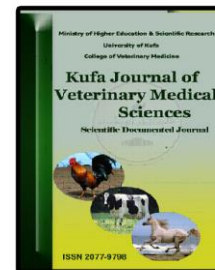




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Anatomical and histological study of adrenal gland in new natal and adult guinea pig (*Caviaporcellus*)

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Abstract

Histomorphological study on the adrenal gland was conducted in guinea pig after birth including three period of life, one day old, 15 days and adult guinea pig. Right and left adrenal glands were collected from guinea pig and fixed in 10% neutral buffered formalin, and Orth stock solution as a fixative for routine paraffin embedding. The organ sections at 6 μ m thickness and after that stains with H&E and PAS stain. Anatomically the adrenal glands are paired white flat organs embedded in fat located cranial to the kidneys within the retroperitoneal space. The adrenal gland has a very characteristic tissue design that is often easily recognizable even without a microscope. Each gland in cross section show an outer cortex appears yellowish connective tissue, and an inner medulla that appears brownish in color. Histologically adrenal gland is surrounded on the surface by a connective tissue capsule and zones, from the outer to inner are; 1. Zonaglomerulosa 2. Zonafasciculata 3. Zonareticularis.. The adrenal cortex represents 80-90% of the adrenal gland.

Introduction

The developing of adrenal gland has both an interesting origin and an fetal role. Furthermore recent studies suggest that the adrenal cortex share a common embryonic origin with the early gonad. The two adrenal glands (glandulae suprarenales suprarenal gland) are named by their anatomical position located cranial to the two kidneys origins (8, 6, 9, 3, and 20). The inside structure the adrenal medulla is originate from neural crest (18). The outer part is adrenal cortex is derived from mesothelium and can be divided into three layers (zonareticularis, zonafasciculata, zonaglomerulosa) each zone have distinct hormonal functions

(10, 14, 7, 8, 6, 9, 3 and 20). Most mammalian adrenal gland is composed of two distinct functional compartments, i.e., the cortex and the medulla. The cortex contains three histological zones, outermost the "zonaglomerulosa", followed by the "zonafasciculata", and the "zonareticularis" directly surrounding the medulla. Each zones play important roles in steroid hormone production in the mouse (19, 5, 18) in camel (12): in Opossum (4). The adrenal gland is a vital African buffalo endocrine gland that occupies a central role in the regulatory mechanisms of the body metabolism. The parenchyma of the adrenal gland of constituted mainly of three components namely the cortical

tissue, medullar or chromaffin tissue and vascular sinusoids (17, 10, 14, 7, 6, 9). There is no histological difference in the right and left glands between the male and female which observed. Two types of cells were observed in rat (13). At the cortico-medullar boundary cortical cells were observed, together with chromaffin cells in porcupine (24). At this time in mouse the zona fasciculate in fetal contains two types of cortical (19, 8, 6, 9, 3, 20). In rhesus macaques the mature cells occupied approximately the outer 75 % of the cortex (15). In the rats two types of cells were observed (13). While, in the mice the cells of zonaglomerulosa were separated by blood sinusoids and arranged in the form of rounded or arched clusters beneath the adrenal gland capsule. The cells of zonafasciculata were arranged in long straight cords separated by blood sinusoids. These cells were large and polyhedral with pale vacuolated cytoplasm and vesicular rounded nuclei. Zonareticularis cells were disposed in the form of cords anastomosing with one another. Some cells appeared with pale nuclei and others with dark nuclei and blood sinusoids were observed in-between the cords (11, 1, 9, 3, 20).

Materials and method

The study was carried out with adrenal glands in 18 both sexes of guinea pig, one day old (n=6), 15 days (n=6) and (n=6) in adult age guinea pig, the gland remove from abdominal cavity after the guinea pig were anesthetized by injection ketamine and xylazine then evisceration and put adrenal glands in 10% buffer formalin fixation and Orth's stock solution contain potassium dichromate to determine medulla of adrenal gland for 48 hours and then dehydrate by using 70%, 80%, 85%, 90% alcohol and absolute alcohol,

xylene and finally paraffin (16). Another step was paraffin section at 6 μ m thickness and final step was stain with H&E, and histochemical PAS stain.

Aim of this study

The aim of this study was to detect the anatomical and histological observation to evolution the adrenal gland as structure for physiological function in new born include one day and 15 days and adult mature in guinea pigs.

Results

The results include anatomical and histological part

I- Anatomical study

In this study was exam three ages period, one-day old depended on the only milk sucking, 15-day old the guinea pig in this time was take rough foods with milk and finally is the adult, at this three stages period which observed the location, shape, color and the weight of adrenal gland table1, (Fig.1) and (Fig. 2).

Location

The adrenal gland in guinea pig were two small glands, located in abdominal cavity embedded in fat mass just cranial to the kidneys within the retroperitoneal cavity, also called suprarenal glands, the left adrenal gland is located closely to the right and left kidney (Fig.1).

Shape and Color

The shape of the adrenal gland vary among species, while in guinea pig the left gland was crescent and right gland is pyramid in shape (Fig.2). Each adrenal gland is composed of 2 distinct parts: the adrenal cortex and the adrenal medulla. The adrenal cortex was forms a layer of uniform thickness around the irregular adrenal medulla and take rather like a pita bread shape. In guinea pigs the color of gland adrenal was gray in color when observed externally.

Weight

The weight of adrenal gland in guinea pig appear in table (1), and can detected the variation of both right and left gland and its correlation with body weigh in all development old periods,

through biostatistician analysis reach benefit ratio (each one kilogram of body weight :grams weigh of adrenal gland). The ratio of left adrenal gland was constant 1:0.1 in all day old, while right gland variation with body weight

age guinea pig	Mean body weight(gm)	Mean R.Adrenal weight(gm)	ratio R.Adrenal gland	Mean L.Adrenal weight(gm)	ratio L.Adrenal gland
1day	39.3	0.003	1:0.08	0.004	1:0.1
15days	79	0.007	1: 0.09	0.008	1:0.1
Adult	247.5	0.03	1: 0.12	0.04	1:0.16

Table (1) Show the weight of adrenal gland and its ratio (body weight: adrenal weight

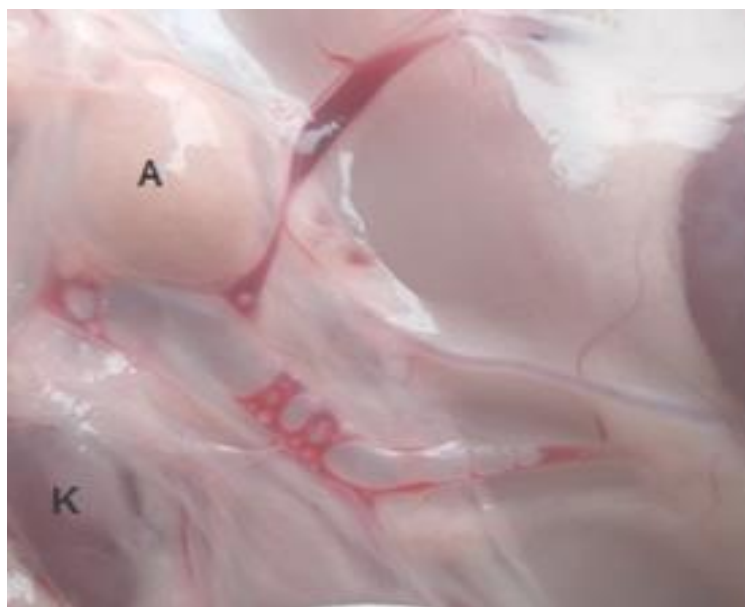


Figure 1. Shows the location of left adrenal gland insitu which embedded in fat of guinea pig. (A) Adrenal gland, (K) kidney



Figure 2. Show shape of both right and left adrenal gland.

II- Histological study

The adrenal glands were developing from two separate embryological tissues (ectoderm and mesoderm). The medulla was originates from ectodermal neural crest cells, which migrating from sympathetic ganglion, this part were surrounding by the mesodermal cells of the adrenal cortex which developed from the intermediate mesoderm. The adrenal gland consists histologically from:

Capsule Fig (3-10)

The capsule was well development in all period after birth and characterized by connective tissue enclosed the adrenal gland, this capsule has projections trabecula into the cortex and medulla as supported the adrenal gland matrix, the trabecula in one day old was very thick and occupied large area of the adrenal gland with enclose circle aggregation of cells, this phenomena was not observed in 15 day old and adult guinea pig.

Cortex is consists of:

I- zonaglomerulosa Fig (5-9)

The Zonaglomerulosa in one day old was characterized by small cell with dark nucleus located under capsule take range as arches or cluster cells, also found that this zone in 15 day and adult guinea pigs take featured as thin and rounded or arched clusters of columnar and cuboidal cells. The columnar cells were close to the inner edge of capsule and the cuboidal cells were found near the deep zone (Zonafasiculata) of the adrenal gland .

II- zonafasiculata Fig (5-9)

The zonafasiculata appear in one day old of guinea pig as undifferentiated cells and occupy the space under the zonaglomerulosa as transitional cells and called the fetal cortex cells which characterized by round cells with central nucleus and some other cell have multinucleated or lobulated nucleus , this indicated of highly proliferation mitosis division to differentiations cells into two zone i.e zonafasiculata and zonareticularis, in this age , also the connective tissue trabaculae from capsule dispersed between cells. While in 15 day old and adult period the zonafasiculata was probably the easiest layer to spot as it is a broad zone

of cells arranged in straight cords, each cord have one or two cells thick, which run at right angles to the surface of the gland. The cells of the in 15 day old and adult period are lightly stained and have a frothy appearance, or small vacuolation which distributed in the cytoplasm due to the extraction of lipid droplets from the cell cytoplasm during tissue processing. The thickness of zona fasciculata takes area about 3 times as much as that of zona glomerulosa, with not obvious boundary.

III- zonarecticularis Fig(5,6, 8)

the zonarecticularis in one old day of guinea pig appear as more minor zone in space than of the upper zone (i.e. zona fasciculata), and characterized by undifferentiated cells like zona fasciculata, that mention above, in 15 day old this zone still not

well developed, in adult the zonarecticularis is Interior to the fasciculata zone, and the cells were adjacent to upper border of medulla which formed a jagged boundaries. The cells of the zonarecticularis are arranged as anastomosing (reticular or net-like) cords and take stains more deeply than the other two regions of the cortex.

Medulla Fig (3,4,6,10)

In all old age of guinea pig, one day old, 15 days and adult due to secretory granules (containing norepinephrine or epinephrine) was stain brown with potassium dichromate, the parenchyma of the adrenal medulla consists of cells loosely organized into clusters and cords. Chromaffin cells are columnar in shape and rather basophilic the cells were darkly whose nucleolus was detected. Cytoplasm was basophilic stained and clearly distinct from the cortex.



Fig 3. Show the internal structure of adrenal gland in guinea pig, the pale outer region cortex and the darker inner region medulla fixated by Orth's solution consist potassium dichromate

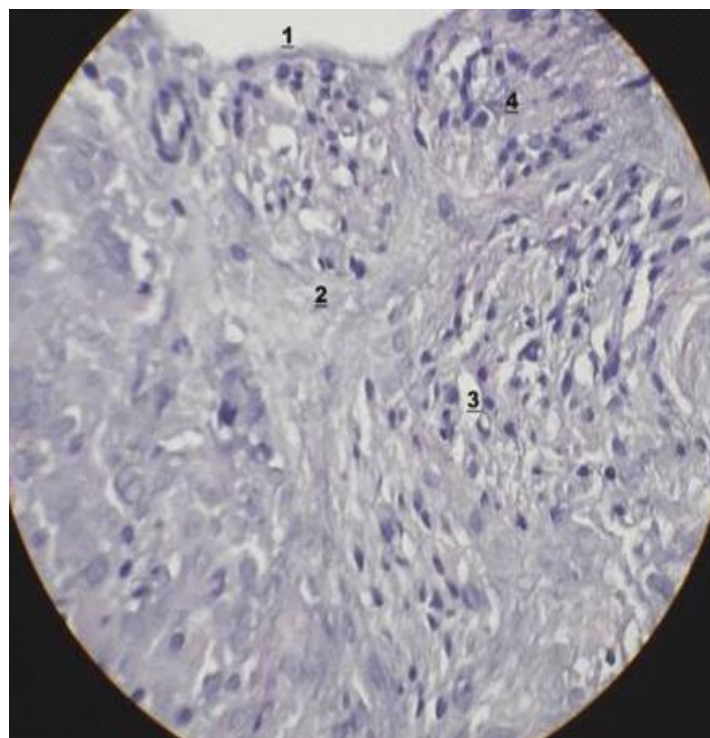


Fig 4. One dayold of the adrenal gland in guinea stain with PAS (X 400) CA: capsule C:cortex V:medullary Vein.

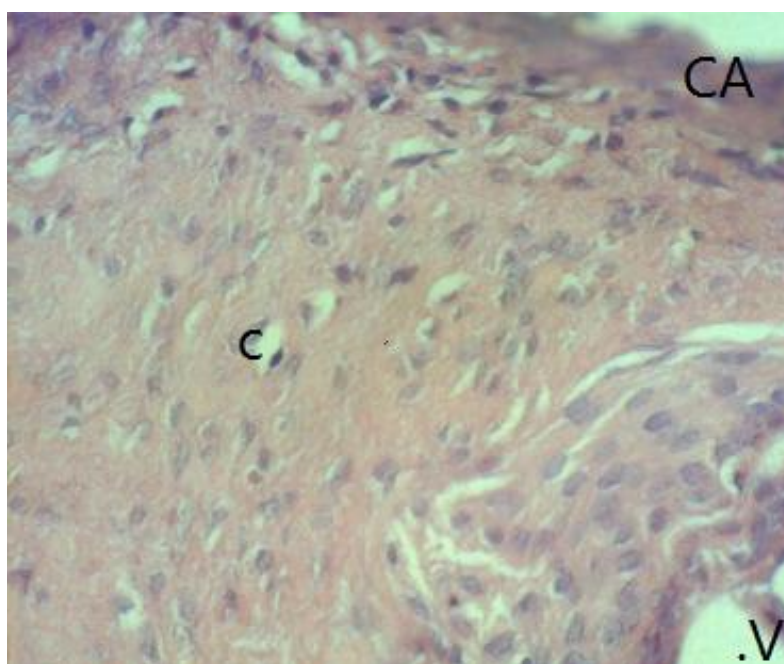


Fig 5. Show the gland of guinea pig at one day old stain with PAS (X 400) 1-capsule 2-zona glomerulosa 3-undifferentiated cells

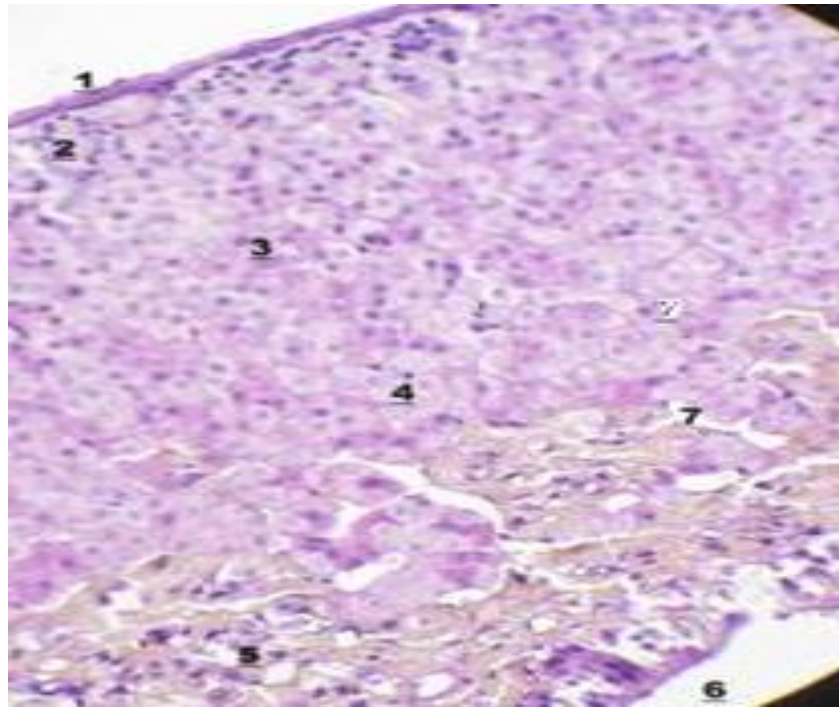


Fig 6. Show adrenal gland of guinea pig at 30 day old stain with H&E (X 100) 1- capsule 2-zona glomerulosa 3-zona fasciculata 4-zona reticularis 5-medulla 6- central vein

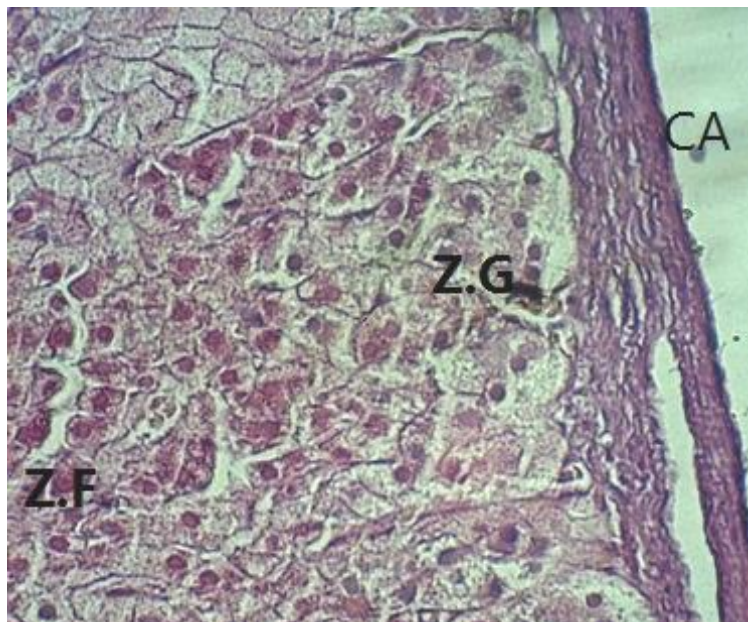


Fig 7. Show adrenal gland of guinea pig at 30 days old stain with H&E (X400) CA: capsule Z.G: zonaglomerulosa Z.F: zonafasiculata

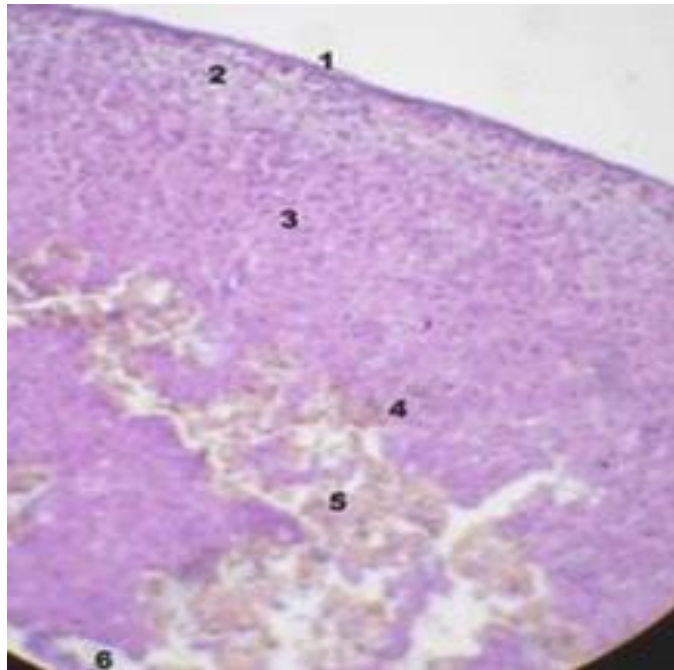


Fig 8. 90 day old adrenal gland of guinea pig at 90 day stain with H&E (X100) E1- capsule 2-zona glomerulosa 3-zona fasciculata 4-zona reticularis 5-medulla 6- central vein

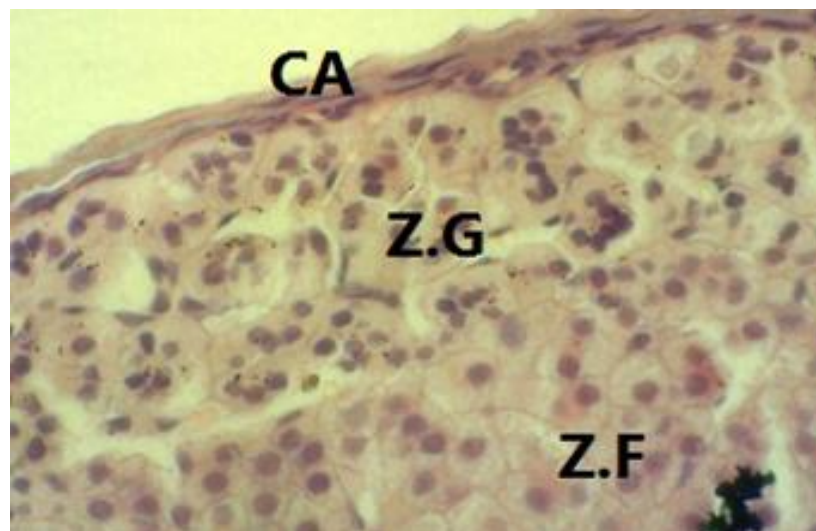


Fig 9. Adrenal gland in guinea pig at 90 day old stain with H&E (X400) CA: capsule Z.G: zonaglomerulosa Z.F: zonafasiculata

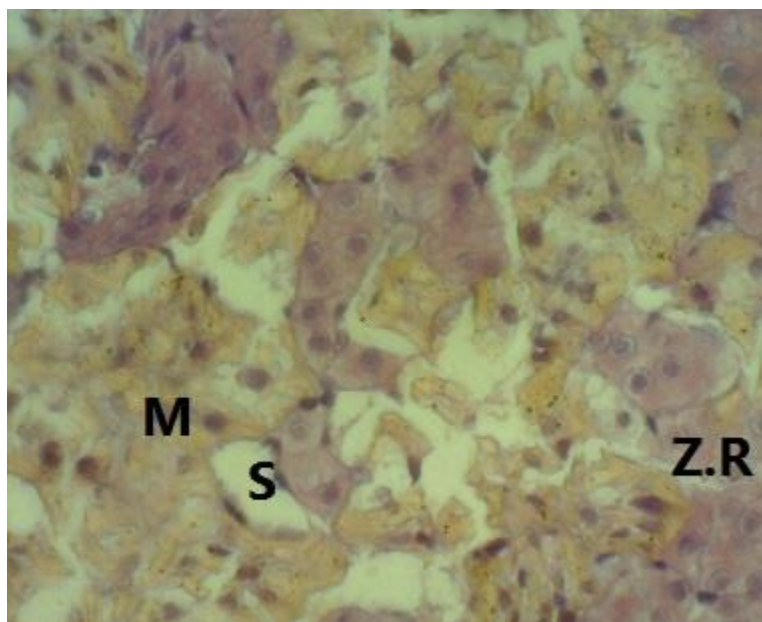


Fig 10. Adrenal medulla of adrenal gland in guinea stain with PAS (X400) M: medulla
S:sinusoid Z.R: zonarecticularis

Discussion

In this study which included both the anatomical and histological investigation of adrenal gland in one day, 15 day old and adult guinea pig. Anatomical results obtained through this study agree with the most author work in adrenal gland domestic animal of (22), (17), (24) and (13), also in guinea pig the left gland position and change weight ratio not mentioned from any authors, so in this can say that identical detection support this work, so this ratio of weight can be explained to determine the hormonal secretory level in blood and blood supply to adrenal gland during the developing period extended from last gestation and one day old and 15 day old and adult because this variation accompanied with histological changes and this well discusses below, so we recommended to researcher take important idea to answer this variation for future.

Histologically the adrenal gland in guinea pig and all animal consist capsule, cortex and medulla (7), (5), (3), (20), (6) in human (4), (8), also no variation observed from all mammalian animal which mentions from (9), in rabbits, (14), (2), (19) and (1) in mouse, (15) and (13) in rats, (21) in lamb, (18) in buffalo, (11) in mice, (23), in camel (12).

In this study thin capsule surrounded the adrenal gland in all ages of guinea pig and this mentions from all researcher above. The zonaglomerulosa can be observed in one day old as small cell mild stain, while authors which deal with glands at fetal period not in one day old (21) in lamb, (20), (6) in human, they found the last gestation period the same as first day after birth also they that the observed the another zones (zona fasciculata, zonarecticularis) were undifferentiated and still as transitional cells with lobulated nuclear cells located under zonaglomerulosa, this phenomena

not remembers by researchers working in adrenal gland , and this may be the characteristic point found in this study in this age due to the animal sucking milk consist simple carbohydrate and rich in mineral so the zonafasiculata unorganized physiological function , and this zone zonafasiculata control from ACTH secreted from pituitary gland , this truths agree with (2) and other researchers (7), (5) , (3), (20), and (6)in human ,while ACTH no relation control in mineral and the metabolism of mineral regulate from zonaglomerulosa which develop in neonatal period

In 15 day old the all zone differentiated with small thickness of zonareticularis ,in this period the guinea pig take rough food with milk ,so the zonafasiculata development needed to carbohydrate metabolism by secreting glyocorticoid hormones this physiological function revealed from (7) , (5) , (3), (20), (6)in human .Finally the adult guinea pig histological observation no variation from all mammalian which mention from all workers. The cytological of all ages and arrangement of cells in three zones of cortex were like the all animal. The medullar cells aresource of norepinephrine (noradrenalin) and epinephrine (adrenalin), are often more basophilic than the cells of the cortex. They are arranged in clusters, usually around medullary veins

The medulla of adrenal gland contain chromaffin cells which contain granules as adrenalin and noradrenalin hormones which take evidence play to regulate any stress may be facing.

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