COMPARATIVE STUDY OF SUBMANDIBULAR SALIVARY GLAND IN MOUSE AND RAT

THESIS

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By

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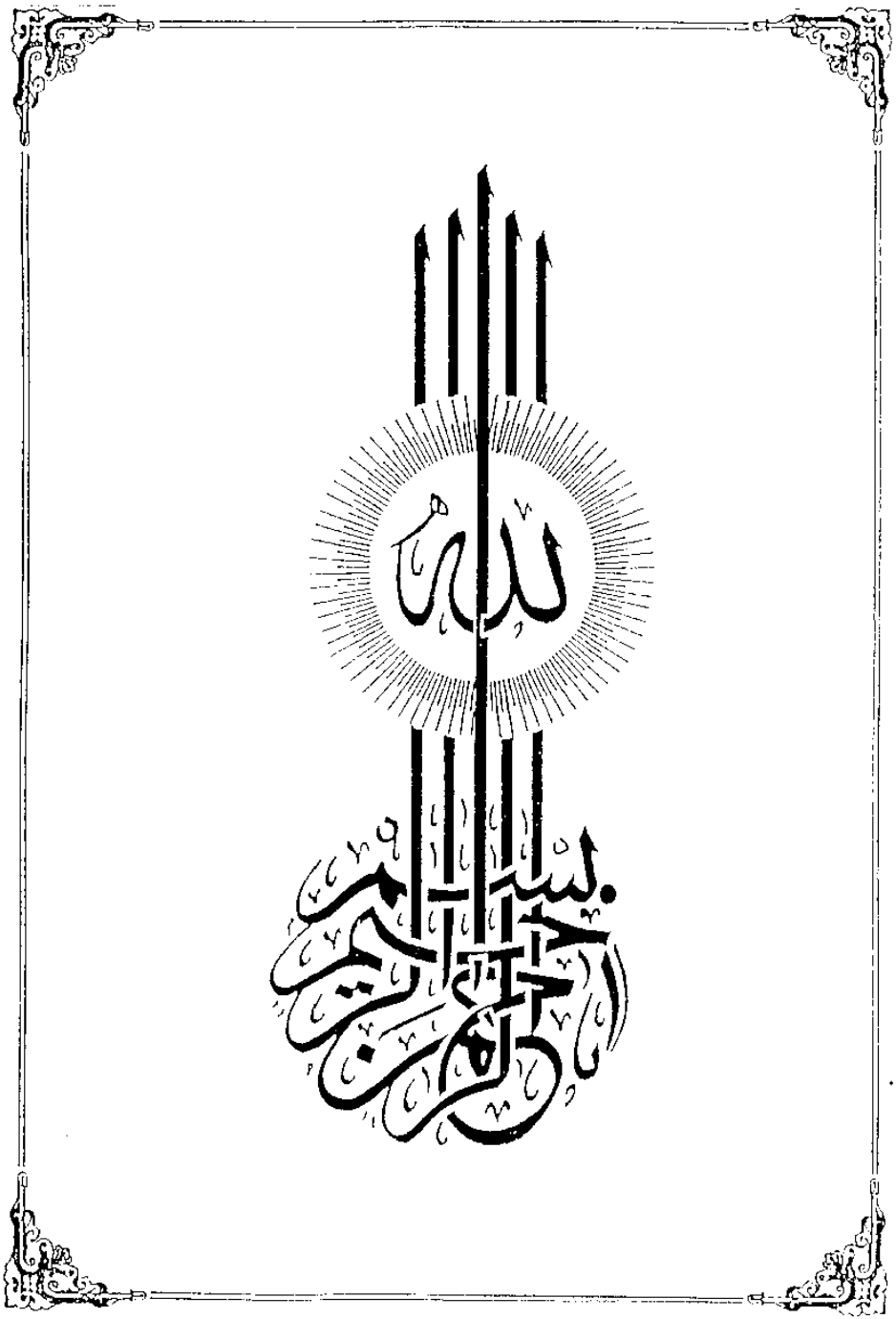

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INTRODUCTION

INTRODUCTION

Previous studies on the submandibular gland in different species revealed variable histological pictures. In recent years, the complex structure of that gland has received a new impetus. In particular, a vast literature around the submandibular gland of mouse and rat need to be investigated.

The present work is a trial to clarify some of the vague points about the structure of this gland, and to do a comparative study on the gland in the two species.

REVIEW OF THE LITERATURE

Review of the literature

The rat submaxillary gland has received considerable attention in recent years as an exocrine gland of complex structure.

In an attempt to classify the gland according to its nature Muller (1895) demontrated that the submaxillary gland of the rabbit is composed of two types of secretory cells.

1- Group of cells which are closely studded with deeply stained granules

2- Cells which form the major part of the secretory tubules of the gland and which remain clear when stained with iron haematoxylin. Morphologically, the second type resembles mucous cells.

Similarly Cohe (1907) in his studies on the submaxillary gland of rabbit, observed the presence of the two types of cells described by Muller in addition, he discovered that the highly granulated type occupied a constant position in between the intralobular ducts and the other type of cells. Using formalin- bichromate fixed material, he was able to demonstrate metachromatic staining of the clear cells with thionin, as well as positive large spherical granules

with mucicarmine. He noticed, in exhausted glands, weaker staining intensity of the granules of the intra lobular duct cells.

Bensley (1908), suggested a classification for the serous cells of the salivary glands based on the metachromatic staining with thionin or toluidine blue. He called, the predominant group of coarsely granulated cells, staining metachromatically, "tropochrome" cells. The cells of the other, minor, group containing smaller granules which did not stain metachromatically, and appeared to be derived directly from the ducts, " homochrome " cells.

He commented that this metachromasia was not present in the cells of the submaxillary gland which resemble mucous cells. He also added that metachromasia or lack of it may be related to the state of aggregation of protein - carbohydrate substances.

Stormont (1928) grouped the two types of cells under the name " Special serous cells " . Stormont (1932), in an attempt to classify the non-mucous cells of salivary and other glands, used the term " Special serous " as distinct from Sero-zymogenic cells. These latter cells are characterized by distinct zymogenic granules, basal chromidial substance and intercellular secretory capillaries. This type

of cells, according to stormont, resembles the pancreatic acinar cells, peptic cells of the stomack and some selected crescent cells of certain salivary glands.

Noback and Montagna (1947) carried out a histochemical studies of the basophilia, lipase and phosphatases in the mammalian pancreas and salivary glands. They investigated the pancreas of the mouse, rat and man, as well as the salivary glands of mouse and rat. They found, using stormont classification, in the submaxillary gland of rat and mouse that, the chromidial basophilia, in the basal portion of the "serozymogenic" cells, appears as a homogenous cloud. It is sligtly less intense than that in the acinar cells of the pancreas and parotid gland, in the distal portion of these cells it is weak.

The basophilia in the basal third of the "special serous " cells is weak and is faint in the distal two - thirds. The nucleoli in both types of cells are basophilic. The special serous cells have large eosinophilic granules in their distal halves, while the granules of the serozymogenic cells are not eosinophilic.

Burstone (1953) studied the salivary gland tissue in the mouse

and he considered the gland to be consisted of alveoli composed of two groups of cells. The first group, forming the major portion of the parenchyma, exhibits finely granular cytoplasm. The other cells resemble mucous cells, are associated with the intralobular ducts, and may contain coarse granules in their cytoplasm.

Jacoby and Lesson (1959) observed such types of cells in the acinar cells of the rat submaxillary gland and the granulated cells of its convoluted tubules and are both referred to as "special serous".

Jacoby (1959), in his study on the post-natal development of the mouse submaxillary gland, observed, what he described as the mucoid definitive acini develop only after birth from terminal tubules. These latter have relatively wide lumens and consist of cells filled with secretion granules which are PAS positive and stain strongly with acidic blue in the Azan stain.

These observations were similar to what Jacoby and Lesson (1959) noticed in their study on the post-natal development of the rat submaxillary gland. They found that the acini were not present at

birth and that the intralobular ducts where shown to end in a branching system of terminal tubules. The acini started to bud off from the terminal tubules begining from the first post-natal week onwards, reaching full development after about 6-8 weeks. In the adult gland, the intercalated ducts were not very easily seen, being compressed between adjacent bulging structures. The authors confirmed the abrupt transition between the intercalated ducts and the convoluted tubule, the name given to the segment of duct system just following the intercalated ducts. This widely branching tubular system was considered to be the most striking epithelial component. They described the lining epithelium of these convoluted tubules being formed of tall columnar cells with almost basal nuclei, below which short acidophilic basal striations could occasionally be detected. The contained granules were considered to be secretion granules which were also found within the lumen, presumably after being discharged from the cells. That is why these tubules were also referred to as " serous " tubules or "granular" tubules. These convoluted granular tubules were found by Jacoby and Lowson (1954) to become continuous with the acidophilic intralobular striated ducts characteristically lined by high columnar cells with centrally or even apically located nuclei and pronounced basal striations (" Streifenstucke " of the German authors.) The transition between the two

segments was found to be either abrupt, with an overall diminution in the diameter of the tubule, or gradual, and even areas in which both types of lining cells could be seen intermingled with one another, were easily detected.

Jacoby (1959) observed a similar complex histological architecture of the submaxillary gland of adult mouse. Histogenetically analysed acini, intercalated ducts, convoluted granular tubules and striated duct have to be considered.

Warren Andrew (1959) stressed that in the rat the parotid and submaxillary gland appear to be of nearly equal size. But he suggested that the mucous part of the submaxillary gland in the rat represents actually a sublingual gland, leaving the true submaxillary gland entirely serous.

To confirm the previous findings, Dobson and Jacoby (1959) studied the electron microscopic (E/M) appearances of the submaxillary gland of rat. They noticed the absence of acini at birth and that they developed later as buds from the terminal tubules. In between the acinar cells, intercellular secretory capillaries could be identified.

Scott and Pease (1959) in their E/M study on the salivary and lacrimal gland of the rat observed that the acinar cells of the submaxillary gland of the rat and most other rodents are considerably different from either typical serous or mucous cells. They observed variations in the cytological appearance of the different alveolar and duct epithelia. The basal surface of the striated duct cells was greatly expanded by extensive infoldings of the plasma membrane in that region . These infoldings of the basal surface tend to make open ended compartments in which mitochondria are aligned . The authors commented that no doubt this system was responsible for the basal "striations" commonly reported in the secretory ducts.

These previous authors noticed in the submaxillary gland vesicles of various sizes and densities in the apical portion of the duct cells often in such numbers astofill the entire cell. These were regarded as an evidence of much secretory activity. Granules were found to be of mucoid type in the sublingual, submaxillary and lacrimal gland alveoli, while granules of the zymogenic type were identified in the parotid alveoli, demilunes of the submaxillary and sublingual glands. Additional watery vesicles were noticed in the secretory ducts.

The authors reported a limited distribution of the myo-epithelial cells and they were confined to the alveoli in the sublingual and submaxillary glands and to the intercalated ducts in the lacrymal gland.

These authors stressed that in the rat, the myo-epithelial cells were limited to the alveolar cells of the submaxillary and sublingual glands and did not involve the demilunes or the duct systems.

A good observation was reported by the previous authors in their E/M study is that the lateral intercellular walls of the cells of secretory and intercalated ducts, as well as submaxillary acinar cells were thrown into -s- shaped folds, so that the neighbouring cells interdigitate one with the other.

Shackleford and Klapper (1962) studied the structure and carbohydrate histochemistry of mammalian salivary gland. They put a nice classification of the salivary glands according to the amylase secretion.

1- The salivary glands which are composed predominantly of mucous acini, e.g. submaxillary gland of dog, cat, cow and sheep,