قســـــــم : التشريح والهستولوجى - كلية الطب البيطرى - جامعة أسيوط.
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النمو الجنينى للغدة الصنوبرية فى الفأر الأبيـــــض

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أجريت دراسات هستولوجية وهستوكيميائية على الغدة الصنوبرية على جنين الفأر الأبيـــض عند أعمار ١٣٪ ، ١٤٪ ، ١٥٪ ، ١٦٪ ، ١٧٪ ، ١٨٪ ، ١٩٪ ، ٢٠٪ ، يوم من الحياه الرحمية وكذلك فى الفأر الأبيض حديث الولادة.

وقد وجد أن الغدة الصنوبرية تظهر ككيس يعرف بالكيس الصنوبرى يبرز من سقف البطـــين الثالث للمخ وذلك عند عمر ١٣٪ يوم من الحياه الرحمية. وعند عمر ١٦٪ يثنى الجدار الظهرى للكيس الصنوبرى للداخل عدة مرات على هيئة ثنيات. وتظهر هذه الثنيات اولا فى الجزء الخلفى من الكيس الصنوبرى ثم يتوالى ظهورها بعد ذلك فى الجزء الأمامى. تكبر هذه الثنيـــات بالتدريج نتيجة لزيادة عدد الخلايا المكونة لها وتسبب اضمحلال ثم اختفاء تجويف الكـــيس الصنوبرى الذى يتحول الى جسم مصمت يسمى الغدة الصنوبرية وذلك عند الولادة.

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PRE-NATAL DEVELOPMENT OF THE PINEAL GLAND OF ALBINO RAT

(With 12 Figures).

By

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SUMMARY

The pre-natal development of the pineal gland of albino rats was studied. In 131/2 days old-embryo, the pineal gland appeared as an evagination from the floor of the third ventricle. In 161/2 days old-embryo, the dorsal wall of the pineal pouch began to be infolded. In 181/2 days old-embryo, the cavity of the pineal pouch started to obliterate. The Obliteration began at the caudal part of the pineal pouch and advanced rostrally. It completed at birth and was achieved by infolding of the dorsal wall and thickening of the pineal epithelium.

The pineal epithelium gave rise to the parenchyma of the gland while the mesenchymal tissue derived from the pia mater gave rise to the stroma.

Histological and histochemical studies carried out on the pineal gland.

INTRODUCTION

Extensive biochemical, physiological and pharmacological studies have been carried out on the pineal gland. However a few reports on its embryonic devbelopment could be obtained. Of these, KAPPERS (1960) and CLABOUGH (1973) stressed principally on the innervation of the gland. Calvo and Boya (1981 a & b) also, described the morphogenesis of the pineal gland.

The present work was done to obtain a detailed information about the morphogenesisand histogenesis of the pineal gland in the albino rat.

MATERIAL and METHODS

Vaginal smear method was adopted to determine the date of pregnancy (SALEH, 1975). The embryos were extracted from the pregnant rats at the ages of 131/2, 141/2, 151/2, 161/2, 171/2, 181/2, 191/2, and 201/2 days and at birth. Their brains were extracted and fixed in Bouin's fluid for 24 hours.

After routine histological processing, the specimens were embedded in paraffin and serial coronal sections were cut at 10 m. Harris's haematoxylin and eosin, Einerson's Galloecyanine, PAS and Bromophenol blue stains were used (DRURY et al., 1967).

RESULTS

In 131/2 days old embryos, the pineal gland appears as an evagination from the roof of the third ventricle just caudal to the level of the interventricular foramen (Fig. 1).

At the 141/2 day of foetal life, the pineal gland is similar to that of the previous stage except that its beging is more caudal in level. The wall of the pouch is thicker than that of the previous stage (Fig. 2).

In 151/2 days old-embryos, the wall of the pineal pouch is further increased in thickness. The pineal epithelium is arranged in cords. Many mitotic figures are present (Fig. 3). The nuclei of the pineal epithelium are rounded and have more than one nucleolus. The boundaries of the cells are not clearly distinct. The pia matter at the roof of the pineal pouch consisted of one simple celled-layer (Fig. 3).

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At the 161/2 day of intrauterine life, the dorsal wall of the pineal pouch projects ventrally into its cavity (Fig. 4). The pineal epithelium is still arranged in cords (Fig. 5). The cells of these cords are mostly rounded with spherical nuclei. Some flattened cells with ovoid nuclei also observed. A condensation of measenchymal cells is present at the site of infolding (Fig. 4).

In 181/2 days old embryos, the pineal pouch is still communicating rostrally with the cavity of the third ventricle. The dorsal wall of the pineal pouch shows many folds projecting into its cavity (Fig. 6). As they are traced caudally, these folds become more numerous (Fig. 7). The pineal epithelium appears as clusters of cells, each have a central lumen (Fig. 8). The cells of these clusters are large with clearly distinct rounded nuclei and nucleoli. Several mitotic figures are observed among the pineal epithelium. Very few flattened cells are also observed.

The mesenchyme condensed on the roof of the pouch gives extensions into the folds (Figs. 6 & 7).

In 191/2 days old-embryos, the rostral part of the pineal pouch demonstrates folds. However, at the caudal part of the pineal pouch, the folds are tremendous transforming this region into a cellular mass, containing many spaces (Fig. 9). This cellular mass is composed of clusters of cells. The lumena of these clusters become smaller than those of the previous stage. The caudal part of the gland has an obvious capsule that sends septa into the gland (Fig. 9).

In 201/2 days old-embryos, the most rostral part of the gland still contains a small recess communicating with the cavity of the third ventricle (Fig. 10). On the other hand the rest of the gland is transformed into a cellular mass, the central part of which is solid while the peripheral part still showing cluster formation. The lumena of these clusters are further reduced in size.

In newborn rat, the pineal gland appears as a solid cellular mass except at its rostral end where there is a minute cavity still communicating with the cavity of the third ventricle (Fig. 12).

Histochemical studies on the pineal gland of the albino rat

1- Polysaccharides:

At 151/2, 161/2, 181/2, 191/2, & 201/2 days of embryonic development, a negligible reaction with PAS was found within the pineal epithelium.

A moderate reaction with PAS was observed within the pineal epithelium of the newly born rats.

2- General proteins:

At 181/2 days of embryonic development, a moderate amount of proteins was noticed in the pineal epithelium.

At 201/2 days of embryonic development, an increasment in the amount of proteins was found in the pineal epithelium at the centre of the pineal gland (Fig. 14).

The density of proteins content was mild within the peripheral pineal epithelium of the newly born rats.

DISCUSSION

The present study shows that the primordium of the pineal gland makes its first appearance at 131/2 days of embryonic life. It appears in the form of a small evagination from the roof of the third ventricle. The same observation was obtained by CALVO and BOYA (1978), in chickens and CALVO and BOYA (1981) in rats. While HAMILTON and MOSSMAN (1972) found that the primordium appears in 11 mm human embryo.

The present work shows that, in 151/2 and 161/2 days old-embryos, the pineal epithelium becomes thicker due to proliferation of its cells as proved by the presence of mitotic figures. The pineal epithelium is less differentiated and is arranged in cords.

The present work proved that infolding of the roof of the pineal pouch begins at 161/2 days of embryonic life but CALVO and BOYA (1981) mentioned, cited that infolding begins at 17 days of prenatal life in rats. In chickens, on the other hand, cellular mammiliform projections are formed at 5 days in the anterior wall of the pouch (CALVO and BOYA, 1978). It is also noticed that condensation of mesenchymal cells occurs at the sites of infolding. These mesenchymal cells are derived from the pia matter that covers the roof of the pineal pouch. In 1974, Ham stated that these mesenchymal cells give rise to the stroma of the gland while the pineal epithelium gives rise to its parenchymal cells which are of two types pinealocytes and glial cells.

In 181/2 days old embryo, the dorsal wall of the pineal pouch is thickenned and its folds, projecting into the cavity of the pouch becomes smaller than that of the previous stage. These changes are more pronounced in the caudal part of the gland, its cavity becomes fragmented into small spaces. From what is mentioned before, it is concluded that obliteration of the cavity of the pineal pouch starts caudally and advances rostrally.

As infolding has occured from the dorsal wall of the pouch, it will give rise to the major part of the gland while the ventral wall shares for a small extent. The same results were obtained by CALVO and BOYA (1981) in rat. However, in chickens, the pineal gland is derived fundamentally from the rostral wall of the pouch while a small part is derived from the caudal wall (CALVO and BOYA, 1978).

The process of infolding of the dorsal wall of the pineal pouch was interpreted by CALVO and BOYA, in 1981, who offered two mechanisms. The first one is the mechanical dictation of the pineal growth by the neighbouring structures. But if such interpretation is correct, the process of infolding must affect both the dorsal and ventral walls of the pouch and not the dorsal wall as in the present work. The second mechanism which is the most acceptable, is the differential mitotic activity. According to this mechanism, areas of less proliferation would tend to inflod towards the cavity of the pouch.

In the present study, it is observed that obliteration of the cavity of the pineal pouch begins at the age of 161/2 days and continues until birth and is attributed mainly to infolding. CLABOUGH (1973), cited that in rat, obliteration starts at 18 days while CALVO and BOYA (1981) found that it begins at the age of 17 days. They reported that obliteration is partly due to infloding and partly due to occupation of the lumen by pinealocytes.

In 191/2 days old embryo, most of the pineal gland presents a compact appearance. Pineal recess is present in the rostral end of the gland. The pineal cells are arranged in clusters. Each cluster has a central lumen produced by fragmentation of the pouch cavity. KAPPERS (1960) and CLABOUGH (1973) described the appearance of these lumena in the rat pineal gland as new formation of follicles from the wall of the pineal pouch. CALVO and BOYA described the same mechanism in chickens pineal gland. The data obtained by the latter authors supported our findings that the minor cavities observed in the rat pineal gland are remnants of the pineal pouch.

This statementis based on the following findings:

1- The small cavities are found where the recess is previously located.
2- The first cavities observed are large and they evolve toward progressive fragmentation untill they disappear. If newformation of cavities existed, the inverse evolution would be observed.

In 201/2 days old-embryo, the pineal gland becomes a solid mass especially in the centre while minute cavities are observed in the periphery. The central part of the gland shows a high cell density. This may explain the large amount of proteins in the central part of the gland.

In newborn rat, the whole of the pineal gland becomes a solid mass.

Histochemical study proved the presence of a moderate amount of proteins in the pineal epithelium in 181/2 days old embryo. This may indicate that the pineal gland starts its function at this age.

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EXPLANATION OF FIGURES

Fig. (1): A coronal section in the pineal gland primordium of 131/2 days old-rat embryo. (Einarson's Gallocyanine X 100).

Fig. (2): Acoronal section in the pineal gland primordium of 141/2 days old-rat embryo. Notice that its wall is thicker than that of the previous age. (Einarson's Gallocyanine X 100).

Fig. (3): A coronal section in the pineal gland of 151/2 days old-rat embryo. Notice that the pineal epithelium is arranged in cords. Mitotic figures are present. (arrow). (Haematoxylin and Eosin X 400).

Fig. (4): A coronal section in the pineal gland of 161/2 days old-rat embryo, showing that the dorsal wall of the pouch is projecting ventrally. (Einarson's Gallocyanine X 100).

Fig. (5): A coronal section of the pineal gland of 161/2 days old-rat embryo showing that the pineal epithelium is still arranged in cords. Two types of cells are seen; rounded (single arrow) and flattened (double arrows). (Haematoxylin and Eosin X 400).

Fig. (6): A coronal section at the rostral part of the pineal gland of 181/2 days old-rat embryo showing folding of its dorsal wall. (Einarson's Gallocyanine X 100).

Fig. (7): A coronal section at the caudal part of the pineal gland of 181/2 days old-rat embryo showing that the folds are numerous and dividing the cavity of the gland into spaces. (Einarson's Gallocyanine X 100).

Fig. (8): A coronal section of the caudal part of the pineal gland of 181/2 days old-rat embryo showing the cluster arrangement of the pineal epithelium. (Haematoxylin and Eosin X 400).

Fig. (9): A coronal section of the caudal part of the pineal gland of 191/2 days old-rat embryo showing that the gland is transformed into a cellular mass with many spaces. (Einarson's Gallocyanine X 100).

Fig.(10): A coronal section at the most rostral part of the pineal gland of 201/2 days old-rat embryo. Notice that the cavity of the gland is reduced to a small recess (arrow). (Einarson's Gallocyanine X 400).

Fig.(11): A coronal section of the most rostral part of the pineal gland of a new born rat showing that the recess is still present. (Einarson's Gallocyanine X 100).

Fig.(12): A coronal section of the pineal gland of 201/2 days old-rat embryo. Notice that the central part is more stainable than the peripheral part. (Bromophenol Blue X 400).

PLATE I

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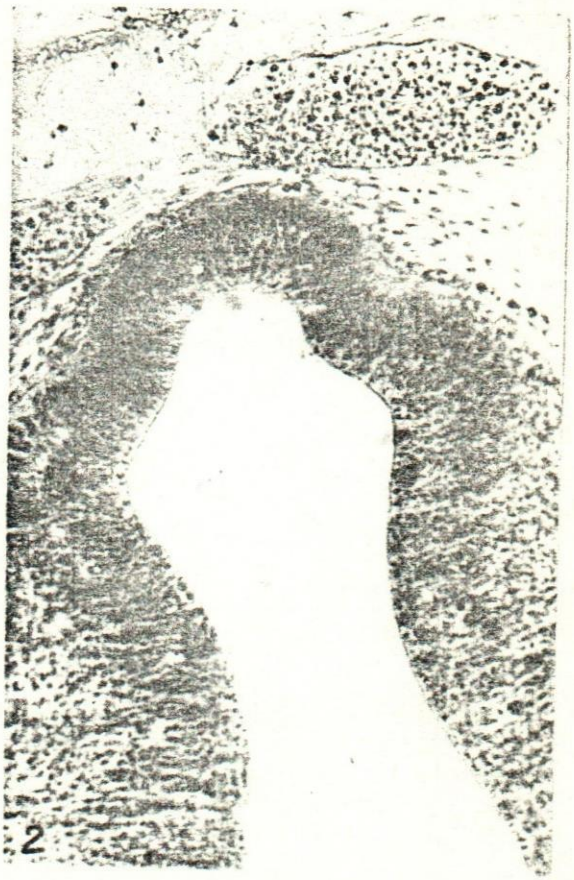

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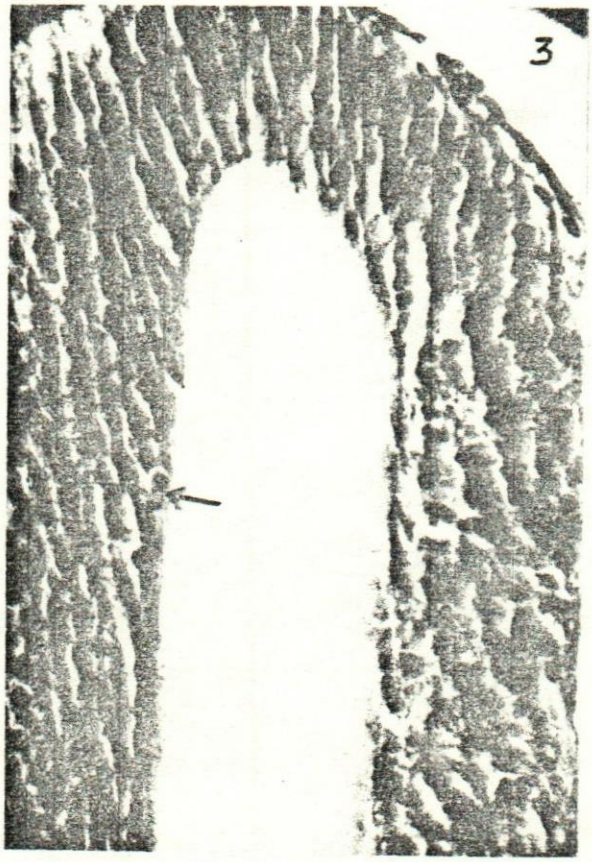

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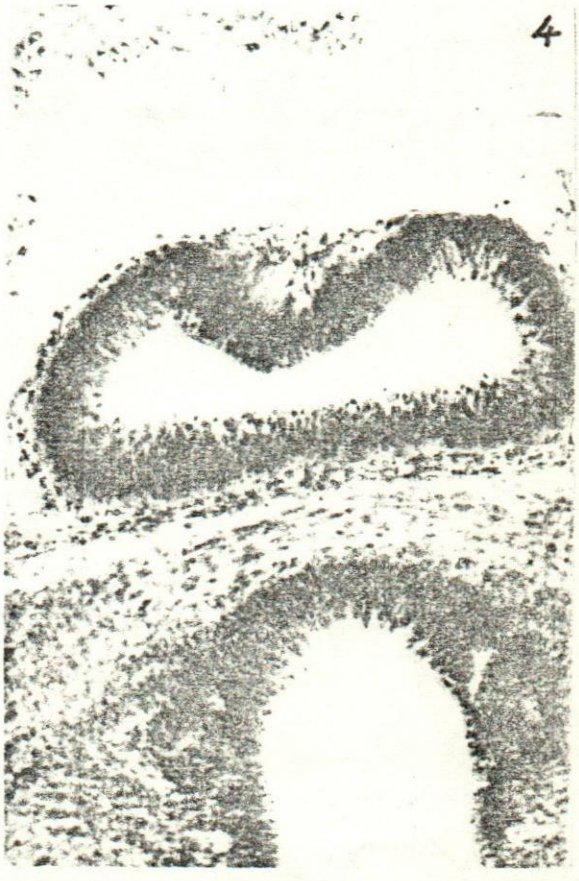

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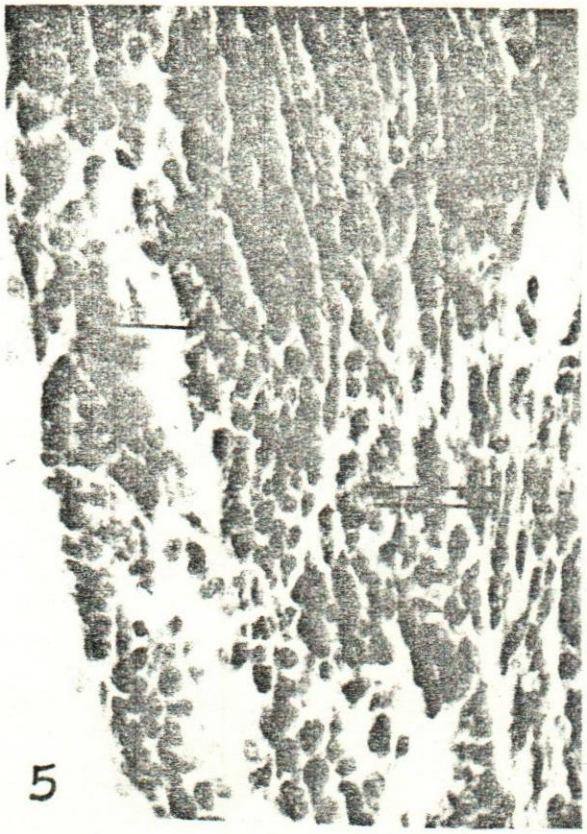
PLATE II



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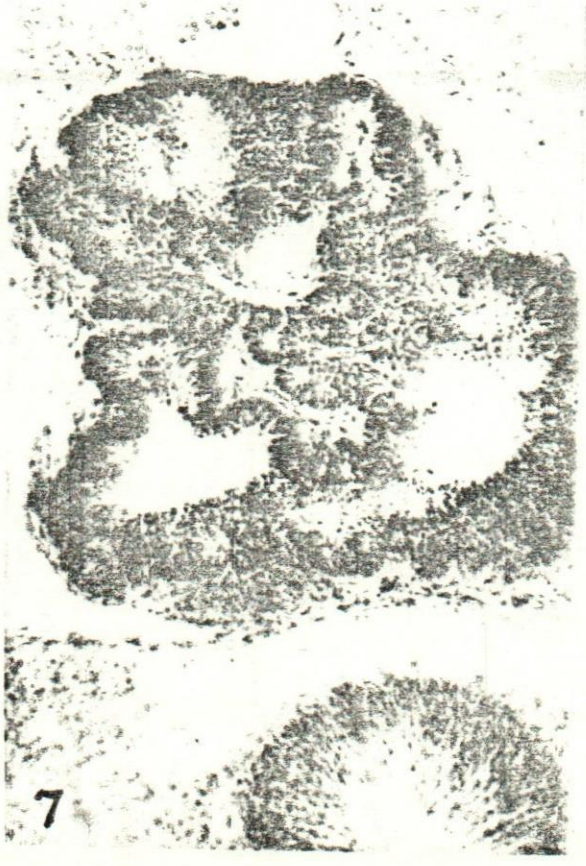

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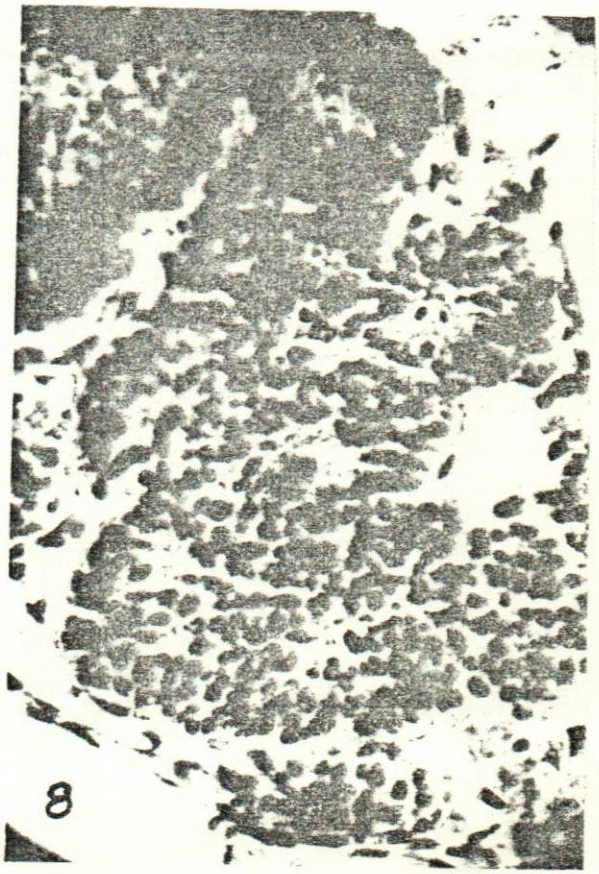

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PLATE III