Morphological and Histological study of the kidneys on the Albino rats

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Abstract

The kidney of the albino rat is bean – shaped, smooth, reddish-brown color it is covered by a thin connective tissue capsule that is adherent to sub capsular connective tissue containing occasional fibroblast. The rat kidneys lay alongside the vertebral column in the abdominal cavity, and the right kidney is situated more cranially than the left one. The mean weight of the right kidney was 1.1gm while, the left kidney is 0.96 gm. The mean length, width and thickness of right kidney is 1.28 cm, 0.88 and 0.81cm respectively while those of the left one the mean length, width and thickness is 1.23cm, 0.85 and 0.79 cm respectively. The kidney consists of two regions, the outer cortex and the inner medulla. The basic unit of the rat kidney is the nephron. Each nephron can be sub divided into number of distinct parts in the cortex and medulla. The nephron forming renal corpuscle, the first part of nephron consists from glumerulus and Bowman's capsule, the proximal convoluted tubules, loop of Henle which consists of ascending and then the descending limb of loop of Henle and distal convoluted tubules. The collecting tubules are not part of the nephron.

دراسة شكليائية نسيجه لكلى الجرذ نوع (البينو)

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الخلاصة

يتضمن هذا البحث دراسة شكليائية نسيجه لكلى الجرذ نوع (الالبينو الأبيض). تكون كلى الجرذ كلوية الشكل ملساء ذات لون احمر مائل إلى البني الغامق ومحاط بمحفظة من النسيج الضام التي تتخللها الاورمات الليفية. تقع الكلى على جانب العمود الفقري في التجويف البطني حيث تقع الكلى اليمنى إلى الأمام من الكلى اليسرى. تضمنت معدلات أوزان كل من الكلى اليمنى واليسرى حيث كان وزن اليمنى 1.1 غم بينما كان وزن اليسرى 0.96 غم. (تم قياس كل من الطول والعرض والسمك لكلا الكليتين حيث كانت معدلات قياس الكلى اليمنى 1.28 سم, 0.88 سم, 0.82 سم. بينما كانت معدلات قياس الكلى اليسرى 1.23 سم, 0.85 سم, 0.81 سم. تتكون الكلية نسيجا من منطقتين القشرة إلى الخارج واللب إلى الداخل. تتكون الوحدة الكلوية من عدة أجزاء مختلفة تقع في القشرة واللب وتشمل الكريه الكلوية وهي الجزء الأول من الوحدة الكلوية وتتألف من الكبيبة ومحفظة بومان, النبيب الداني الملفوف, عروة هنلي النازل والصاعد والجزء الأخير النبيب القاصي الملفوف ولا تعتبر النبيبات الجامعة جزء من الوحدة الكلوية.

Introduction

The rat is one of the most widely used research animal particularly the urinary physiology. The rat is also useful in assessment of toxicological insult to the urinary system. They are initially used for experimental purposes since the half of the nineteenth

century. Several strains have been developed for studying genetic diseases, neuroanatomy, nutritional disorders, diabetes, hypertension, and others. The rat also is the most important animal used as a model for biological experiments in research laboratories worldwide (1). Generally the urinary system of mammals consists of the paired kidneys, renal pelvises ureters, urinary bladder, and urethra. The kidneys are highly vascularized, compound tubular glands that function to maintain the composition of body fluids at a constant level and to remove excretory wastes (2). The kidneys also regulate the fluid and electrolyte balance of the body and are the site of production hormones as rennin and erythropoietin. Renin participates in the regulation of blood pressure and erythropoietin is a growth factor glycoprotein that stimulates the production of erythrocytes (3). According to (4), the kidney of mammalian species has typical bean-shaped appearance characteristic of the unipolar mammalian kidneys. The nephron is the functional unit of the kidney; each nephron consists of corpuscle, proximal convoluted tubules, loop of Henle, distal convoluted tubules and collecting tubules. The aim of this work is to study the morphology and histology of the kidney of Albino rat which is beneficial in pathological and physiological research.

Material and Method

Five male albino rats, weighing 150 to 200 gm were obtained from animal house Department of physiology, Veterinary College, Baghdad University. The animals were sacrificed under anesthesia. Its extremities were fixed to the dissection board with drawing pins. A vertical midline incision was done from the xiphoid process down to the pubic symphysis under the skin, abdominal muscles to the abdominal cavity. The viscera were retracted and the kidneys were exposed. Kidneys were released from their fatty covering connective tissue and gently removed, weighed by balance[*] and measured (length, width and thickness) by vernier caliper[†]. The kidneys were cut along the mid dorsal plane and immediately fixed in 10% neutral formalin. The tissue was washed in tap water and dehydrated in ascending grades of ethyl alcohols, cleaned in xylene and finally embedded in paraffin wax at 60 C° using (Hestion -ATP7000 tissue processor-Germany) (5). The paraffin were sectioned at 5-6 μm thickness using (digital microtom (Hestion ERM 4000 Germany) were prepared and stained with Haematoxylin and Eosin according to (6) and PAS (7) stain.

Results and Discussions

- **Anatomical and Morphometric observations:** The kidney of the albino rat was bean–shaped, smooth and possess convex and concave borders. Each of the kidney had dorsal and ventral surface, medial and lateral borders. The lateral border was convex while, the medial border was concave, indented hilus, and an upper and lower pole. This is in agreement with (8) whom they noted also that the kidneys of African gaint rat and wistar rat were bean shape and smooth. The hilus and sides of the kidney of albino rat were surrounded by adipose tissue. Anatomically the rat kidneys lay alongside the vertebral column in the abdominal cavity and suprarenal glands situated above their poles. The right kidney was situated more cranially than the left; this result is similar to (9). The right kidney is located more cranial than the left kidney and was related to the liver while, the left was related to the stomach, pancreas, descending colon, spleen and small intestine. This result is similar to the result of (10) who registed that the paired kidneys of the two investigated rodents were bean shape and dark red bodies located in

[*] Diamond (model 500).
[†] Battery sr 44.

the dorsal wall of abdominal cavity. The mean weight of the right kidney in this research was 1.1 gm while, the left one was 0.96 gm. The mean length, width and thickness of the right kidney were 1.28 cm, 0.88 and 0.81 cm respectively while those of the left were 1.23 cm, 0.85 and 0.79 cm. This study was in contrast to (11) who reports the mean weight of kidneys 0.95 g and the length of right kidney of the rat was 1.35 cm and the left was 1.49 cm.

- **Histological observations:** The rat kidneys were reddish-brown in color and were covered by a thin connective tissue capsule that was adherent to sub capsular connective tissue (Fig.1, 2). Is in agreement with (12). Each kidney is of connective tissue which may contain a distinct layer of smooth muscle in its deepest portion. (4) also reported that each kidney is enclosed by a fibro connective tissue capsule. The histological sections of each kidney showed. That the kidney of albino rat consists of two regions, the outer cortex and the inner medulla. The cortex and medulla are arranged into more pyramidal shape called renal pyramids. The apex of the each pyramid is called renal papilla. The basic unit of the rat kidney is the nephron. Each nephron can be sub divided into number of distinct parts in the cortex and medulla. The nephron composed of renal corpuscle and the first part of nephron consists from glumerulus and Bowman's capsule, the proximal convoluted tubules, loop of Henle which arranged into ascending and descending limb and then the distal convoluted tubules (Fig. 3). The cortex consists from renal corpuscles, proximal convoluted tubules and distal convoluted tubules. The renal corpuscle is a rounded or irregular structure which forms the glomerule that enveloped by Bowman's capsule. The bowman capsule is formed of two thin cellular layer, the outer parietal layer and inner visceral layer. The parietal layer consists of a flat single layer of squamous epithelium enclosing a narrow space, (Fig. 4) or the urinary space is continuous with the lumen of proximal convoluted tubule. The visceral layer is surrounding the glomerular capillaries. The visceral space of renal corpuscle comunicates with arteries of glomerula (Fig. 4). This research agreed with (4). The renal corpuscule is a spherical structure formed of glomerulus which is enclosed by Bowman's capsule. The proximal convoluted tubule and distal convoluted are the initial and terminal parts of the nephron. The proximal convoluted tubule arises from the arterial epithelium of Bowman's capsule of the urinary space of the renal corpuscle. The proximal tubule exibit a small, uneven lumen and a single layer of cuboidal cells with eosinophilic, granular cytoplasm. A brush border lines cells (Fig. 1, 2, 3). This research disagree with (13) who reported that the proximal convoluted tubules are lined with columnar epithelial but in agreement with that proximal tubule is more narrow than the distal convoluted tubule. The distal convoluted tubules were the second tubules of the cortex differs from the proximal tubules in that the cells lining were of cuboidal type with rounded and large nuclei possess no brush border. The distal convoluted tubules tend to be rather shorter than the proximal convoluted tubules and are fewer in number in the regional cortex (Fig. 1, 4). Part of the distal convoluted tubule in contact with glomerular root has rather modified appearance than the rest of these tubules; this region is identified as the macula densa. This result agreed with (14) who registered that the distal convoluted tubule is fewer in number and may be recognized by the pale cuboidal epithelial cells, and with (2) who claimed that the distal convoluted tubules have a smooth internal surface, and lack of brush border. The medulla of each kidney is formed from collecting tubules, thick and thin parts of the loops of Henle and the

thin limb had a distinct rounded lumen (Fig. 3). It could be clearly distinguished from the other parts of the nephron on the bases of its low lining epithelial squamouse cells and the cytoplasm was homogenous eosiophilic. The thinner wall of this limb resembles the capillaries or small venules in their lumina. The thick descending portion in medulla is similar to the proximal convoluted tubules in cortex, while the thick ascending portion of medulla is similar to distal convoluted tubules in the cortex. The ascending limb of loop of Henle appears large in size than that of the descending limb and is enclosing a wider lumen (Fig. 3). This is in agreement with (13) who stated that the Henles loop consisting of thick descending limb, which is very similar in structure to the proximal convoluted tubule, a thin descending limb, a thin ascending limb, and a thick ascending limb which is very similar in structure to the distal convoluted tubules. The collecting tubules are not part of the nephron. These tubules are lined by cuboidal epithelium with rounded nuclei and basophilic cytoplasm (Fig. 3). This result agreed with (2) as they noted that the epithelial cells of the collecting tubules are pale and vary form cubiodal to columnar close to the papilla. Cell boundaries are normally clear when compared with the cells of the proximal and distal convoluted tubules in progress toward the renal papilla. The terminal portion of these tubules is lined by columnar or pseudostratified epithelium and is called papillary duct. The renal pelvis appeared as a dilated cavity at the proximal end of ureter lodged in of sinus and facing the renal papilla.

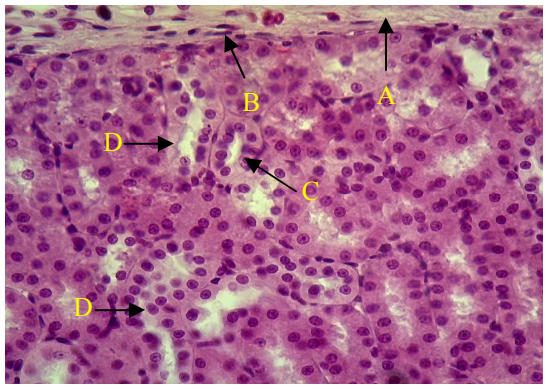

Fig. (1) A- Capsule… B- Fibroblast cell…C- Proximal tubule…D- Distal tubule…(400 × H&E)

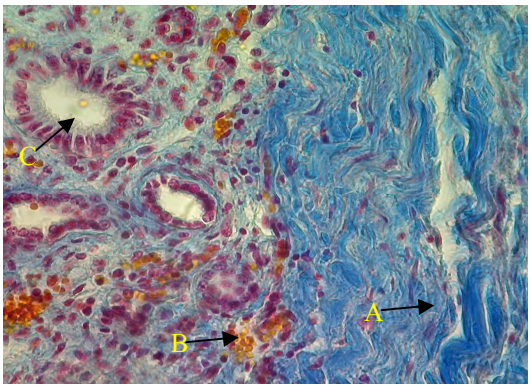

Fig. (2) A-Capsule…B-Sub capsular region… C- Proximal tubule. (400 × PAS)

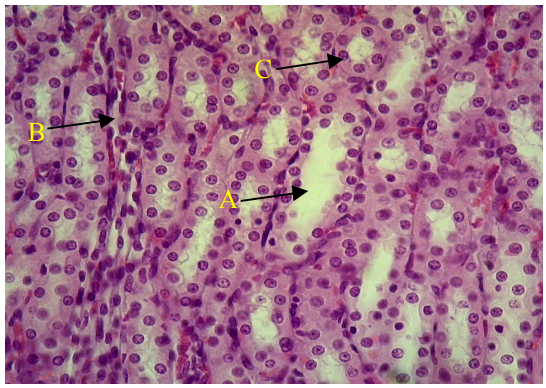

Fig. (3) A-Collecting tubule… B-Thin limb… C- thick descending limb. (400 × H & E)

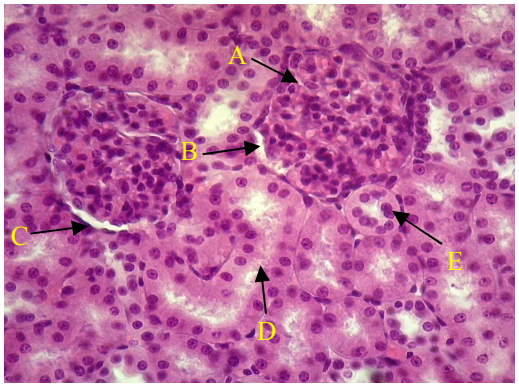

Fig. (4) A- Glomerula. B- Visceral layer. C- Parietal layer. D- Distal tubule. E- Proximal tubule. (400 × H & E)

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