Dept. of Anatomy,
Fac. Med., Assiut University,
Head of Dept. Prof. Dr. W.M. Matta.

PRENATAL DEVELOPMENT OF PINEAL GLAND IN BOUSCAT RABBIT (*Lepus Caniculus*)

(With 24 Figures)

By

M.A. GABR, SOAD S. ALI* and SANA A. MOHAMED*

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التطور الجنيني للغدة الصنوبرية في الأرنب الأبيض

محمد عبد الغني ، سعاد شاكر ، سناء عبد اللطيف

أجري هذا البحث بغرض دراسة التطور الجنيني للغدة الصنوبرية للأرانب (بوسكات) وذلك لمعرفة توقيت ظهورها ومراحل تطورها ومقارنتها بمثيلتها في حيوانات التجارب المعملية المعروفة . وقد أخذت العينات إبتداء من اليوم الثالث عشر واليوم الرابع عشر للحمل وتتابع ذلك كل يومين حتي الولادة . وتم فحص شرائح متتالية من كل عمر بعد صباغتها بصبغات خاصة لتوضيح الأنوية والسيتوبلازم والألياف والكربوهيدرات وأظهرت النتائج : يبدأ أول ظهور للغدة الصنوبرية في الأرنب في اليوم الرابع عشر للحمل علي شكل بروز خارجي من منتصف سطح تجويف البطين الثالث وتكون خلايا هذا البروز في البداية مماثلة لما حولها من الشكل ، ويزداد حجم هذه البروز في اليوم السادس عشر في الإتجاه الخلفي وإلي أعلي ، وفي اليوم الثامن عشر تبدأ بعض الخلايا في التميز وتصبح ذات أنوية مستديرة ولها نويات واضحة وتبدو متباعدة عن بعضها بالمقارنة بالأعمار السابقةوتتصل الغدة الصنوبرية بالبطين الثالث عن طريق إنضغاد التجويف من خلاياها يتميز بأنه منحل ومتسع . ومن اليوم العشرين وحتي الرابع والعشرين يحدث زيادة واضحة في حجم الغدة وتتميز لأجزائها وخلاياها ويستمر هذا حتي ميعاد الولادة ، وتتميز الغدة الصنوبرية في الأرنب حديث الولادة بما يأتي : يوجد إختلافات بسيطة في تركيب الغدة عما كانت عليه في أعمار ٢٤ ، ٢٦ ، ٢٨ ، ٣٠ قبل الولادة تتمثل في قلة عدد الخلايا المنقسمة وفي وصول الغدة إلي أقصي حجم لها وفي ظهور كثير من الأوعية الدموية علي السطح ، ووتتكون الغدة الصنوبرية من ثلاثة أجزاء واضحة وهي : جزء عميق ملاصق للبطين الثالث ولا يفصل بينهما سوي بطانة رقيقة تختفي أحيانا في بعض الأماكن مما يجعل خلايا الغدة علي إتصال مباشر بالسائل النخاعي وجزء سطحي يقع مباشرة تحت غطاء الجمجمة العلوي في ملتقي تجمعات الأوردة وربما يلتصق بها وجزء سميك نفس تكوين الجزئين السابقين ويربط بينها ويأخذ مسار ملتوي غير منتظم بين الجزئين ، وتتركب الغدة الصنوبرية أساسا من نسيج ضام من الألياف الشبيكية بالإضافة إلي خلايا تتميز من عمر ٢٤ قبل الولادة إلي نوعين : نوع أساسي وهو يمثل الغالبية ويتميز بتعدد أشكال الأنوية وإحتوائها علي نويات واضحة ولكن حدود الخلايا لا يمكن تميزها بسهولة بالبقع المستعملة وتتميز هذه الخلايا بكثرة وجودها علي شكل وردات او حويصلات وأما الأقلية من الخلايا فلها أنوية داكنة وتتمثل الخلايا الرابطة هذا بجانب خلايا النسيج الضام والخلايا المبطنة للشعيرات الدموية ، كذلك كثرة الأوعية الدموية المحيطة بالغدة الصنوبرية من كل جانب مع تعرض جزء كبير منها إلي السائل النخاعي .

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* : Dept. of Histology, Faculty of Medicine, Assiut University.

SUMMARY

The development of pineal organ in fetal and newborn Boscat rabbit was studied by examination of serial histologic sections. The sections were stained with Gallocyanin, H & E, iron Hx, van Gieson, orcein, silver impregnation for reticular fibers and PAS. It was found that, the first pineal anlage appeared in 14 days-old embryo as a midline evagination of the roof of the third ventricle. The pineal analge increased rapidly in size. The neuro-epithelium bordering the evagination underwent mitosis and gaves rise to pinealocytes and glial cells. Differentiation into these two types started to present at 22 days and can be distinguished in 24 days embryo. The growth increased rapidly in size and acquired a compact appearance. Its connection with the third ventricle was shallow and short and known as pineal recess. So, a large surface area of the pineal at this site was exposed to the ventricular CSF. From 24 days of gestation, differenitiation of the pineal into three parts was evident. The organ possessed 3 parts; (1) a superfacial or distal part, located in the vicinity of confluens sinuses, with its floor sharing in the formation of pinal dorsal capsule (2) a deep or proximal part of considerable size with an intimate relation to the third ventricle via the shallow pineal recess and the long suprapineal recess lined with highly convoluted choroid plexus (3) a thick voluminous stlak connecting the deep and superfacial part. Histologically, the pineal was formed of stroma derived from meningeal mesanchyma. The only connective tissue fibers that could be detected were the reticular fibers. These were PAS positive. The parenchyma was formed mainly of pinealocytes with pleomorphic vesicular nuclei, and in Bouscat embryos showed characterestic ro sette-shaped arrangment. Glial cells were few, and evenly distributed throughout the organ. The organ was characterestically surrounded by abundant vascular channels, the great cereberal, vein, the transverse sinuses, and the confluens sinuses. The functional significance of the relationship of the organ and nearby structures are discussed.

INTRODUCTION

The pineal gland in mammals hasa a long and interesting evolution during which it shows which it shows a striking transformation in structure, function and innervation (KAPPERS, 1960). In most species, the pineal can be considered as indirectly sensory neuro-endocrine organ. This organ shows considerable embryological, anatomical and morphological diversity that have intimate relationship to its function in each specie (QUAY, 1970; SHERIDAN & REITER, 1970; QUAY, 1981 and MOHAMED, 1988).

Most published researches dealing with embryonic development are carried on laboratory animals particularily rats (CLABOUGH, 1973; CALVO & BOYA, 1981 a,b and SALEH et al., 1984). The age at which pineal analge appears, the age of cellular

differentiation and the pattern of cellular arrangment exhibit great variations among different mammals (SHERIDAN & REITER, 1970 and QUAY, 1980, 1981). Also, there is marked species variations in the relationship of the pineal gland to the surrounding strucutres. In fact, the prenatal development of the pineal is not sufficiently covered in Bouscat rabbit.

Therefore, the present work was carried out in order to investigate the morphogenesis and histogenesis of this organ in fetal Bouscat rabbits.

MATERIAL and METHODS

This project was done on Bouscat rabbits (Lepus Caniculus). The adult animals were maintained under normal conditions and were adequately fed with a sufficient diet (SONDFORD, 1979). The onset of pregnancy was considered to be the day at which mating occured (MuCONALLED, 1977). A total number of 45 rabbit embryos was used. They were divided into 9 groups, each consisting of 5 embryos, taken at the ages of 13,14,16,18,20,22,24,26,28 and 30 (newborn) days of gestation. The mothers were lightly anaesthetised with diethyl ether, eviscerated and the embryos were removed and kept in neurral formaline. The embryos were decapitated and the heads of large embryos (16,18,20,22,24,26,28 and 30 days) were decaficified using neural ethylene diamine tetra acetic acid (EDTA). The brains were removed, dehydrated in ascending grades of alcohol, cleard in methyl benzoate, then impregnated in paraffin wax. Serial coronal sections were done for all brains used in this project. In addition, serial sagital sections were done for that of the newly born rabbits (day 30). sectioning was done at 7-10 Um.

The sections were stained with the following stains :

A) Einarsons Gallocyanine method.
B) Haematoxylin and Eosin.
C) Iron Haematoxylin.
D) Silver impregnation.
E) Van Gieson.
F) Orcein.
G) P.A.S. stain (periodic acid schiff method.). (DRURY and WALLINGTON, 1980).

RESULTS

The anlage of Bouscat rabbits pineal gland presented itself at the 14th day of gestation. The pineal appeared as a short shallow midline evagination of the roof of the third ventricle (Fig. 1). The evagination was deeper at a rostral direction (Fig.2). It was noticed that the epithelium forming the pineal anlage was similar to the nearby neuroepithelium bordering the third ventricle Few Periluminal mitotic figures are observed (Fig.2) Undiffereniated mesenchymal tissue and thin walled blood vessels, filled with nucleated RBCs were seen over the dorsal part of the anlage (Fig. 2). At 16 days of embryonic life, the rabbit pineal anlage showed an increment in cell mass (Fig.3). The cells became less crowded than at the previous age and their nuclei were rounded and vesicular, with promient nuceoli. Mitotic figures were evident in the vicinity of the third ventricle (Fig. 4).

From 18 days of embryonic life onwards, the pineal growth increased rapidly in volume. The evagination of the third ventricle into the pineal tissue became shallow or less apparent and, in some specimens, the growth appeared caudal to the third ventricle without any apparent connection (Fig. 5). Meningeal stromal tissue became more differentiated and blood vesels started to invade the pineal growth (Fig.4). Pineals taken from 20 and 22 days embryos showed quantitative rather than qualitative changes.

At the 24th day embryonic life, the pineal growth attained a considerable size, after which it grew at a solwer rate. Abundant pineal tissue could be traced in coronal sections from the vicinity of the third ventricle to the level of confluens sinuses (Fig. 6-9). The pineal was consisted of two components; a superfacial distal part lying caudally and attached firmly to the floor of the confluens sinuses (Fig. 9), and a considerably large deep part having intimate relationship to the third ventricle and the transverse sinuses (Fig. 6). The two components were connected together by a voluminous pineal stalk.

Figures 6-9, showed the relationships between the pineal parts and the surrounding vascular channels (Transverse sinuses, great cerebral vein and confluens sinuses).

A marked stromal and parenchymatous differentiations were observed. The stroma was mainly formed of reticular fibers (Fig. 10) which were more abundant in the dorsal part, forming the floor of the confluens sinuses. Collagenic and elastic fibers were hardly observed by the use of specific stains.

The parenchyma of both superfacial (Fig. 11) and deep pineals (Fig. 12)showed compact appearance. Cavities could not be observed within the pineals. The parenchymatous cells had indistinct cell boundaries. However, their nuclei showed pleomorphism being rounded to oval in shape. Rossette shape arrangments or elongated circular arrays were characteristic features at that age. Interstitial mitosis was evident both in superfacial and deep pineals. The flat nuclei observed were most probably related to vascular endothelium or connective tissue fibroblasts (Fig. 11, 12).

Dorsal to the deep parts of the pineal, there was the dorsal sac (supra pineal recess) constituting an extension from the third ventricle. It is lined by cuboidal epithelium (Fig. 12).

Pineals obtained from 26, 28 and 30 days Bouscat rabbit embryos did not show great differences from that obtained from 24 days embryo, apart from a slight increase in size, and more differentiation of parenchymatous cells evident by pleomorphism. The parenchyma appeared to consist primarily of pinealocytes with vesicular nuclei and a very few dispersed glial cells with deeply stained nuclei (Fig. 14). Rosette shape formations were still present, with interstitial mitosis (Fig. 15). Fig. 16, shows three small parts of pineal tissue near the main one in a section taken just caudal to that of Fig. (15). Most probably these represent parts of the ragged irregular surface of the proximal pineal and its stalk.

The pineal Gland of the Newly Borns :

Serial sagittal sections of the newly born Bouscat rabbits pineal region showed that the pineal organ has unique considerable size, with a distinct deep part, in intimate relation to the posterior commissure, habenular commissure and the third ventricle, and a distal superfacial part reaching to the vicinity of confluens sinuses (Fig.18). The two components were connected by a characterstic continuous voluminous ragged irregular pineal stalk. The stalk had a sinuous irregular course (Fig. 17), and this explained what have been described previously in (Fig. 16). The superfacial or distal part was similar in structure to what was previously described in 24 and 26 days-old embryo. It was evident that it still possessed the abundant rossette-shape formations especially in the ventral parts and the interstitial mitotic activity (Fig. 19). Pineal capillaries were collapsed and hardly visualized in H & E stained sections.

The proximal part of deep pineal is of considerable size, it lies between the habenular and posterior commissures and in contact with a flat pineal recess (Fig.20). Aneriorly, the deep pineal was separated from the cavity of the third ventricle by the ependymal lining (Fig. 20). The ependyma seemed to be deficient in certain parts, thus some pinealocytes came in contact with the C.S.F. of the ventricular cavity.

Above the habenular commissure and part of the pineal stalk, there is the suprapinal recess; an ependymal dorsal evagination of the third ventricle, it had a highly convoluted choroid plexus (Fig. 17), but could not be observed directly aputting the pineal tissue.

The pineal stalk in Bouscat rabbit, was formed of pineal tissue similar to that described in both superfacial and deep parts. Regarding stromal elements, silver impregnation showed predominance of reticular fibers in the capsule and peripheral septa of both superfacial, deep and intermediate (stalk) components of rabbit pineal organ (Fig. 21, 22). No collagen fibers could be demonstrted by the use of Van Gieson stain (Fig. 23).

On the other hand, PAS stain revealed high positive reaction in C.T. of pineal capsules, around blood vessels and in the basement membrane of numerous blood capillaries which were well visulized by PAS technique (Fig. 24).

DISCUSSION

The present investigation revealed that in Bouscat rabbit embryos the pineal primordium appeared at the age of 14 days postcoupling, as an evagination of the diencephalic roof and this simulated what was reported by KAPPERS (1960); CLABOUGH (1973); CALVO & BOYA (1981); SHERIDAN & ROLLING (1983) and SALEH et al. (1984) in rats and hamsters. However, there is great variations in the time of appearance of the first pineal analge or primordium (QUAY, 1974 and ALTAR, 1982). It is difficult to compare the results between species because of the species dependent length of the gestational period which is related to body size. Therefore, in hamsters, pineal

development occurs during the last 5 days of gestation (11-16th day) (SHERIDIAN and ROLLING, 1983); in rats during the last eight days (KAPPERS, 1990; CALVO & BOYA, 1981 a,b and SALEH et al., 1984), while in man, the initial pineal anlage appears at the 33rd postobulatory day (O'RAHILLY, 1968).

In agreement with reviewed literature the development and differentiation of pineal anlage occured first by periluminal mitosis and later by interstitial (within the pineal) mitotic activity. Mitotic figures were described in Fetal pineal of many species and results in development of the organ. QUAY and LEVINE (1957) could detect mitotic activity in rats pineal at birth and pointed that this activity showed a decrease in post natal life. However, QUAY and RENZONI (1966) described some mitotic activity in adult rats pineal. BARGMANN (1943) give comments on mitotic activity in the pineal of a four week-old dog indicating the postnatal mitotic activity.

The present results revealed that rapid growth of pineal anlage occured after 18 days of development till 24 days then the pineal grew at a slower rate. During this period, important changes took place in the configuration of the pineal anlage. The pineal showed compact appearance with differentiation into distinct three parts; the deep or proximal pineal in the vicinity of the third ventricle; the superfacial or distal pineal in the vicinity of confluens sinuses and the connecting intermediate voluminous pineal stalk.

The extension of the third ventricle into the pineal tissue is called the pineal recess which was relatively shallow and not deep in Bouscat rabbit embryos. This relationship showed great species variations and seemed to depend upon the location of the pineal, the presence or abscence of a deep component (QUAY, 1970; 1974; SHERIDAN & REITER, 1970; BECKMANN, 1980; QUAY, 1981 and CALVO & BOYA, 1981 a).

The presence of both deep and superfacial pineal also showed great species differences. The presence of the deep pineal have not been mentioned neither in rats (SALEH, 1984) nor in the rabbits (MOHAMED, 1988). On the other hand, the two components were described in hamsters by SHERIDAN and REITER (1970) and in rats by CLABOUGH (1973) and BOECKMANN (1980).

Also, a complex pineal structure had been described in gerbils (GREGOREK et al., 1977 and WELSH, 1986). A deep component was also described in the pineal of chinese hamsters, Kangaroo rats (GREGORKE et al., 1977) and in white footed mice (QUAY, 1956).

The present results revealed that there was an evagination of the choroid plexus of the third ventricle, contiguous with the dorsal side of the proximal pineal, dorsal to the habenular commissure. Also, at this site and in the region of shallow pineal recess the deep pineal parenchymatous cells became exposed to the CSF in the third ventricle where the ependymal lining was deficient. The close juxta position of the deep pineal to the third ventricle in the present study and that described in other species (HEWING, 1978 and 1980, 1982) offer insights into the question of

potential routes of pineal secretion into the CSF, via which secretory substances would easily be transported to be the hypothalamus which is regarded as the main target organ for the pineal substances (VOLLRATH, 1981).

Another suggestion is given by HEWING (1978) that pinealocytes directly exposed to CSF possibly act as sensor for various chemicals in the CSF, which is known to contain a considerable number of biologically active substances.

A surprising finding in the present study was the extensive exposure of the pineal surfaces to blood vessels from all sides and this suggests, another chief route for the release of pineal substances into blood that drains into confluens sinuses. The presence of scattered and variable distribution of small arterioles over the pineal connective tissue capsule appeared to be the general rule for mammals (QUAY, 1965) and as in other species, these arterioles do not extend far within the organ but rapidly divide into a capillary or sinusoidal plexus that was best demonstrated in the sections from newlyborn pineals stained with PAS. It was observed that vascular variability in the pineal region as well as the anatomical relations of the large veins and sinuses formed a point of differences that characterise the pineal in different kinds of mammals (VON BARTHEL and MOLL, 1954 and QUAY, 1974).

In comparison with known and figured pineals of other species, the pineal stalk in newly born bouscat rabbits had unique characterestic size connecting the deep and superfacial components. In rabbits the pineal stalk is formed mainly of paranchymatous cells. However, the size, course, continuity and structure of the stalk shwoed interspecies differences (SHERIDAN & REITER, 1970; QUAY, 1970 and BOECKMANN, 1980).

The migration and presence of a superfacial pineal in the vicinity of the confluens sinuese just under the vault of the skull poses the question as to the functional significance of such location. QUAY (1965) speculated that: (i) early meningeal attachment of the pineal anlage lead to its dorsal position and this what was found in the present work where the floor of the confluence sinuses form the dorsal capsule of the pineal organ. (ii) the more superfacial position may have had adaptive significance in reception of light. (iii) a dorso posterior migration of the pineal may have occured along the path of primary innervation the nervi conarri. The last two points needs more study in Bouscat rabbit.

Histological study of Bouscat rabbits pineal during development and in newly born, revealed that the stromal elements of the gland was derived from embryonic meningeal mesenchyme, while the neuroepithelium of the primary anlage gave rise to parenchymatous elements. Stromal elements could be demonstrated at 22 days agedembryo and were well formed in 24 days embryo pineal. It was observed that reticular fibers formed the main components of connective tissue fibers, while both collagenous and elastic fibers were hardly detected by routine specific stains. similar presence and distribution of reticular fibers were described by CALVO & BOYA (1981a) and SALEH et al. (1984) in rats pineal. The reticular fibers appeared to be PAS positive.

The pineal parenchymatous cells were differentiated from the neuro epithelium of pineal primordium and this in rabbits seemed to start at 18 days old embryos and reached its maximum at birth. Most studies overcome the ages at which the cells were differentiated or become most active metabolically.

QUAY (1974) reported a number of studies of developmental changes in pineal biochemistry and metabolism that indicated that specific activities of pinealocytes were low or not notable unitll few days or weeks after birth.

However, it was evident from the present study that certain degrees of structural differentiation of parenchymal cells of the pineal mainfested itself, in 24 days embryo, in the form of an increase in cell density and pleomorphism of the parenchymatous cell nuclei. The majority of them were vesicular, rounded or oval in shape with prominent nuceoli representing the nuclei of pinealocytes. The rest were few and have deeply stained appearance and form the glial cell nuclei.

Most authors, working in the field of pineal, reported that cytoplasmic, nuclear and nucleolar hypertrophy, combined with nuclear foldings and pleomorphism, of pinealocytes were mammalian pineal cytological features suggestive of full differentiation and activity. However, accurate data needs quantitative and more corelative studies of pinealocyte cytology, differentiation and metabolism.

Classification of pinealocytes into type I, II nd III or dark and light cells as mentioned in adult pineal gland (ROMIJN, 1973 and MOHAMED, 1984) was out of the scope of the present work.

However, the illdefined lobulation of pinealocytes and their arrangment in Rosette shape or circular arrays formations were also described in fetal rat pineal by CALVO and BOYA (1981 a,b) and SALEH et al. (1984). Such arrangment were not described in adult rabbit pineal (oryctolagus caniculus) (MOHAMED, 1984). This could be due to age or species difference. Instead, he described the division of the gland intocortex and medulla with different pattern of cellular arrangment and density.

Although, the pineal gland is slightly darker than brain tissue in newborn Bouscat rabbits, no evidence of pigment or pigmented cells could be observed within the parenchyma.

In conclusion, this study revealed the following data:

1- Bouscat rabbits pineal is a median dorsal intracrainal organ dervied as an evagination from the root of the third ventricle.
2- In comparison to rodent pineal, no infolding of the evagination occurs, so intrapineal cvities were not observed in the course of development.
3- Prolifertion and mitotic activity of pineal parenchymatous cells were observed throughout the embryonic life as well as in the newly born pineal.
4- The pineal organ in rabbits is unique in having large, size and consists of three parts: a superfacial or distal part in intimate relation to confluens

sinuses, a deep or proximal part located between posterior and habenular commissures coming in contact with the third ventricle and an intermediate voluminous connecting pineal stalk.

The large size of pineal organ in Bouscat rabbits may have functional importance that needs extensive studies. The pineal has been shown in several species to be involved in neuroendocrine transduction contributing to timing and phase tuning of biological rhythm's including those affecting annual or seasonal timing of reproductive activity (QUAY, 1980).

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LEGENDS

Figs. 1-5: Coronal sections of the brain of rabbit embryos.

Fig. 1: On the 14th day, showing the pineal evagination (arrow) in the diencephalic roof, P.C. (posterior commisure), VIII (cavity of third ventricle). [Gallocyanin X 125].

Fig. 2: On the 14th day at a more caudal level demonstrating mitotic figure (arrow). B.V. (blood vessels). [Gallocyanin X 200].

Fig. 3: On the 16th day at rostral level, showing thickning of the pineal anlage. [Gallocyanin X 200].

Fig. 4: On the 16th day, showing deep evagintio and periluminal mitotic figures (arrows). [Gallocyanin X 400].

Fig. 5: On the 18th day, at rostral level, showing almost separated pineal mass from the wall of the third ventricle. Blood vessels (arrows) penetrating pineal mass can also be seen. CT (connective tissue). [Gallocyanin X 200].

Figs. 6-9: series of coronal sections of pineal of 24 days old rabbit embryo, following its begining in contact with the 3rd ventricle (V) to its distal part in relation to confluens sinuses.

Fig. 6: Demonstrates the deep pineal (DP) with the transverse sinuses (TS) at each side of its lower border. [Gallocyanin X 125].

Fig. 7: Shows the meeting of the transverse sinuses at caudal levels. CS (confluence sinuses), PC (Posterior commisure), SCO (subcommisure organ). [Gallocyanin X 200].

Fig. 8: Shows a large part of the superficial pineal (SP). Note the presence of the great cerebral vein (arrow) under the transverse sinuses. [Gallocyanin X 200].

Fig. 9: Superficial pineal (SP) is firmly attached to the floor of confluence sinuses (*). Note the opening of the great cerebral vein (arrow) to the transverse sinuses in their way to drain in superior sagittal, then confluens sinuses. [Gallocyanin X 200].

Fig. 10: Coronal section of the pineal of 24 days old embryo. It shows the presence of reticular fibers (RF) in the capsule (dorsally) and in the connective tissue septa. [Silver stain X 250].

Fig. 11: The superficial pineal of 24 days old rabbit embryo. Note the compact appearance of the cells, with numerous rosete shape formations, and interstitial mitosis (arrow). Blood vesseles (BV) can be seen entering from the dorsal surface of the gland. [H & E X 320].

Fig. 12: The deep pineal of 24 days-old rabbit embryo. Note the compact appearance of the cells. The suprapineal recess (*) is lined with cuboidal epithelium TS (transverse sinus), PC (Posterior commisure). [Gallocyanin X 320].

Fig. 13: Coronal section of pineal of 24 day old rabbit embryo, rostral to the previous section, showing a very small part of the pineal tissue (arrows). SHR (suprahabenular recess, V(third ventricle), HC (habeaular commisure). [Gallocyanin X 320].

Fig. 14: Coronal section of superficial pineal of 26 days old rabbit embryo, demonstrating the different types of parenchymatous cells. Pinealocytes (P) having vesicular nuclei, whereas glial cells (G) having deeply stained nuclei. Presence of numerous pineal blood vessels (BV) and interstitial mitosis (arrow head) can be observed. [H & E X 320].

Fig. 15: Deep pineal of 26 days old rabbit embryo, showing rosette shape formations (*) of the cells.Interstitial mitosis can also be noticed (arrow), V (third ventricle). [H & E X 320].

Fig. 16: Coronal section of 26 days old rabbit embryo, slightly caudal to thethird ventricle (V). A thick part of the pineal stalk (St) which connects the superficial and deep pineal can be observed. Three small parts of pineal tissue (arrow) representing parts of the irregular sinuous pineal stalk. Posterior commisure (PC) lies caudal to the third ventricle. The suprapineal recess (SPR) is lined by cuboidal epithelium, and lies dorsal to the pineal stalk. [H & E X 200].

Fig. 17: The pineal of newly born Bouscat rabbit. Note the irregular outline which explains the findings of the previous figure. SC (superior colliculus), SPR (suprapineal recess), V (third ventricle Ch P (Choroid plexus). [Iron Hx X 400].

Figs. 18-24: The pineal of newly born Bouscat rabbit.

Fig. 18: Demonstrates the voluminous pineal tissue forming the deep pineal (1), pineal stalk (2) and the superficial pineal (3), SC (swperior colliculus), SPR (suprapineal recess), PC (Posterior commisure), HC (habenular commisure). [Iron Hx X 400].

Fig. 19: The superficial pineal. showing a compact arrangement of parenchymal cells, with follicular arrangement (*). Note the presence of interstitial mitois (arrow head). [H & E X 320].

Fig. 20: The deep pineal region. Note that the ependymal lining is defecient along some parts of the pineal tissue (arrows) making some cells to be in direct contact with C.S.F. in the third ventricle (V). [Iron Hx X 320].

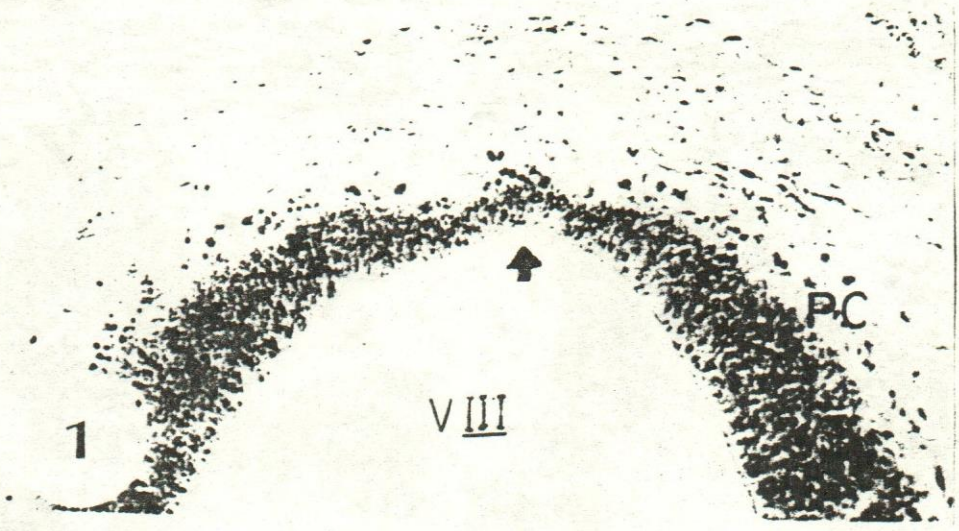
Fig. 21: Part of the superficial pineal showing presence of abundant reticular fibers within the dorsal region o the gland, particularly around the blood vessels. CS (confluens sinceses). [Silver impregnation X 400].

Fig. 22: Part of a deep pineal and pineal stalk demonstrating the presence of reticular fibers in the capsule and a arround the pineal blood vesseles.

Fig. 23: The superficial pineal Note the paucity of collagen fibers. [Van Gieson X 250].

Fig. 24: The superficial pineal demonstrating the highly positive PAS reaction in the connective tissue fibers of the capsule, walls of the blood vessels and basement membrane of pineal blood capillaries. [PAS X 200].

PINEAL GLAND, RABBIT



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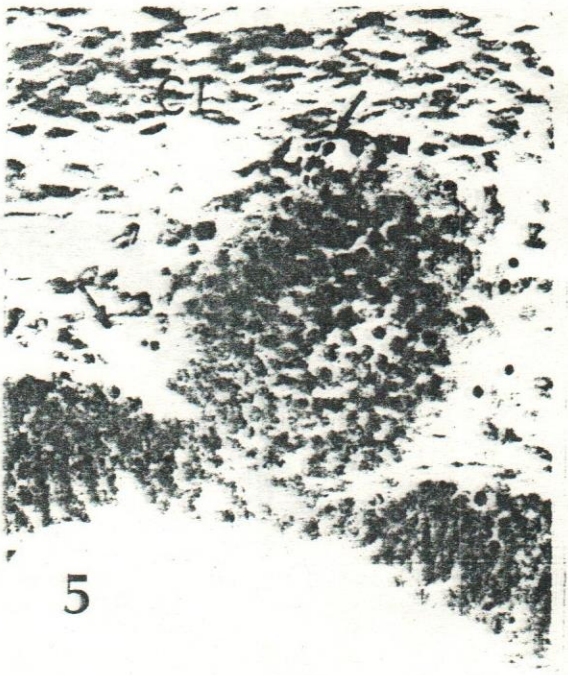

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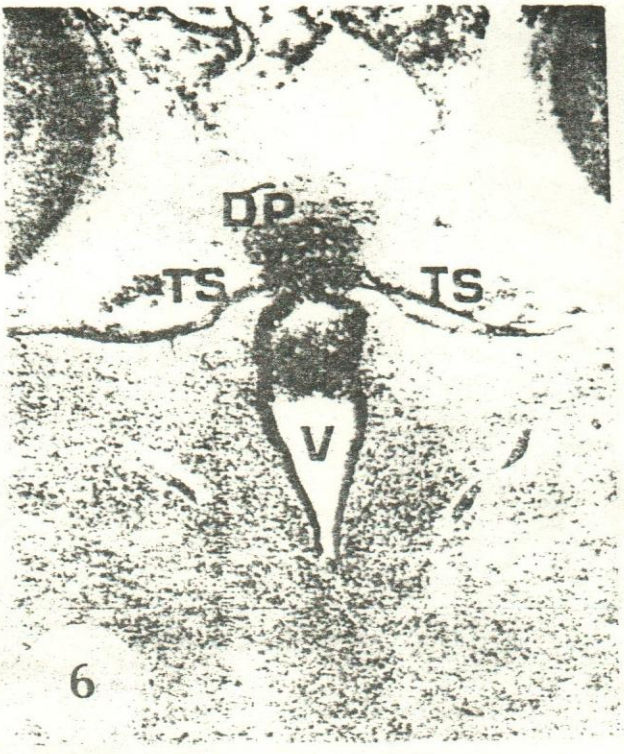
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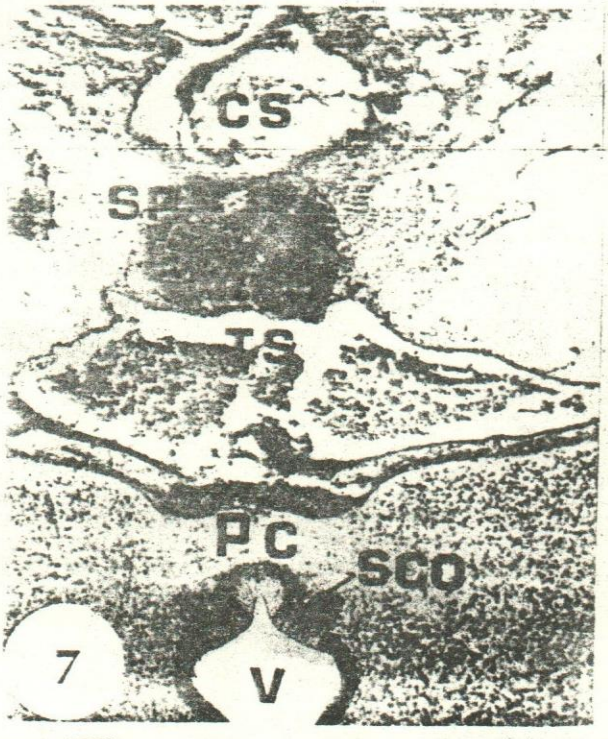
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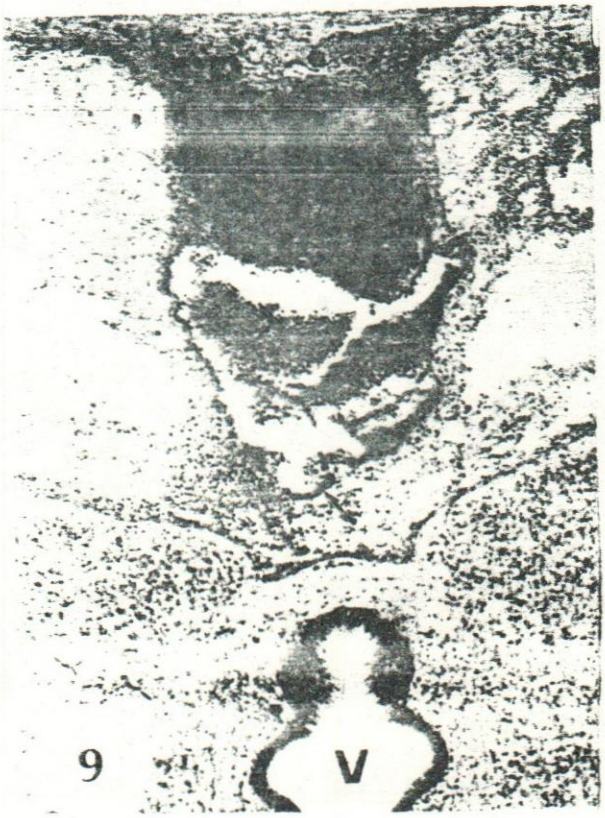

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PINEAL GLAND, RABBIT

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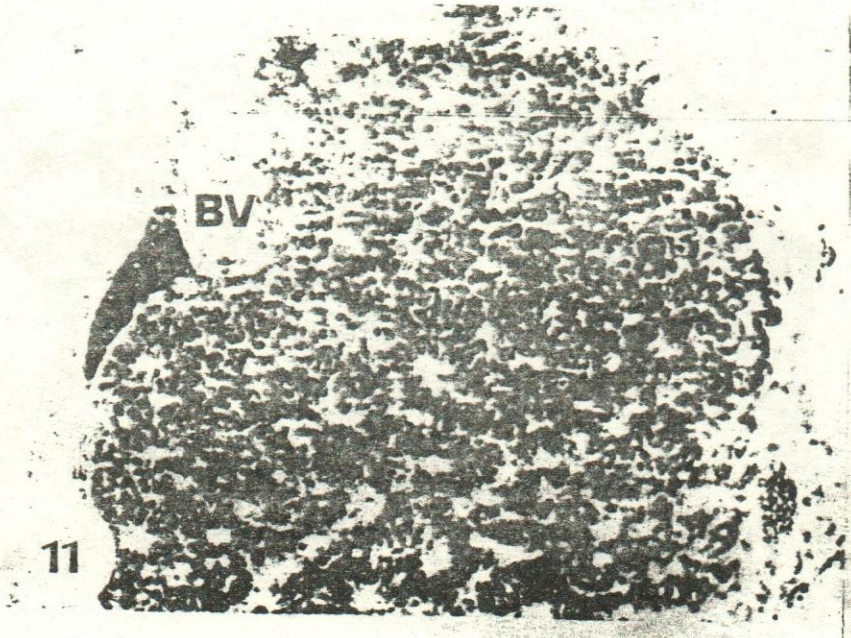

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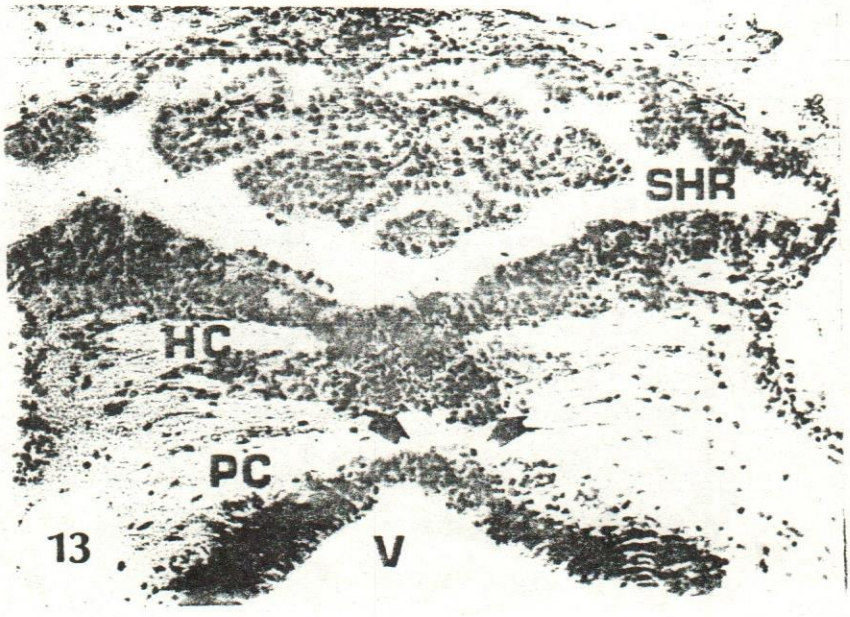
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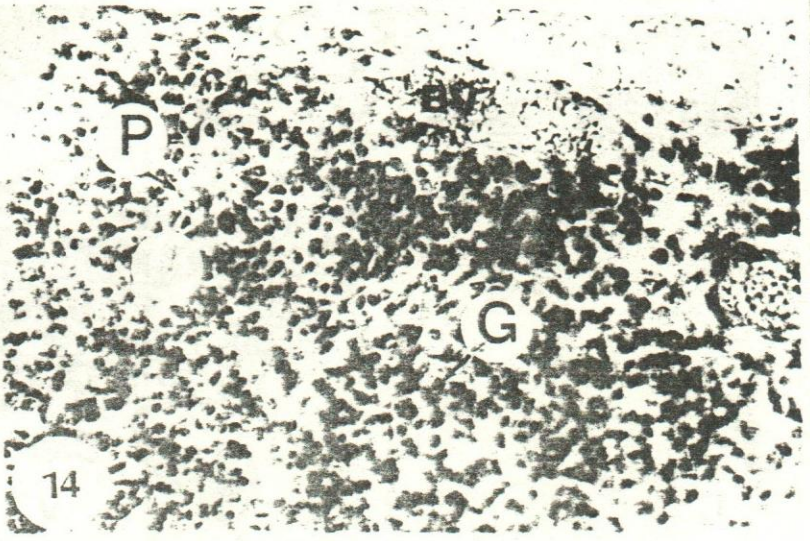

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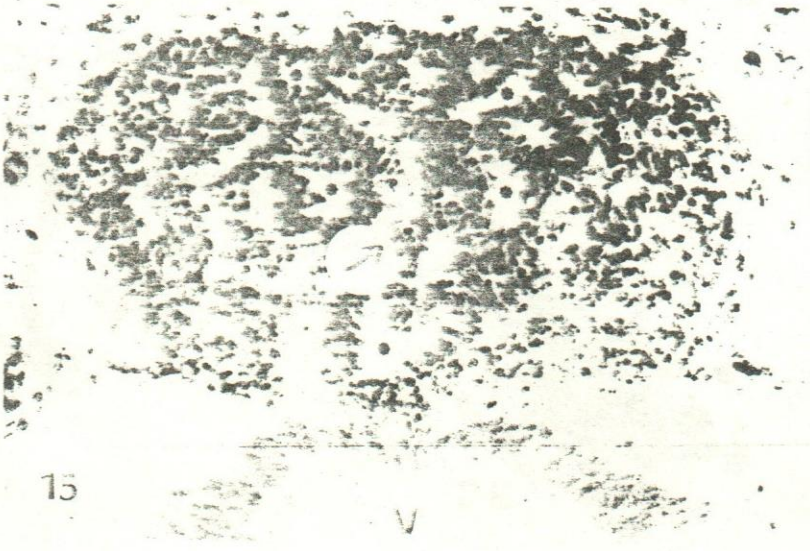

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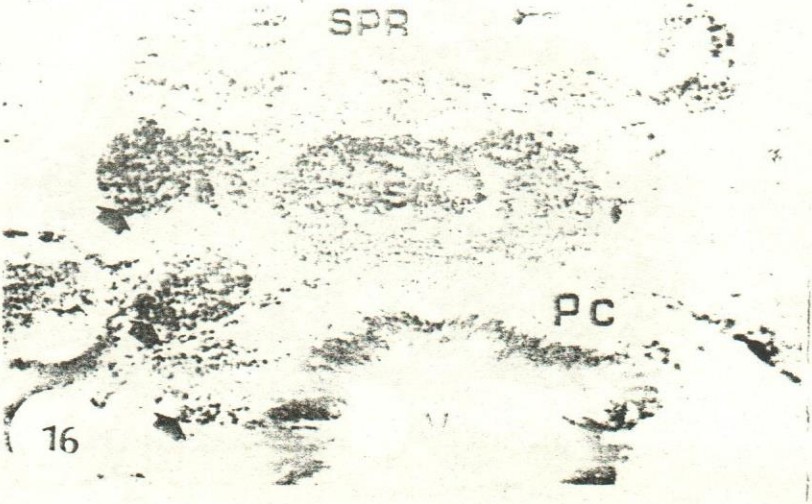

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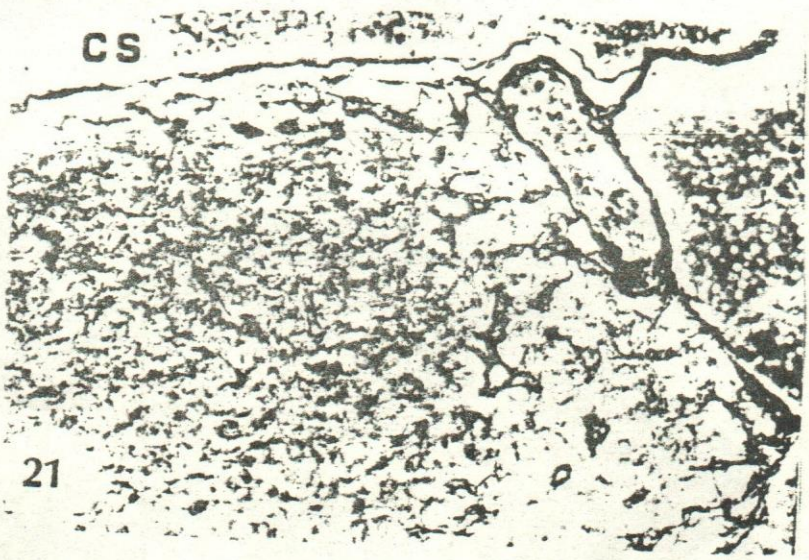
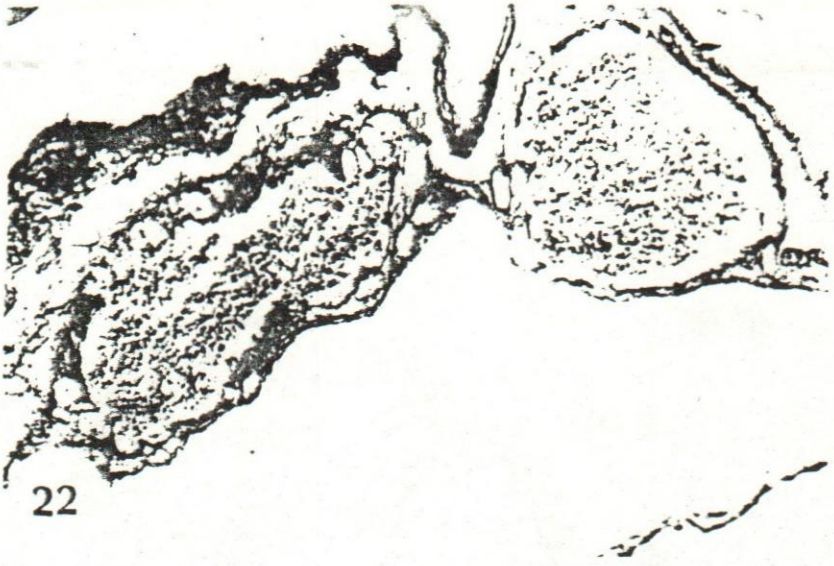
PINEAL GLAND, RABBIT





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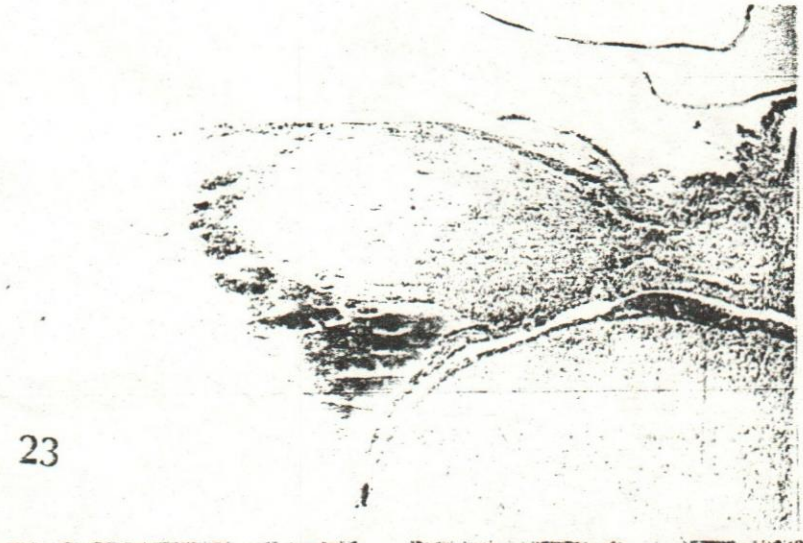

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