STUDY OF THE ADRENAL CORTEX IN ADULT ALBINO RAT

THESIS

SUBMITTED FOR PARTIAL FULFILMENT

FOR THE DEGREE OF (M.Sc.)

IN

(ANATOMY)

BY

AHMED FATHALLA IBRAHIM

SUPERVISORS

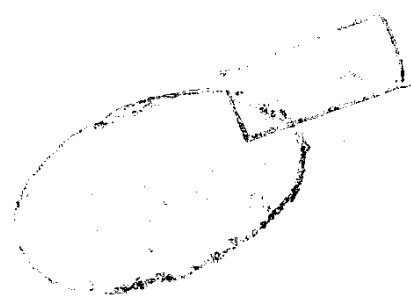
Prof.Dr. YAHIA YOUSSEF AHMED
Prof. and Head of dep.
of anatomy
Faculty of Medicine
Ain Shams University

Prof.Dr. FAKHRY AMIN ISKANDER
Prof. of anatomy
Faculty of Medicine
Ain Shams University

Prof.Dr. MOUSTAFA KAMAL IBRAHIM
Assist. Prof. of anatomy
Faculty of Medicine
Ain Shams University

Dr.EL EHIAN YOUSSEF BALADIOUS
Lecturer of anatomy
Faculty of Medicine
Ain Shams University

FACULTY OF MEDICINE
AIN SHAMS UNIVERSITY
1987



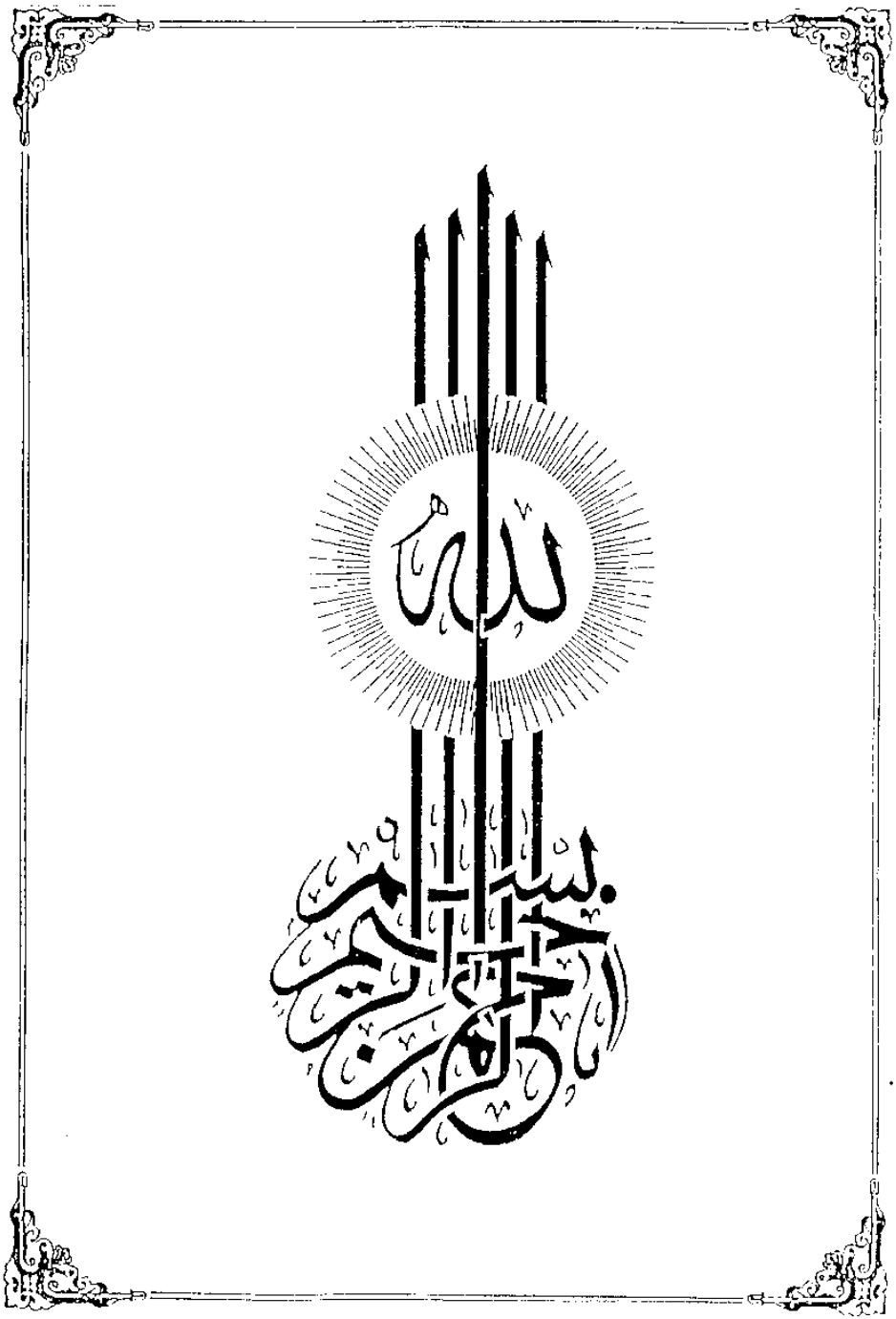
A C K N O W L E D G E M E N T

I would like to express my sincere feelings of gratitude to Professor Dr. FAKHRY AMIN ISKANDER , Professor of Anatomy, Faculty of Medicine, Ain Shams University, for his valuable advice, true encouragement, continuous guidance in the progress of this work.

My grateful thanks and sincere gratitude are expressed to Professor Dr. MOUSTAFA KAMEL IBRAHIM , Ass. Professor of Anatomy, Faculty of Medicine, Ain Shams University, for suggesting the point of this work, unlimited cooperation, constructive supervision and repeated revision of every item of this work.

I wish to express my appreciation to Dr. EL ERIAN YOUSSEF EKLADIOUS , Lecturer of Anatomy, Faculty of Medicine, Ain Shams University, for his kind advice and encouragement, as well as instructions and criticism which were essential for the progress of this work.

*****



C O N T E N T S

Introduction and Aim of the Work

I N T R O D U C T I O N

The adrenal cortex is one of the most dynamic tissues in the body. It is responsible for the maintenance of body reserve and resistance to various types of stress and diseases.

Cortical hormones are proved to be steroid in nature, and it is believed that their formation begins with cholesterol. Furthermore, the adrenal cortex contains a higher content of ascorbic acid than any other tissue, but the mechanism by which this high level influences secretion is still undetermined.

Many investigators such as Tobin and Whithead (1942), Dean and Greep (1946), Cater and Lever (1954), Pauly (1957), Mikhail (1973a, b). Iskander and Naga (1974) and Iskander (1976), studied the normal histology of the adrenal cortex of the rat. Others, such as Harrison and Cain (1947), Bergner and Dean (1948), Dempsy, Greep, and Dean (1949), Bacchus (1950), Stebbins (1951), Symington (1951), Cater and Stack-Dunne (1953), Mikhail (1973b) and Moussa, Moustafa, and Geith (1977) studied the histochemical picture of the rat adrenal cortex.

This work is planned with the aim of studying the histological picture of the adrenal cortex in the adult albino rat, including the study of its innervation and its intrinsic vasculature.

Furthermore, the present study reinvestigate the adrenal cortex from the histochemical point of view.

Review of Literature

REVIEW OF LITERATURE

ANATOMY OF THE ADRENAL GLAND

Holmes (1961), studied the adrenal glands of the ferret. He mentioned that they were embedded in fatty tissue adjacent to the upper medial borders of the left and right kidneys, but the exact position of the glands varied from one animal to another. The left gland usually lay close to the left side of the abdominal aorta, caudal to the origin of the superior mesenteric artery and rostral to the left renal artery, in relation to the upper third of the kidney. The gland was oval, 6-8 mm in length and usually grooved across its ventral surface by the adrenolumbar vein, which crossed it to enter the vena cava. The right gland usually lay more rostral than the left, close to the right side of the aorta, level with or rostral to the point of origin of the superior mesenteric artery. The gland was always related ventrally to the posterior vena cava which either overlapped the medial half of the gland, or overlay it completely. The right gland was usually more elongated than the left, measuring between 8 and 11 mm in length. The upper pole was often larger than the lower and the ventral surface was flattened or concave where it was in contact with the

vena cava.

Russo and Pelagalli (1972), studied the adrenal glands of sheep and goats. They stated that, in sheep, the right gland was medial to the cranial pole of the kidney, it was related to the liver, renal vein, and its medial pole was adherent to the I.V.C. The left gland had the same relation to its corresponding kidney. Its caudal border was related to the renal vein and its dorsal surface was in contact with the aorta at the level of the superior mesenteric artery. The medial pole was not adherent to the I.V.C. as in the right side.
They mentioned that, in goats, the glands were more cranial in position than those of the sheep. The right gland had no direct relation to the I.V.C.

Last (1972), mentioned that the human adrenal glands lay one alongside the upper part of each kidney. They were somewhat asymmetrical. The right gland was pyramidal in shape and surmounted the upper pole of the right kidney. It lay between the I.V.C. and the right crus of the diaphragm; its right border projecting to the right of the vena cava and coming in contact with the bare area of the liver. Like the left gland, it had three sources of arterial supply. Its own proper branch from the aorta was reinforced by adrenal branches of the phrenic and renal arteries. It was drained by one vein directly into the

I.V.C. where that vessel lay behind the bare area of the liver. The left gland was crescentic in shape and draped the medial border of the left kidney above the hilum. Its lower pole was covered in front by the tail of pancreas; the rest of the gland was covered with peritoneum of the lesser sac and formed part of the stomach bed. It lay on the left crus of the diaphragm. Like the right gland, it had three sources of arterial supply, directly from the aorta and by branches from the phrenic and renal arteries. Its single vein drained into the left renal vein; this is in embryological symmetry with the right side, since in each case the suprarenal vein drained into a persisting segment of the subcardinal vein of the embryo.

Warwick and Williams (1973), mentioned that the human adrenals were two small bodies of a yellowish colour, flattened antero posteriorly, and situated one on each side of the median plane, behind the peritoneum and immediately antero-superior to the superior pole of each kidney. They were enclosed, together with the kidneys, in the renal fascia, but were separated from the kidneys by a little fibro-areolar tissue. The right gland was somewhat pyramidal, bearing a resemblance to a 'cocked' hat; the left was semilunar, and was usually larger and extended to a more cranial level than the right. The suprarenal gland was exceedingly vascular. The arteries, which were of comparatively large size, were derived from the abdominal aorta, and the in-

rerior phrenic and renal arteries. The suprarenal vein emerged from the hilus of the gland; the right opened into the I.V.C., that on the left, into the left renal vein. The lymph vessels ended in the lateral aortic nodes. The nerves were exceedingly numerous.

THE HISTOLOGICAL PICTURE OF THE ADRENAL CORTEX

Bennett (1940), studied the adrenal cortex of cat. He mentioned that the capsule consisted of dense network of reticular fibres merging with the collagenous fibres of the retroperitoneal connective tissue. The reticulum of the capsule was continuous with supporting framework of gland parenchyma. He said that the reticular fibres enclosed groups and columns of cells in the outer cortex, and showed clearly that the columns of cells in the zona fasciculata were continuous with coils of glomerulosa. In the zona reticularis, each cell was individually enclosed in basketwork of reticular fibres. He added that the fibres between parenchymal cells became gradually more dense as one proceeded centrally from the zona fasciculata to the zona reticularis.

Tobin and Whithead (1942), described a fat free zone, the zona intermedia, lying between the zona glomerulosa and the zona fasciculata of the rat adrenal cortex. They also, reported the absence of such zone in the adrenal cortices of mice, guinea pigs and rabbits.

Dean and Greep (1946), described the normal histological features of rat's adrenal cortex. They mentioned that it was

formed of three major zones : an ill defined zona glomerulosa, composed of loops of cells, followed by a broad fasciculata, with long straight columns of cells, and a narrow juxtamedullary zone in which these columns of cells were distended and broken down, the reticularis.

Rogers and Williams (1947 and 1948), described the normal histology of the human adrenal cortex, stained with haematoxylin and eosin. They observed three distinct zones. The zona glomerulosa, the outermost one, characterized by a thin layer of cells arranged in well circumscribed clusters, with darkly stained nuclei. The cytoplasm of such cells appeared fluffy and vacuolated. The outermost part of this zone was formed of smaller cells with dark nuclei and acidophilic cytoplasm. They noted that the zona glomerulosa blended with the fasciculata, which appeared to be the widest zone, and was composed of moderately larger polyhedral cells, arranged in cords. The nuclei were larger and paler than those of the glomerulosa. The cytoplasm was fluffy and vacuolated. They found no distinct line between this zone and the inner zone, zona reticularis, in which the cells were arranged in an irregular fashion, and had more acidophilic cytoplasm. Such cells lacked vacuolation, and frequently contained brownish yellow pigments.

Delost (1952), studied the adrenal cortex of mice. He

noted that the zona fasciculata, in fifteen days old male and female animals, was differentiated into two parts : an outer part, formed of large, clear trabecular cells, and an inner part, formed of small, numerous eosinophilic cells. This zoning persisted in females, but disappeared in adult male after testicular development.

Nicander (1952), described the zona intermedia of the adrenal cortex, in a wide variety of domestic animals. He found that the cells of such zone were intermediate in type between those of zona glomerulosa and zona fasciculata.

Cater and Lever (1954), studied the comparative morphology of the adrenal cortex in certain non mammalian and mammalian animals, with special reference to the presence or absence of the zona intermedia. They regarded such zone as a transitional or intermediate zone since the component cells appeared intermediate in type between those of the zona glomerulosa and zona fasciculata, in a large number of domestic animals.
They stated that, in the frog adrenal, the cortical elements were arranged in short irregular cords, extending into the gland from the deep surface of the capsule. The cells at the capsular end of the cords had an eosinophilic, homogenous cytoplasm and a round to oval reticular nucleus. The cells next encountered, appeared crowded and might constitute a zone of cell compression.