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ENDOCRINE CELLS FROM THE GASTROINTESTINAL-PANCREATIC ENDOCRINE SYSTEM IN THE GASTROINTESTINAL TRACT OF HUMAN EMBRYOS IN THE 5TH – 6TH GESTATION WEEK

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ABSTRACT. The gastroinestinal – pancreatic endocrine system, being a part of the diffuse neuro – endocrine system contains diffusely scattered cells and cell groups in the covering epithelium and glands from the gastro-intestinal tract. Although there is still no digestion in those early stages of embryo development the endocrine cells are highly differentiated and show morphologic characteristics that are identical with the ones in adults. The aim of the current study is the making of an ultra-structural characteristic of the different types of endocrine cells in the mucosa of the gastrointestinal tract of human embryos in the 5th-6th gestation week. The ultra-structural description of the endocrine cells in the mucosa of the gastro-intestinal tract of human embryos is one of the directions in their study which is trying to uncover the fundamental question of their embryonic origin.

KEY WORDS. endocrine, cells, huma embryo, gastrointestinal tract.

INTRODUCTION

The gastroinestinal – pancreatic endocrine system, being a part of the diffuse neuro – endocrine system, has some important regulating functions in the human body. It contains diffusely scattered cells and cell groups in the covering epithelium and glands from the gastro-intestinal tract. The total volume of endocrine cells in it is greater than the volume of all endocrine glands. The gastroinestinal – pancreatic endocrine system has not yet been completely studied. New types of endocrine cells as well as new biologically active substances that take place in the regulation of both digestive processes and metabolic processes in other organs and systems are being discovered all the time. The endocrine cells of the the gastroinestinal – pancreatic endocrine system are one of the first cells that differentiate in the primitive

endodermal tube during the early embryogenesis. Although there is still no digestion in those early stages of embryo development these cells are highly differentiated and show morphologic characteristics that are identical with the ones in adults.

AIM The aim of the current study is the making of an ultra-structural characteristic of the different types of endocrine cells in the mucosa of the gastrointestinal tract of human embryos in the 5^{th}-6^{th} gestation week.

MATERIAL AND METHODS

Material from 16 human embryos of 5-th – 5-th weeks of gestation, obtained by vacuum extraction carried out for normal pregnancy interruption (after parents consent) was studied. Small pieces of embryonic gastro-intestinal tract were fixed in 2,5% glutaraldehyde and 0,1M cacodylate buffer (pH 7,4), postfixed in1% osmium tetraoxide and embedded in durcopan. Examination and microphotographs were done of TEM "Philips CM 12".

RESULTS AND DISCUSSIONS

The endocrine cells of the gastroinestinal – pancreatic endocrine system are diffusely scattered along the whole length of the primitive endodermal tube between the endodermal cells of the covering epithelium and the glands. They have oval or pyramid shape and the basal part of the cell lies on the basal membrane. The narrow apical part of the so-called closed type cells does not reach the surface of the mucosa. These cells react to mechanical stretching and or blood stimuli of the blood vessels located under the basal membrane in the connective tissue of lamina propria (fig. 1.). The apical part of the cells of the so-called opened type reaches the lumen and analyses the chemical composition of the food. Pinocytosic vesicles can be seen in this part of the cell (fig. 2., 3.). The cytoplasm of endocrine cells is brighter than the one of the neighbouring epithelium cells. The nucleus is oval and contains a great amount of euchromatin. The cell organelles are similar to those of the other cells of lamina epithelialis. Mitochondria are relatively small, prolong and uniformly scattered in the cytoplasm. The quantity of GER is different in the different types of endocrine cells. The dictiosomes of the Goldgi complex are situated perpendicularly. Although the specific secretory granules in some of the cells are located in the basal part of the cells, it is more likely for them to fill the whole cytoplasm. The different types endocrine cells are determined by their specific secretory granules:

- G-cells, or gastrin-producing cells. They have round or oval granules with well outlined granule membrane, different size (180 – 300 nm) and different electron density (Fig. 4.).
- D-cells, or somatostatin-producing cells. They have large homogeneous granules (250 – 400 nm) with moderately dense core. The granule membrane is interrupted (Fig. 5.).
- EC cells have polymorphous granules. They are rod – like or biconcave, with high electron density. EC1 cells, or serotonin and substance P producing cells have granules with large diameter 200 – 300 nm (Fig. 6.). EC2 cells, or serotonin and motilin-producing cells have granules with large diameter 200 – 400 nm (Fig. 7.).

The cells that have a mixed exo-ednocrine secretion are an interesting finding (fig. 8.). The specific granules containing peptid show some characteristics typical of the endocrine cells of the EC-type: electronic density varying from moderate to high, a prolonged biconcave shape, well outlined restrictive membrane with narrow halo. Mucous granules can be found in the cytoplasm. They are of great size, spheric shape and low electronic density. On fig. 9. we can see that the content of a mixed type cell is pouring out in the intestinal lumen. It is consisted of a great number of fusing mucous granules, vacuoled mitochondria with destroyed cristae and specific sector granules in a different state of ripeness: full – with high electronic density, half-full – with scarce granular material and empty – with no content.

CONCLUSION

The ultra-structural description of the endocrine cells in the mucosa of the gastro-intestinal tract of human embryos is one of the directions in their study which is trying to uncover the fundamental question of their embryonic origin. Different theories such as the APUD concept, the one of the diffusion endocrine system or the para-neuronic concept treat the endocrine cells of the digestive tract as a homogeneous group of cells that have migrated from the critae neurales and have reached their final place in the primitive endodermal tube in their early stages of their embryonic development. A proof of the neuroectoblast origin is the common phenotype characteristic that the endocrine cells and the neurons share. It can be seen in the expression of distinguishing marks such as neuropeptides, chromogranins, neuropeptide enzymes – neuron specific enolase and synaptophysin (Kvethnoy, I.M., 1996, Tischler, A. S., 2002).

The discovery of cells with mixed exo-endocrine secretion undermined the concept of the neuroectodermal origin of endocrine cells of the gastroinestinal – pancreatic endocrine system. That is why some of the researchers maintain hypothesis of the endoblast origin of the endocrine cells in the gastro-intestinal tract and the islets of Langerhans in the pancreas. According to them the endodermal cells in the primitive endodermal tube differentiate in four directions: surface absorptive, goblet, endocrine and Paneth cells. (Дерижанова И. С. 1995, Турбин Д.А. 1996, Andrew A. 1998, Цанева М. 1999).

REFERENCES

ДЕРИЖАНОВА, И. С., Л. М. МЕНДОСА, А. САЛМН. 1995. Эндокриннокltчные опухоли желудка. Арх. пат. 57, 4, 16 – 20. 2.

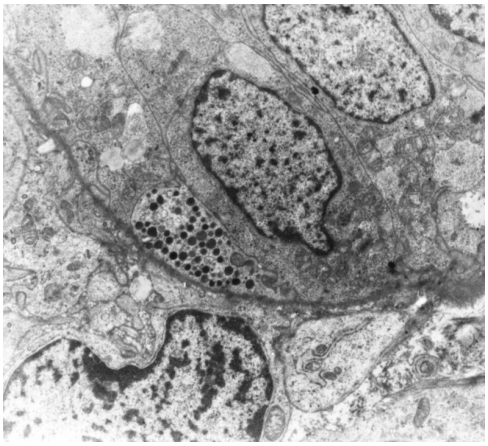
ЦАНЕВА, М., 1999. Морфофункционално състояние на ендокринните клетки на стомаха при някои форми гастрити. Автореферат. Стара Загора.

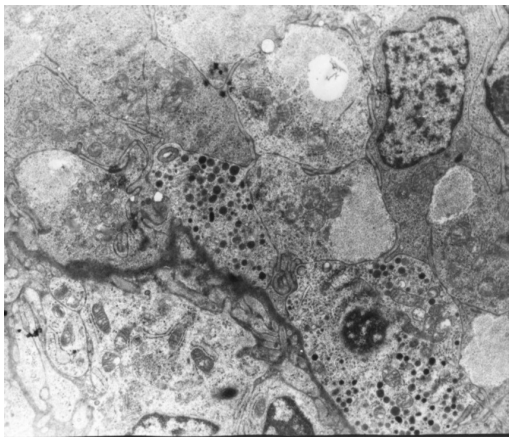
ТУРБИН, Д. А., А. Г. ПЕРЕВОИКОВ, О. В. ЧИСТЯКОВА, Л. Н. КОНСТАНТИНОВА, О. П. КИРИЧЕНКО, Е. В. ФЛЕЙШМАН. 1996. Метахронный рак желудочно – кишечнего тракта с признаками эндокринноклетъчной дифференцировки. Арх. пат. 58, 4, 28 – 32.

ANDREW, A., B. KRAMER; RAWDON BB. 1998. The origin of gut and pancreatic neuroendocrine (APUD) cells – the last word? J. Pathol, 10; 1869 (2):117 – 8.

KVETHNOY, I. M., V. YUZHAKOV, A. MOLOTCOV, L. BANDURCO, R. BRODSKY, N. YACOVLEVA, 1996. Diffuse neuroendocrine system: structural and functional effect of radiation injury to APUD cells, Scanning Microsc., 10(1): 261 – 76.

TISCHER, A. S., 2002. Chrimaffin cells as models of endocrine cells and neurons, Ann N Y Acad. Sci., 10, 971:366 0 70.





Fg. 1. Endocrine cells closed type. The narrow apical part of the closed type cells does not reach the surface of the mucosa. TEM (x 1850)

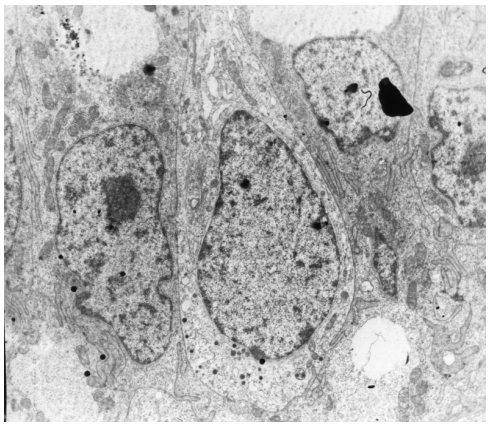


Fig. 2. G - endocrine cell opened type – bazal part. TEM (x 1850)

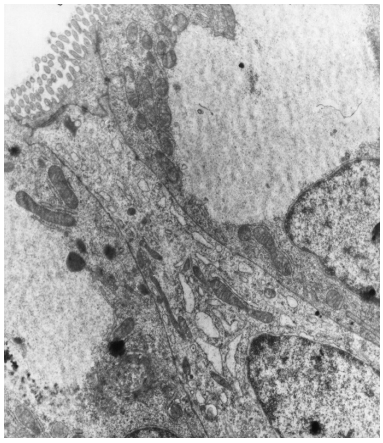


Fig 3. The some G - endocrine cell opened type. Apical part with pinocytosic vesicles reaches the lumen. TEM (x 2350)

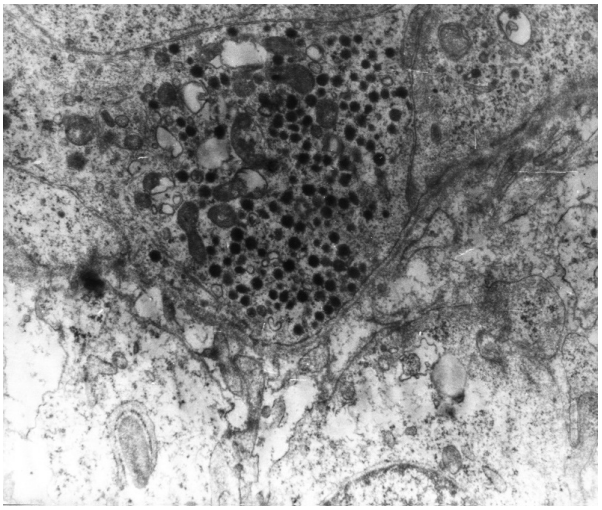


Fig. 4. G-cell. Round or oval secretory granules with well outlined granule membrane, different size (180 – 300 nm) and different electron density. TEM (x 3900)

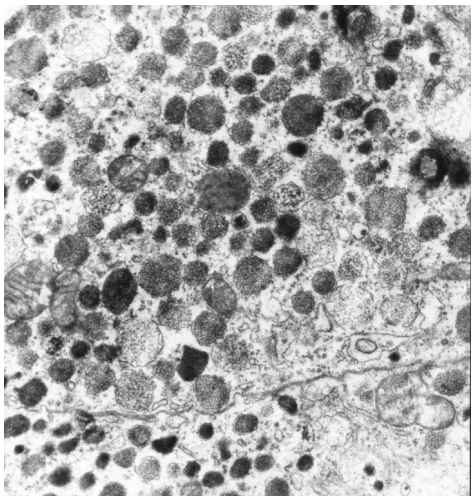


Fig. 5. D-cell - large homogeneous secretory granules (250 – 400 nm) with moderately dense core. The granule membrane is interrupted. TEM (x 5000)

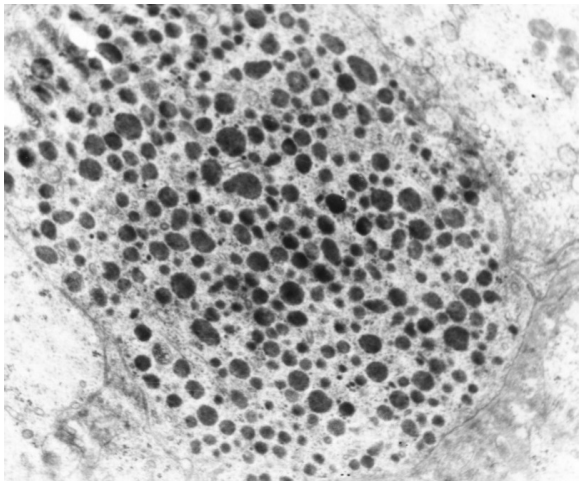


Fig. 6. EC1 cell (serotonin and substance P producing cells). Polymorphous secretory granules with large diameter 200 – 300 nm and high electron density.
TEM (x 3900)

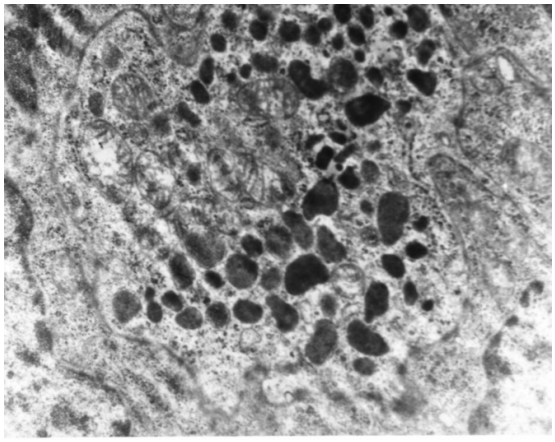


Fig. 7. EC2 cell (serotonin and motilin-producing cells). Rod – like or biconcave secretory granules, with high electron density. TEM (x 3900)

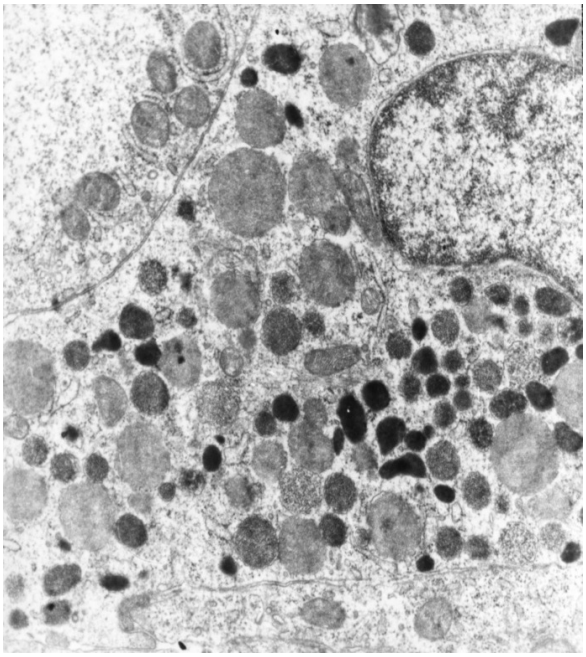


Fig. 8. Exo-ednocrine cell - specific secretory granules EC type and mucous granules with spheric shape and low electronic density. TEM (x 3900)

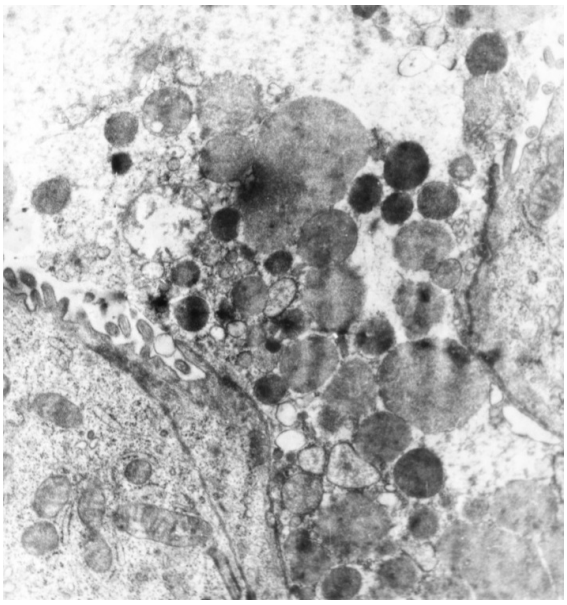


Fig. 9. The content of a mixed type cell is pouring out in the intestinal lumen - great number of fusing mucous granules, vacuoled mitochondria with destroyed cristae and sector granules. TEM (x 3900)