in chinchilla presents high villi, with high columnar enterocytes and goblet cells from place to place (Figure 1). The mucosa is formed of epithelium, lamina propria, and muscularis mucosae. The mucosa does not appear well delimited form the submucosa because the muscularis mucosae is not present as a distinct layer, but only as isolated and dispersed bundles. The duodenum of chinchilla has two types of glands like all mammals, intestinal glands (Lieberkuhn) and duodenal glands (Brunner), but their disposition and relationships are particular

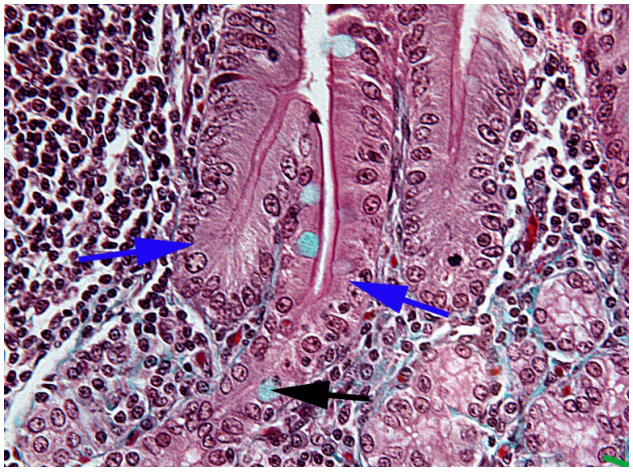

Figure 2. Duodenum Lieberkuhn and Brunner glands; Goldner's trichrome stain; black arrow - goblet cells; blue arrow - Lieberkuhn glands; green arrow - Brunner glands

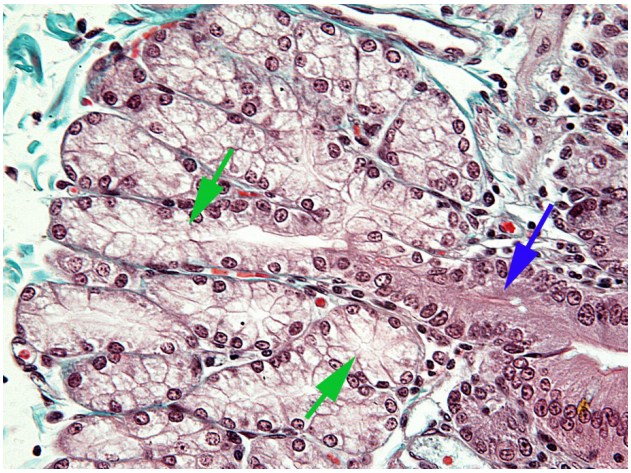

Figure 3. Branched Brunner's glands; Goldner's trichrome stain; blue arrow- Lieberkuhn glands; green arrow- Brunner glands.

here. As for the intestinal glands, they are short and communicate, in the deep portion, with the duodenal glands (Figure 2).

The intestinal glands have two types of cells, enterocytes with a significantly lower height than those of the villi (which are the majority) and rare goblet cells. The duodenal glands (Brunner) are disposed between the bottom of the intestinal glands and the muscularis externa. The deeper part of the Brunner glands is separated by the muscularis externa by a relatively thin layer of loose connective tissue.

In other words, the duodenal glands do not appear separate from the intestinal glands but appear to form common glands, which look like Lieberkun glands in the upper half and duodenal glands (Brunner) in the deeper area.

The Brunner glands are much more developed and, as proportional representation, occupy at least three times more space than the Lieberkuhn glands. In many places, Brunner glands are clustered like a bunch, suggesting that more than one such gland spills its secretion product through a common Lieberkuhn gland in the space between villi (Figure 3). Brunner's glands are present in the transition zone between the duodenum and jejunum (Figure 4).

The duodenum exhibits high villi covered by a simple columnar epithelium consisting of enterocytes and some goblet cells intercalated between them. In chinchilla, the intestinal mucosa of the duodenum is not well delimited from the submucosa, the two components being very difficult to appreciate because the muscularis mucosae is discontinuous and is represented only by isolated bundles formed by smooth muscle cells. Because the muscularis mucosae does not form a continuous layer, the two components (mucosa and submucosa) seem to form a common component in chinchilla. In this context, the Lieberkuhn glands are no longer well delimited from the Brunner glands, but give the impression that they are intercalated on an area. Moreover, it seems that the two types of glands are disposed in continuity, namely they form mixed glands with the upper half represented by Lieberkuhn glands and the deeper one by Brunner glands. It is very difficult to tell whether this aspect has functional significance or not because the secretion of the cells in the two types of glands is mixed anyway once it reaches the surface of the duodenal mucosa.

Studies conducted by researchers in the field of Brunner glands' origin have shown that they can derive either from undifferentiated gastric epithelium or from the epithelium of the proximal duodenum (Schumacher *et al.*, 2004). The large chemical diversity of carbohydrate residues in the mucus of the Brunner glands suggests that they are highly adaptable. The appearance is also supported by the fact that the cells of the Brunner glands can undergo metaplasia processes much more frequently than goblet cells in the mucosa near the chronic intestinal ulcers (Ahnen *et al.*

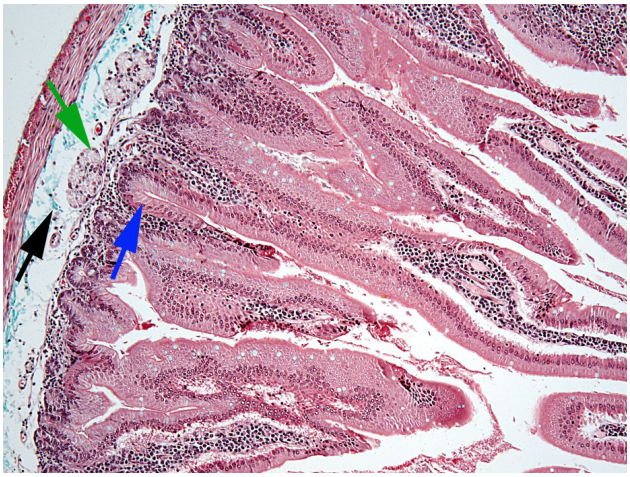

Figure 4. Passage zone between duodenum and jejunum; Goldner's trichrome stain; black arrow – submucosa; blue arrow- Lieberkuhn glands; green arrow- Brunner glands.

1994; Kushima *et al*., 1999; Schumacher *et al.,* 2004).

In mammals, Brunner glands are present only in the duodenum, but their development degree in this segment of the small intestine is not identical in all species. There are differences between mammalian species regarding the distance on which these glands extend into the initial portion of the small intestine.

The excretory ducts of the Brunner glands open either directly in the intestinal lumen or into the lumen of the Lieberkun glands in the duodenal mucosa, with differences from one species to another. The secretion of Brunner glands is represented by mucins forming a viscoelastic film that lubricates and protects the surface of the mucosa from the proximal intestine (Akiba *et al.,* 2000; Krause, 2000). The mucins produced by Brunner glands are composed of oligosaccharides attached to the central protein, thus forming glycoprotein molecules. The secretion of these glands also contains small amounts of bicarbonates and other substances (epidermal growth factor, bactericidal factors, inhibitory proteinases). All of these substances are included in the mucus layer and contribute to providing both a mechanical and a chemical protection barrier to residual gastric acid, pancreatic enzymes or other agents that can reach this region.

Conclusion

We can affirm that regarding their disposition, appearance and the absence of distinct muscularis mucosae, Brunner glands are disposed into the thickness of the mucosa and submucosa in chinchilla (together with the Lieberkuhn glands) and not strictly submucosa like the other mammals.

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