Ultrastructure of Basal-Granulated Cells in the Rectum of Human Fetuses and Children

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Summary. The electron microscopic investigation of the rectal mucosa of human fetuses and children revealed the occurrence of two types of basal-granulated cells mainly in the lower half of crypts. By use of the Wiesbaden terminology these cells could be identified as intestinal enterochromaffin (EC) cells and large granule (L) cells. EC cells were never seen reaching the luminal surface. L cells in the rectum of fetuses tended to have their long axis along the basement membrane and were never seen reaching the lumen, whereas L cells in the rectum of children frequently were observed to reach the luminal surface with a cytoplasmic process.

Light and electron microscopic investigations on the gastrointestinal mucosa of mammals have led to the identification of several types of basal-granulated cells producing biogenic amines and/or polypeptide hormones (VASSALLO et al., 1969; FORSSMANN et al., 1969; PEARSE et al., 1970).

Mainly on the basis of the morphology of their secretory granules, electron microscopy allows the distinction of at least four types of basal-granulated cells in the human gastric mucosa and three types in the mucosa of the small intestine (PEARSE et al., 1970).

By electron microscopic studies of human biopsy materials FUJITA and his associates have identified five types of basal-granulated cells in the gastric mucosa (SASAGAWA et al., 1970; KOBAYASHI et al., 1971), at least five types in the duodenal mucosa (KOBAYASHI et al., 1970) and at least two types in the colon and rectum (OSAKA et al., 1971).

This study was concerned with the ultrastructural characteristics of basal-granulated cells in the rectal mucosa of human fetuses and children.

Material and Method

The material comprised samples of the rectum of 14 human fetuses and biopsies of rectal mucosa from 8 children with no illness related to the gastrointestinal tract. The fetuses were removed by Caesarean section in connection with legal abortion, Crown rump length of the examined fetuses varied from 52 to 141 mm. Measurements were made on unfixed fetuses held in a supine position. The age of the children varied from 10 months to 9 years. The biopsies were taken with biopsy forceps 6-7 cm from the anal region. By rectoscopy the mucosa was normal in all cases.

Fetuses were fixed by whole body perfusion through the umbilical vessels. Ice cold 3% glutaraldehyde in 0.2 M cacodylate buffer at pH 7.4 was used as perfusate. After perfusion samples of the rectum cut perpendicular to the long axis were fixed further by immersion for 3 hrs, and rinsed with sucrose-cacodylate buffer. The specimens were post fixed in osmium tetroxid 1%, dehydrated and embedded in epon
Biopsies were flattened, cut surface down, onto a cardboard and were fixed by immersion and rinsed as described above. The specimens then were cut into wedge-shaped blocks, post-fixed, dehydrated and embedded on edge in epon or araldite according to Pittmann et al. (1966). The sections were cut on a Reichert OM U2 ultramicrotome. One µ thick sections were stained with toluidine blue and examined with a light microscope in order to locate areas to be trimmed for thin sections. These sections were stained with Zn-uranylacetate 4% and Pb-citrate 0.4% and were examined with a JEM-T7 electron microscope.

Cytoplasmic granules were measured on a Zeiss TGZ 3 particle size analyzer.

Results

The structure of the basal-granulated cells in the rectal mucosa presents some common features. The nucleus was generally oval. Mitochondria, lysosomes, free ribosomes and ergastoplasm were observed in the cytoplasm. All cells were in direct contact with the basal membranes. Neither direct contact between nerve structures and basal-granulated cells nor intraepithelial nerve endings were observed. Almost all basal-granulated cells were located in the lower half of the rectal crypts; only very few were seen in the surface epithelium.

On the basis of the morphology of the granules at least two cell types could be distinguished.

Cell type I. The cells of this type contained polymorphic granules mainly rod-like, ovoid or kidney shaped. As a rule the granules were heavily contrasted, but in fetal cells similar, but less dense granules filled with coarse material were seen. In

![Histogram showing the distribution of the osmiophilic granules in the basal-granulated cells of the rectal mucosa.](image-url)
fetal granules, furthermore, one or more internal bodies of very high osmiophilia and a surrounding, less osmiophilic material were observed. Most granules were surrounded by closely applied membranes although some showed clear spaces interposed between the dense core and the membranes. The Golgi complex, located supranuclearly, often contained pro-granules but the largest number of granules was found in the basal part of the cell. The results of measurements of the granules are given in Figure 1. The cells were of pyramidal shape and were never seen reaching the lumen (Fig. 2, 4A).

Cell type II. The cells of this type exhibited almost uniform round granules surrounded by a rather tightly fitting membrane. The granules were moderately to highly osmiophilic and of rather uniform size. The granules were primarily localized in the basal region of the cells but in cells reaching the lumen the granules might be observed in the apical cytoplasm. The Golgi complex was seen in a para- or supranuclear site; Golgi associated granules were observed. Results of measurement of the granules are given in Figure 1. The cells were of oval or elongated pyramidal
form. Some fetal cells tended to have their long axis along the basement membrane and were never seen reaching the lumen, whereas cells in biopsies from children frequently were observed to reach the lumen where they might be provided with microvilli (Fig. 3, 4B).

Discussion

By electron microscopy it was possible to distinguish two types of granulated cells in the rectal epithelium of children and human fetuses.
Cell type I was characterized by polymorphic, highly electron opaque granules and corresponded to EC cells of the Wiesbaden terminology (Pearse et al., 1970), i.e. enterochromaffin cells.

The morphology of the rectal EC cells was quite comparable to that observed in human duodenum and jejunum (Pearse et al., 1970; Kobayashi et al., 1970) and in human colon and rectum (Osaka et al., 1971), although they were never seen reaching the lumen of the crypt. This could be due to the cell shape, forming a shallow cone, the apex of which often may be missed in electron micrographs of thin sections. Kobayashi et al. (1971) described basal-granulated cells of “open” type (reaching the lumen) and “closed” type (isolated from the lumen by other cells covering them). In the human pyloric antrum and duodenum all basal-granulated cells were observed to be of “open” type, whereas those in the gastric fundus were of “closed” type.

In the human rectum two types of basal-granulated cells were identified (Osaka et al., 1971) and a part of both types was observed reaching the luminal surface with long slender cytoplasmic processes.

The EC cells are known to be the source of 5HT (serotonin) but beside this they are supposed to produce a low molecular weight polypeptide hormone (Pearse, 1969).

Cell type II contained round granules of moderate to high electron opacity and of very uniform size. In human small intestine two types of basal-granulated cells besides EC cells have been described (Pearse et al., 1970). Because of the size of their granules the cells are referred to as large granule (L) cells and small granule (S) cells

Fig. 4. A: Cell type I and B: cell type II located in the epithelium of rectal mucosa from human fetuses. A: ×5,500, B: ×7,500
(Wiesbaden terminology). The ultrastructure of type II cells of the rectum corresponded to the L cells of the small intestine.

In the rectum of human fetuses the L cells were flattened in shape and were never seen reaching the lumen of the crypts. However, in biopsies of children the L cells were observed to reach the lumen. Furthermore, in some cells reaching the lumen most of the granules were located in the apical cytoplasm.

By immunofluorescent studies (Polak et al., 1971) L cells in the intestine of dogs are shown to be the source of enteroglucagon.

References


