

Histological and anatomical changes of the kidney after entire unilateral nephrectomy in the rabbits (at 15 and 30 day)

Abdulrahman M. S.¹, Ayad H. I.², Samira A. A.³

¹ salah alden Health office

² Vet. Medicine, Tikrit University, Tikrit, Iraq

³ Department of Anatomy, College of Medicine, Tikrit University, Tikrit, Iraq

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Abstract

Ten adult rabbits, of different sexes, more than one year of age, grouped in to two groups (A.B.), 5 rabbits in each group, during the period from October 2011 to nov. 2011. Surgical interference (unilateral nephrectomy) and close monitoring was made. Second nephrectomy of contralateral kidney in limited time for each group was done also as follows: A (15 day post operation), B (30 day post operation). The kidney specimens were inspected grossly for their shape, anatomical position, length, width and cortical thickness, and microscopically for diameter of renal corpuscles, diameter of proximal and distal convoluted tubules, distance of urinary spaces, thickness of glomerular basement membrane and the interstitial spaces. The gross metrical measurement revealed that a positive correlation was observed between the post operative period and of the weight of rabbits, weight of kidney and width of kidney.

Histologically, a significant statistical variations was found between glomerular size, urinary space and proximal and distal convoluted tubules in the two groups. Glomerular size in mostly of the cortical and many of juxtamedullary type showed marked increase even on expense of urinary space size, some time obliteration of space was seen. There were necrotic and shrinkage of some of the glomeruli seen also. Some of tubules undergo necrotic and cuboidal transformations even sloughed cells from basement membrane. The blood vessel showed obvious congestion occasional hemorrhage may be appear in cortical, subcapsular and interstitial areas from rupture of arteriolar or capillary injury.

Introduction:

The kidneys are the first, largest and most important organs in the urinary system due to their important anatomical position in relation to other vital organs. The kidneys constitute 0.5 % of total body mass & receive 25% of the cardiac output, approximately one Liter of blood per minute. This large perfusion volume leads to a high level of blood flow per gram of renal tissue, about forty – fold higher than the average of blood flow per gram of tissue elsewhere in the body⁽¹⁾.

The kidneys serve as vital organ responsible for maintain normal human physiologic function. They are the primary organs for maintaining fluid and electrolyte balance, and they play a large role in maintaining acid-base balance⁽²⁾.

The kidneys process the plasma portion of blood by removing substances from it, They affect calcium metabolism, They excrete drugs, pesticides, food additives and metabolic waste products into the urine as fast as they are produced⁽³⁾. In addition, during prolonged fasting, the kidneys synthesize glucose from amino acids and other precursors and release it into the blood. Finally, the kidneys act as endocrine glands in that they produce rennin, erythropoietin and prostaglandins^(4,5).

Materials and Methods:-

Ten adult rabbits (*Oryctolagus cuniculus*), local breed, weighing 1000 g -1479 g and their ages were between 12 months to 18 months were used in the present study which was carried in Tikrit University, College of Medicine from September 2011 to nov. 2011. All rabbits were allowed for free access to food. The animals were divided according two groups and housed in normal room (3 meter length, 2.5 meter

width, and 2.5 meter high, temperature (10-18)°C., humidity(40-45))

Surgical operations:

All animals were survived until the end of the experiment. Unilateral nephrectomy was made at 15 day (group A) and 30 day (group B), under general anesthesia using intra venous ketamine 0.5mg/kg, using butterfly cannula through auricular vein.

Position of rabbit on the table was posterolateral approach, adequate loin incision in the skin was made.

Dissection of posterior abdominal wall muscle was made. Followed by dissection of gerota fascia and perirenal fat.

Identification of the renal vascular pedicle was made followed by ligation of ureter and renal vascular pedicle using number zero silk, then excision of the kidney was made.

Homeostasis was made. The posterior abdominal wall muscle was sutured using catgut 2/0. Suture of skin using 2/0 nylon and dressing was made. Post-operative antibiotic ceftriaxone 0.1mg/kg for two day were applied. Follow-up and monitoring for all groups were carried continuously^(6,7). Measuring of the kidney dimensions length, width and the cortical thickness (mm)

Histological technique :

Preparation of Tissue for Light Microscopy includes:

• Fixatives and Fixation:

Fixation of the specimens was made using 10% isotonic formal saline for 24hour.

• Dehydration, Clearing, Embedding and Blocking:

By graded alcohol series from 50%, 70%, 80%, 90% and 100%. Clearing by xylene an embedding by paraffin.

• **Sectioning and Routine Staining:**

The tissue blocks were serially sectioned at (5 μ m) thickness using a manual microtome, routine staining of sections was performed using haematoxylin and eosin stains⁽⁸⁾.

Microscopical Examinations:

The microscopic investigation of sections kidney involved the morphometric and the descriptive histology

Morphometric Histology:

The glomerular, tubular and urinary space dimensions were counted in twenty microscopic fields for each specimen and then the mean values of these numbers were calculated.

Descriptive Histology:

Microscopic examination of kidney tissue included the cortex and medulla, the sections were performed to investigate the alterations and abnormalities that may take place in the kidney tissue.

Statistical analysis:

Results were analyzed statistically using correlation analysis and (ANOVA) tests, analysis of variance and standard deviations (SD), were used for this purpose. These statistical tests were performed using a statistical program under SPSS and Microsoft Excel XP systems⁽⁸⁵⁾.

Results:-

Length of Kidneys:

The mean length of kidneys in control and groups A, B, were 2.810 ± 0.26 , 3.275 ± 0.03 cm and 2.900 ± 0.1 cm respectively. No significant variation was exist

Width of Kidneys:

The mean widths of kidneys were 1.90 ± 0.10 , 2.30 ± 0.05 cm and 1.95 ± 0.15 cm respectively. Statistical analysis revealed a significant variations ($P < 0.05$) between groups.

Cortical thickness of the kidney:-

Mean cortical thickness were 0.60 ± 0.19 cm, 0.50 ± 0.10 cm and 0.55 ± 0.15 cm respectively. the statistical analysis revealed no significance variations.

• **Descriptive histology:**

• **Group A :**

Most of the glomeruli appeared normal in shape encapsulated by the Bowman's capsule fig. (1). R.B.C present inside and out side of capillaries .Degenerative changes of the cells in proximal and distal convoluted tubules were present as damage and desquamated cell in lumen of their tubule fig(2,3). Pyknotic nuclei were demonstrated in the most epithelial cells of these tubules fig. (4). the renal collecting tubules few of them showed mild desquamation. In certain region appeared with low cuboidal cells, and foci of increase the interstitial connective tissue were found, there were widening of the lumen of the P.C.T. due to atrophy of these cells (fig. 2).

• **Group B:**

The glomeruli were normal; however, some of them were atrophied, associated with increase of capsular space. P.C.T.s and D.C.T.s were mostly narrowed and some have necrotic epithelial cells. The medulla contained a normal pattern tubules and ducts. subcapsular hemorrhage occasional seen fig. (5).

Morphometric Histology:-

Diameter of renal glomeruli:

Means diameters of the renal glomeruli were 3.147 ± 0.22 μ m, 3.290 ± 0.27 μ m, 2.481 ± 0.16 μ m control, A, B respectively Statistical analysis show a highly significant variations at ($P < 0.01$).

Distance of Bowman capsule:

The mean equal 0.5069 ± 0.04 μ m, 0.5067 ± 0.08 μ m, 0.8200 ± 0.06 μ m, 0.5267 ± 0.04 μ m for control, A, B respectivel. The statistical analysis showed significant variation at ($P < 0.00$).

Diameter of proximal convoluted tubule (PCTs):

Mean diameters of PCTs 1.080 ± 0.18 μ m, 1.4909 ± 0.05 μ m, 1.664 ± 0.12 from control, A,B group respectively. The statistical analysis showed highly significant variation ($P < 0.00$).

Diameter of distal convoluted tubule (DCTs):

Mean diameters were 1.610 ± 0.11 μ m, 1.6364 ± 0.11 μ m, 2.050 ± 0.11 μ m respectively, from control, A and B. There are highly significant variations at ($P < 0.00$).

Discussion

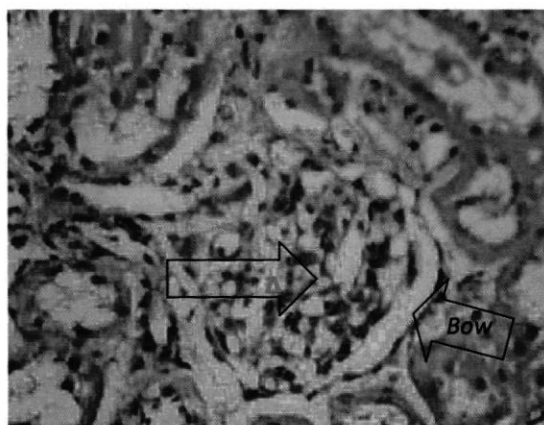
Although in between 10 experimental animal unilateral nephrectomy did, all of them still life till the end of experiment. Most nephrologists tend to agree, but at same time they are well aware of the possibility, though rare, that chronic renal disease may occur after the nephroctomy⁽⁹⁾.

The metric measurement length, width and cortical thickness statistically there are significant increase in the width only, the shape of the kidneys was more or less rounded in the consequent groups in contrast to the bean shape of control kidney but Gavzng observe increase body weight and length of kidney (experimental research on the compensatory enlargement of survival kidney after unilateral nephroctomy in albino rat) so the response may vary with other animal⁽¹⁰⁾.

Histological examination was done by compare control and A,B groups both by metrical and examination under light microscopy, there were significant increase in glomerular size in mostly of cortical nephron This may lead to increase the surface area to compensate the needs for filtrations, this result agree with other study (the state of the glomerulous in the experimental hypertrophy of the kidney of the rabbit marked difference between central and peripheral glomeruli⁽¹¹⁾, occasional necrosis of cells can be seen ,some times increase the size at urinary space even may occupy whole urinary space

Tubular hypertrophy reflect increase the demand of reabsorption⁽¹²⁾, But, there are tubular necrosis, pyknotic nuclear changes rise possibility of long term renal tubular disease post unilateral

nephrectomy. Peritubular hemorrhage and congestion observed in cortical, medullary and subcapsular area also seen, which reflect the pattern of vascular injury. The parietal layer of urinary space were still single cell layer, with elongated nuclei, occasional thickening of basement membrane was seen but showed variable dimensional changes. From these changes we concluded that unilateral nephrectomy may increase propensity of chronic renal disease.



Fig(1) glomerular hypertrophy (A) and narrowing of bowman's capsule group B (H&E 40X)

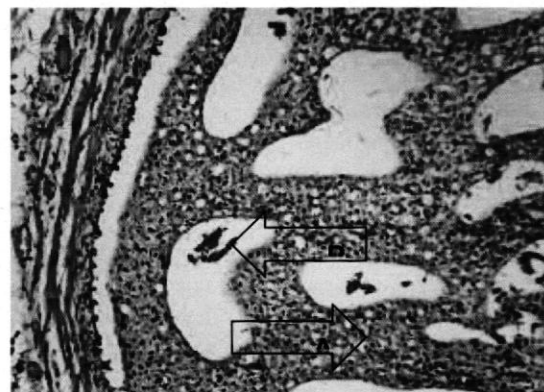


Fig. (2) Interstitial hyperplasia (A) and tubular necrosis (B) seen group B (H&E 10X).

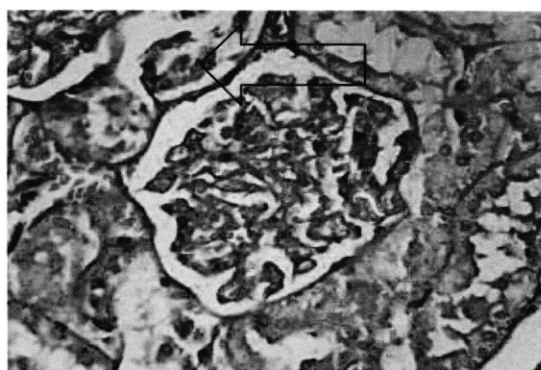


Fig. (3) Tubular necrosis (H&E 40X).

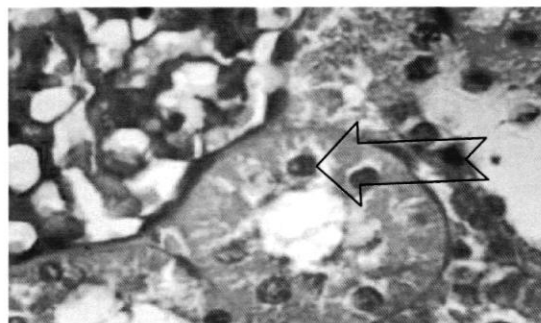


Fig. (4) pyknotic change in tubular cell in group A (H&E 40X).

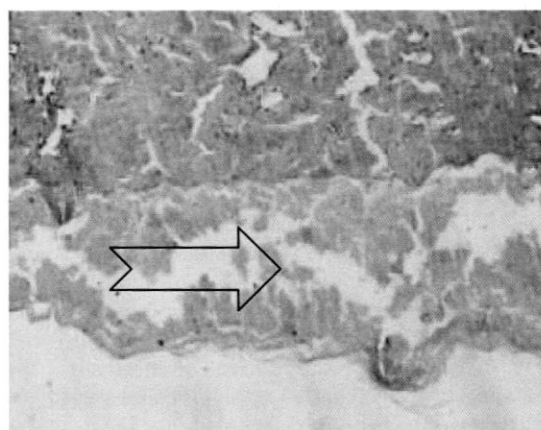


Figure (5) subcapsular hemorrhage group B (H & E, 10X)

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تغيرات نسيجية وتشريحية للكلية بعد رفع إحدى الكلى في الأرنب (للفترة 15 الى 30 يوم)

عبدا لرحمن مهدي صالح الترف¹ ، أياد حميد إبراهيم² ، سميرة عبدالحسين عبدالله³

¹ دائرة صحة صلاح الدين

² كلية الطب البيطري ، جامعة تكريت ، تكريت ، العراق

³ كلية الطب ، جامعة تكريت ، تكريت ، العراق

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الملخص

تم استخدام عشرة أرانب أكبر من سنة عمرا، ذات أجناس مختلفة، صنفت إلى مجموعتين، خمسة حيوانات في كل مجموعة للفترة من تشرين الأول إلى تشرين الثاني 2012. رفعت إحدى الكلى من جميع الحيوانات ثم رفعت الأخرى بعد 15 يوم في المجموعة الأولى ثم 30 يوم في المجموعة الثانية و وضع الجميع تحت العناية الطبية الدقيقة. بمقارنة التغيرات الحاصلة في المجموعتين مع الكلى المرفوعة مسبقا من حيث الشكل، الموقع التشريحي، الأبعاد والفحص المجهرى للكبيبات والنيبيبات ومحفظة بومان والمنطقة البينية. تبين إن هناك تباين إحصائي واضح في وزن الأرناب والكلية وفي عرض الكلية. وبعد الفحص نسيجي للكلية تحت المجهر الضوئي وجد تضخم في حجم الكبيبات والنيبيبات و تضيق محفظة بومان. وقد لوحظ تغيرات نسيجية فيها، ولوحظ تلف في الخلايا الظهارية المبطنة للنيبيبات، و زف واحتقان في الأوعية الدموية لمناطق متعددة من القشرة ولب الكلية في المجموعتين.