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# COMPARATIVE HISTOLOGICAL AND HISTOCHEMICAL STUDIES ON THE PITUITARY GLAND IN DIFFERENT MAMMALS

## THESIS

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# **INTRODUCTION**

## INTRODUCTION

From birth through puberty the anterior pituitary cells undergo changes in morphology and relative proportions until finally the appearance of the adult mammalian pituitary gland is achieved at the 8th week. Prior to the study of the pituitary cytogenesis, most of the literature relating the cytology of the hypophysis in many mammalian species were reviewed searching for previous descriptions of the different pituitary cell types and the methods utilized for their demonstration. Current studies of the cytology and histology of the anterior pituitary gland were done in many mammalian species e.g. studies done by Pearse (1952), Wilson and Ezrin (1954), Fand (1955), Herlant (1956) and Adams and Swettenham (1958) on the human hypophysis. Other studies were done by Romeis (1940), Halmi (1950, 1951 and 1952), Siperstein, Nichols, Griesbach and Chaikoff (1954) on the rat pituitary gland, Abolins (1948 and 1949) on guinea pig hypophysis, Salazar (1963) on rabbit, Purves and Griesbach (1957) on dog, Clarke and Purves (1960) on sheep, Fahmy and Nasr (1963) on camel and by Kerdawy (1981) on the goat pituitary gland.

The present investigation is aiming to study and to compare the morphology and the distribution of the

different cell types of the pituitary gland in the mammalian species examined, therefore a variety of staining procedures were employed to demonstrate the staining characteristics and to analyse the morphology of each of the cellular forms characterizing each adenohypophysis. Halmi (1950) distinguished two types of basophil cells in the rat adenohypophysis by employing a modification of Gomori's aldehyde fuchsin method (1950). With the aid of this technique, Purves and Griesbach (1951) continuing and amplifying the concept of Halmi (1950), also distinguished two types of basophils; the thyrotrophs and gonadotrophs. This present study was aiming to establish further the distinct entity of these cell types. The application of Gomori aldehyde fuchsin technique to the human pituitary gland was not very helpful in differentiating between two types of basophil cells and Fand (1955) was unable to obtain convincing results, so another method of Wilson and Ezrin (1954) was tried. Histochemical studies also were done to localize the activity of certain enzymes as alkaline phosphatase, acid phosphatase and succinic dehydrogenase enzymes and to compare the results obtained with those previously found. In this study the results were obtained and sections of the human hypophysis stained with a variety of histological and histochemical stains were compared with those of other species examined and stained with the same stains.

## **REVIEW OF LITERATURES**

## REVIEW OF LITERATURE

In 1904 Erdheim detected areas of stratified squamous epithelium in the capsule of the human pituitary gland and he noticed that the largest areas were found in older persons.

Studies by Cappell (1929) established that the sinusoids of the anterior pituitary gland possessed intimately related perivascular cells which he regarded as histiocytes.

Evans and Simpson (1929) attributed the elaboration of the follicle stimulating hormone to the basophil cells and proved his finding by the low follicle-stimulating hormone content in the female pituitary which was poorer in basophils.

Rasmussen (1919) first drew attention to the fact that the pattern of cellular distribution of the pituitary gland was much more uniform in horizontal than in sagittal sections. According to his account, the acidophils were more or less concentrated in two areas occupying the central, and part of each lateral half of the gland in horizontal sections.

According to Meyer's classification (1938) naturally occurring hexosamine-containing compounds fell into three groups:

- A. Neutral and acid mucopolysaccharides (which include all the true mucins).
- B. Mucoproteins.
- C. Glycoproteins.

In the last two classes, hexose and hexosamine were linked to protein to form an integral part of the molecule.

Rasmussen (1938) described two vascular trabeculae traversing the horizontal sections of the human pituitary gland.

The follicle stimulating hormone was proved by Evans, Fraenkel, Simpson, Mirian and Li (1939) to contain both hexose and hexosamine in its molecule and therefore it was proved to be a mucoprotein. These authors also stated that the luteinizing fraction contained both hexosamine and mannose. The gonadotropic hormones were proved to be proteins containing both hexose and hexosamine in their molecule.

Romeis (1940) distinguished two types of basophils in the adenohypophysis of several species including the

man and rat. He called them "beta" and "delta" cells. This author was the first to describe the "delta" cell as a basophilic type and he noticed that the incidence of these "delta" cells was extremely variable between individual glands.

Bourne (1943) found that the nuclei of the anterior pituitary cells of the guinea pig showed a positive reaction to alkaline phosphatase enzyme which, however had not been localized to any particular cell type.

Reese, Koneff and Wainman (1943) had also pointed out easy distinction between two types of glycoprotein containing cells in rat pituitary gland. They also observed differences in their functional response.

The ingenious studies of Griesbach and Purves (1945) also offered good evidence that the hyperplasia of the basophils following thyroxine deficiency was the sign of thyrotrophin production and that the basophil cells were the source of the thyrotrophic hormone.

McManus (1946) described the histological demonstration of mucin by Schiff's reagent following the action of periodic acid and came to the conclusion that certain pituitary cells, the colloid of the pituitary

stalk, the colloid of the thyroid gland and the mucous of the goblet cells of the human intestine were coloured strongly.

Caspersson (1947) reported that the protein synthesis and hence the distribution of phosphatase enzymes in the secretory cells were mainly found in the nucleus and in different parts of the nucleus but rarely in the cytoplasm.

Abolin's (1948) was able to demonstrate considerable quantities of the alkaline phosphatase enzyme in the anterior pituitary lobe of both male and female guinea pig. He found that the acidophil cells exhibit the strongest reaction while the basophils and chromophobes showed no or very slight enzymatic reaction. In acidophil cells, the strongest reaction was given by the nuclei and cell surface; but in many cells the cytoplasm also showed a high phosphatase content. In all the glands examined a smaller number of acidophil cells were found where the phosphatase activity was confined to the nucleus or the nuclear surface. He found also that the amount of the enzyme varied in different stages of activity and there was no direct correlation between the enzyme content and the quantity of acidophilic granules present. Abolin's

also reported that in rat hypophysis both the enzyme and ribonucleic acid contents were low.

Hogeboom, Schneider and Palade (1948) showed that succinic dehydrogenase enzyme was usually associated with the mitochondria.

McManus (1948) stated that some of the acidophil cells of the human hypophysis were stained positively with the periodic acid schiff.

Abolin's (1948 and 1949) found that the ribonucleic acid and alkaline phosphatase were associated together in the acidophils in the anterior hypophysis of the guinea pig.

Abolin's (1949) noticed that all the nuclei of all cell types in the guinea pig pituitary gland were rich in acid phosphatase enzyme, and he believed that, there were at least two different acid phosphatases of pH 5.5 - 5.0 and of pH 6.6 co-existing in the anterior pituitary of the guinea pig. He found that at pH 5.5 - 5.0 acid phosphatase enzyme could be demonstrated in the interior of the nuclei where they showed a very strong reaction. On the other hand, the cytoplasm did not react and no acid phosphatase could be

demonstrated outside the cell surfaces. At pH 6.6, the cytoplasm of a large number of cells showed the presence of acid phosphatase which could be demonstrated also outside the cell surfaces.

He concluded that, the pH optima in the guinea pig pituitaries were shifted to the alkaline side and at pH 5.5 - 5.0 acid phosphatase was a typical nuclear enzyme, whereas, at pH 6.6, it was an enzyme of the cytoplasm and cell surfaces.

Catchpole (1949) also was able to demonstrate an accumulation of certain granules in the basophil cells which gave a positive periodic acid Schiff reaction for glycoprotein. He found correlation between the content of these granules in female rats with the stage of oestrus cycle.

Pearse (1949), on applying the periodic acid Schiff method to the human hypophyses, could differentiate between two types of mucoprotein particles in the basophils which he named "beta" and "gamma" granules, both were PAS positive. On the other hand, he could not demonstrate any PAS +ve material in the cytoplasm of the acidophil cells and their alpha granules were completely colourless. A particular type of vesiculate

chromophobe had been also described by Pearse. He stated that the nature of the vesicles inside this vesiculate chromphobe was lipoidal or composed of lipid coated mucoprotein. He suggested that this cell represented a phase in the secretory cycle of the basophil. Pearse also had done extensive work on various animal pituitary bodies to localize mucoprotein hormones and he reported that, the chorionic gonadotropins in man and animals were mucoproteins and these hormones were represented in the pituitary bodies by the PAS +ve granular material in the basophil cells.

Gomori (1950) found that the purple dye aldehyde fuchsin which was obtained by adding paraldehyde to an acidified alcoholic solution of basic fuchsin had great affinity for the cytoplasmic granules of some of the basophils of the anterior pituitary (the beta cells of Remeis).

Halmi (1950) could demonstrate two types of basophils in the anterior pituitary gland of the rat which he called "beta" and "delta" cells. These two types of cells showed a characteristic differences in the number, distribution and cytological appearance. He found that beta cells were most numerous in the central