Endocrine Cells in the Gastrointestinal Tract of the Cat as Revealed by Various Staining Methods

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Abstract. Various parts in the gastrointestinal tract of the cat was investigated utilizing the several methods for light microscopy to estimate the frequency of occurrence of the gastrointestinal endocrine cells. Grimelius-positive endocrine cells were numerous in the fundus, the cranial flexure of the duodenum and the rectum. Hellerström-Hellman-positive endocrine cells were the most numerous in the pyloric area. Masson-Hamperl- and lead-hematoxylin-positive endocrine cells were numerous in the cranial flexure of the duodenum and the rectum. Significantly high frequency of occurrence of endocrine cells were found in the rectum with all four methods.

The mucosa of the gastrointestinal tract contains many different types of hormone producing cells. These cells are grouped with cells of the endocrine pancreas as the Gastro-Entero-Pancreatic (GEP) endocrine system. Although hundreds of studies on GEP endocrine cells have been actively performed, few quantitative data regarding endocrine cells are available. Although cats have been used as convenient laboratory animals, no attempt has been made in the past to quantify endocrine cells throughout the gastrointestinal tract, so far as we know. Thus this paper reports work on the relative frequency of occurrence of endocrine cells throughout the gastrointestinal tract of the cat.

Materials and Methods

Nine healthy adult cats weighing approximately 2 to 3 kg were killed by an overdose of Nembutal®. Fifteen portions of the gastrointestinal tract (Fig. 1) were dissected out and fixed in Bouin's fluid or buffered neutral formalin, dehydrated in a graded ethanol series, cleared in xylene and embedded in paraffin. The following staining methods were applied to paraffin sections; Masson-Hamperl's argentaffin reaction [5], argyrophil methods of Grimelius [2] and Hellerström-Hellman [3], and leadhematoxylin method [6].

In order to chart the frequency of occurrence of endocrine cells in the feline gastrointestinal tract, such cells were counted in sections taken from various portions. The frequency of occurrence of endocrine cells were clarified by analyzing the counting on the 4 μm thick sections. Counting was performed at a total magnification of 100× and included only cells with definitely visible nuclei. The result (Fig. 2) is expressed as the mean of cell number per field of vision (0.25 mm²) in 10 estimations on every section.

Results and Comments

Grimelius-positive endocrine cells: These cells were more numerous in every portion than other types of cells stained positively with three other methods. They were the most numerous in the fundus, numerous in the cranial flexure of the duodenum and the rectum, and somewhat numerous in the ileum. In the gastric region, these cells were the most numerous in the fundus but less numerous in the pyloric area. In the
small intestine, the cells were the most frequently found in the cranial flexure of the duodenum and decreased in number gradually toward the jejunum but increased slightly in the ileum. In the large intestine, the cells were less numerous but in the rectum (Fig. 3) where they were almost as numerous as in the cranial flexure of the duodenum.

Hellerström-Hellman-positive endocrine cells: These cells were the most numerous in the pyloric area and somewhat numerous in the cranial flexure of the duodenum and the rectum. In the gastric region, these cells were found to be relatively few in the fundus but increased in number remarkably in the pyloric area where they were detected in the greatest number in the gastrointestinal tract. In the small and large intestine, these cells were constantly few in number but relatively frequent in the cranial flexure of the duodenum and the rectum (Fig. 4).

Masson-Hamperl-positive endocrine cells: Argentaffin cells stained with this method were found to be few in number in the gastric region. In the small intestine, these cells were the most numerous in the cranial flexure of the duodenum and they decreased

Fig. 1. Portions of the gastrointestinal tract of the cat, where the materials were taken.

Fig. 2. The frequency of occurrence of endocrine cells in the different portions of the cat gastrointestinal tract. Each line shows the number of cells reacting with each method (cell number/0.25 mm²). The pylorus-duodenal junction (4) is divided into two portions: the pyloric mucosa prior to the pylorus (4a) and the juxtapyloric duodenum (4b).
toward the jejunum. Then the cells increased gradually from the cecum to the rectum (Fig. 5) where they were detected as numerous as in the cranial flexure of the duodenum.

Lead-hematoxylin-positive endocrine cells: Relatively few of these cells were detected in the gastric region, although the tendency of occurrence in the small and large intestine was almost the same as cells stained with Grimelius’ method. In the gastric region, these cells were scarce in the fundus but numerous in the pyloric area. In the small intestine, these cells were the most numerous in the cranial flexure of the duodenum, less numerous in the duodenoojejunal flexure, and numerous again in the ileum. In the large intestine, they were found to be constant in number but numerous in the rectum (Fig. 6) where they were detected in the greatest number in the gastrointestinal tract.

Some argyrophil cells extended a long cytoplasmic process along the basement membrane. They were found not only in the gastric region but also in the small and large intestine (Fig. 7). A few cells detected in Brunner’s glands by all four methods (Fig. 8).

In this study using several methods to detect the endocrine cells, the frequency of occurrence of endocrine cells varied in the gastric region but appeared almost the same tendency in the small and large intestine, steadily numerous in the rectum. The high frequency of cells in the cranial flexure of the duodenum was considered to be related to the opening of pancreatic and bile ducts in this area.

Although it is also reported that the frequency of occurrence of endocrine cells were high in the rectum of sheep [3] and human being [1], the reason for this is not clear yet. The significance of high frequency of endocrine cells in the rectum may be an important subject to be clarified in the near future. Immunoreactivities and ultrastructure of the endocrine cells in the feline rectum is now under investigation.

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References
要約
ネコの消化管における内分泌細胞の光学顕微鏡的研究: 北村延夫・山田純三・山下忠幸・三須幹男
(帯広畜産大学家畜解剖学教室) ——ネコの消化管全長における内分泌細胞の出現頻度を光学顕微鏡で検
索した。Grimelius グリメリウス法陽性細胞は胃底部、前十二指腸曲および直腸で多数認められた。Hellerström-Hell-
man ヘルストローム＝ヘルマン法陽性細胞は幽門部で最も多か認められたが、前十二指腸曲および直腸でも比較的多数認められ
た。Masson-Hamperl マッソン＝ハムペル法陽性細胞および鉛ヘマトキシリン法陽性細胞は前十二指腸曲と直腸で多数認
められた。各陽性細胞の出現傾向は、胃領域では様々であったが、小腸および大腸では同様の傾向が認められ、前十二指腸曲および直腸における増数が顕著であった。

Explanation of Figures

Fig. 3. Many argyrophil cells in the glands of rectum. Bouin. Grimelius. ×560.
Fig. 4. Many silver reacting cells in the glands of rectum. Bouin. Hellerström-Hellman. ×560.
Fig. 5. Many argentaffin cells in the glands of rectum. Formalin. Masson-Hamperl. ×560.
Fig. 6. Many endocrine cells in the glands of rectum. Formalin. Lead-hematoxylin. ×560.
Fig. 7. Argyrophil cell extending a long cytoplasmonic process along the basement membrane in the glands of the descending colon. Bouin. Hellerström-Hellman. ×1,680.
Fig. 8. Two argyrophil cells in Brunner's glands. Bouin. Grimelius. ×560.