



HISTOLOGICAL AND ULTRASTRUCTURAL STUDY OF THE KIDNEY IN ONE – HUMPED CAMEL (*Camelus dromedarius*)

Ban. K. Yousif ¹ , Adel. J. Hussen ²

Department of Anatomy and Histology, College of Veterinary Medicine, University of Basrah, Iraq..

Corresponding Authors Email Address: adel.husseini@uobasrah.edu.iq

Abstract

The current study was carried in the college of Veterinary Medicine-University of Basrah for observing the histological and ultrastructural of the kidney in one-humped camel. In this study 10 adult healthy kidneys of one-humped camel bought from slaughterhouse of Al-Samawah city, (2-3) years in summer (2020). The histological study include 5 kidneys investigated by using histological methods, the samples were fixed with 10% formaldehyde solution. Three stains were used H&E, PAS and Mallory. Five kidneys were used for ultrastructural study, samples were then processed for ultrastructural technique. The histological examination show that high number of long loops of Henle and vasa recta in the kidney and the density percentage of renal corpuscles more in the midcortical region than in a juxtamedullary region and the diameter of renal corpuscle was nearly similar in midcortical and in juxtamedullary region. The nephron was investigated by transmission electron microscopy is unique in having thick basal lamina, the thickest being found in part of the parietal layer of Bowman, s capsule and the thin loop of Henle. The characteristics above showed that the one – humped camel 's kidney possessed a high reabsorption and hence promoting the production of high concentrated urine. The current study was aimed to report some of the histological and ultrastruchural characteristics of the kidney in normal state to provide basic data which will utilized in the other studies.

Key words: kidney, camel, histology, renal corpuscle, TEM.

of animals [4]. Kidneys in camel play a main function in the concentrated urine due to periodic differentiation of the cortex and medulla.

Material and methods

Ten adult healthy kidneys of one – humped camel (*Camelus dromedarius*) were used, bought from slaughterhouse of Al-Samawah city, age between (2-3) years in summer (2020). In histological study, the samples were fixed with 10% formaldehyde solution, and many slides prepared from upper and middle of the renal cortex and renal medulla from the center of the kidney. Their size of pieces were 8mm*7mm*2mm. Paraffin sections were then stained with H&E, PAS and Mallory. A number of samples (about 1 cm³) were collected from cortex and medulla, samples were then processed for ultrastructural technique.

Introduction

Camels are a large animal that lives in deserts with harsh environments. In addition it is thought that the dromedary was first domesticated in southern Arabia about 5000 years ago. It is used for transport and for meat and milk [1]. The function of urinary system, especially kidneys is to excrete the waste products and nitrogenous substances, and maintain the balance of salt in the body with regulation the blood pressure by manufacturing some enzyme such as rennin [2]. The kidneys of dromedary camel are bean shape located in the lumber area, outside the peritoneal cavity and surrounded by large amount of fat. The renal parenchyma surrounded by thick fibrous capsule, and consist of two areas, cortex and medulla. Cortex is granulated appearance, reddish brown in color, the medulla is striated and pale [3]. The histological and functional of kidney contain chiefly of renal nephron and collecting ducts. The thickness of medulla with the long loop of Henle is the best adaptive features in the kidney

Histological results

Approximately (63.17%) nephrons originate in glomeruli located in sub-capsular & mid-cortical region of the cortex & have relatively short loops of Henle. The remaining (34.23 %) originate in glomeruli located in the juxtamedullary cortex, with long loop nephrons. The renal medulla consists of outer and inner medulla. The vasa recta in the outer medulla were well developed. The change of the simple cuboidal epithelium lining the descending limb of loops of Henle was observed (fig.5). The wall of collecting tubules (fig.6,7) are lined with simple cuboidal epithelium. Their cytoplasm was bright and the boundary was clear.

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Table (1) showing the distribution and diameters of renal corpuscles

| Measurements of renal corpuscles | Percentage Means \pm S.F. | Diameter Mean \pm S.F. |
|----------------------------------|-----------------------------|--------------------------|
| Sub capsular region | 22.12 \pm 0.13 | 112.3 \pm 0.5 |
| Mid cortical region | 37.05 \pm 0.12 | 125 \pm 0.3 |
| Juxtamedullary region | 31.23 \pm 0.12 | 124 \pm 0.1 |

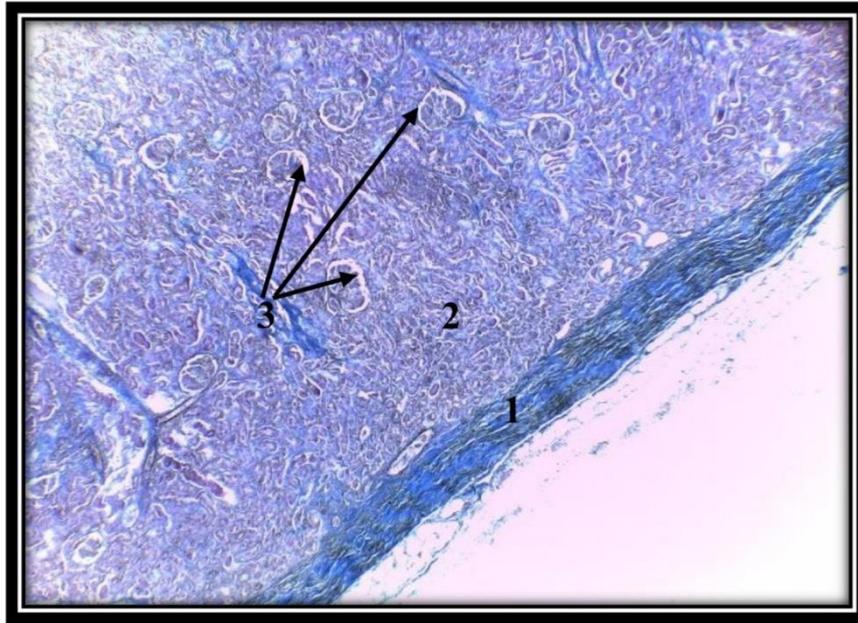


Fig. [1] cross section of kidney show [1] renal capsule [2] renal cortex [3] renal corpuscles. Stained with Mallory, low power magnification 4x.

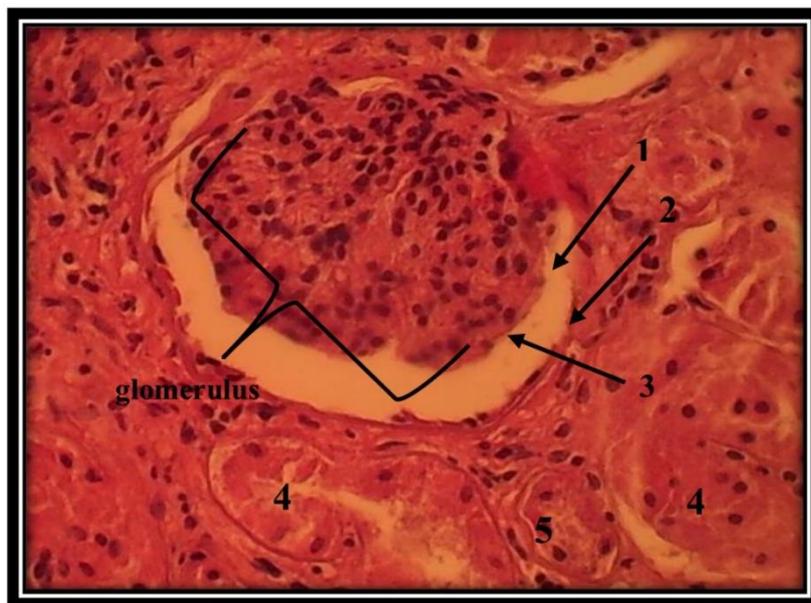


Fig.[2] renal corpuscle with glomerulus, Bowman space[1], parietal layer[2], visceral layer[3], Proximal tubule [4], distal tubule[5], high power magnification 40x. Stained with H&E.

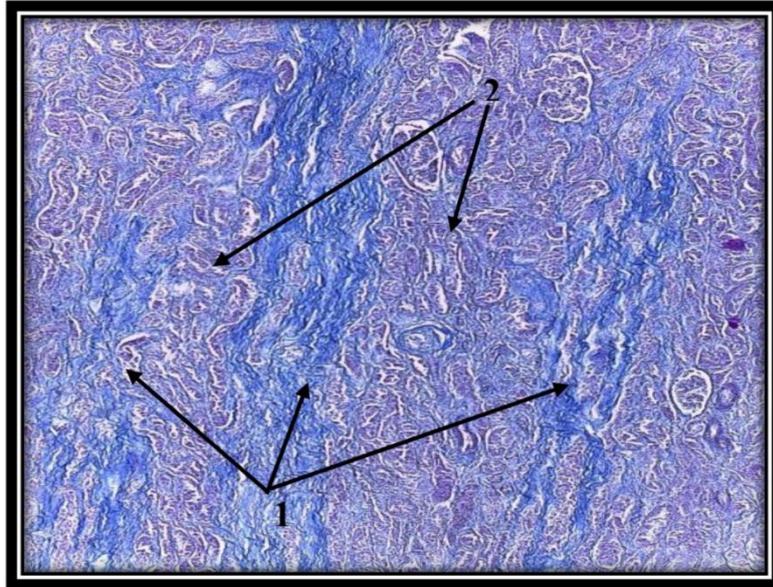


Fig. [3] cross section in cortex show, medullary ray[1], cortical labyrinth[2],low magnification 10x. Stained with Mallory.

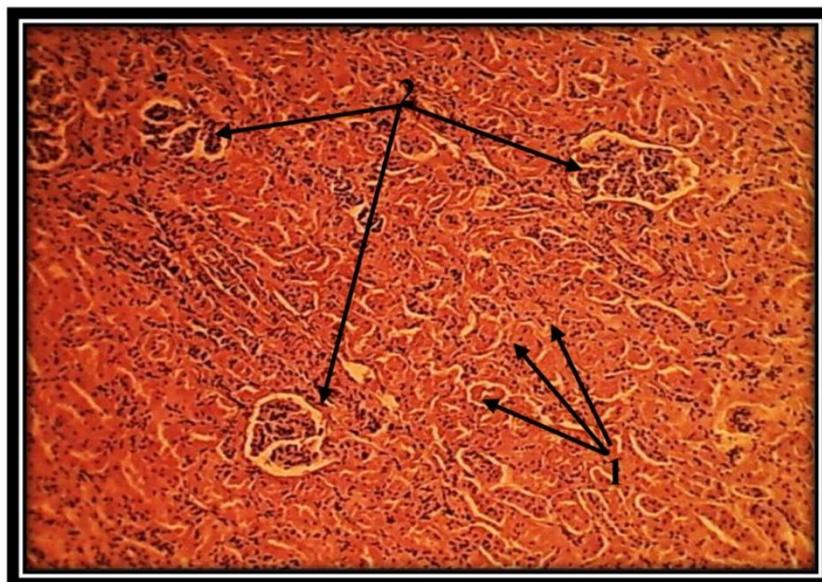


Fig. [4] cross section in cortex show proximal convoluted tubules[1], distribution of renal corpuscles[2], low magnification 10x. Stained with PAS.

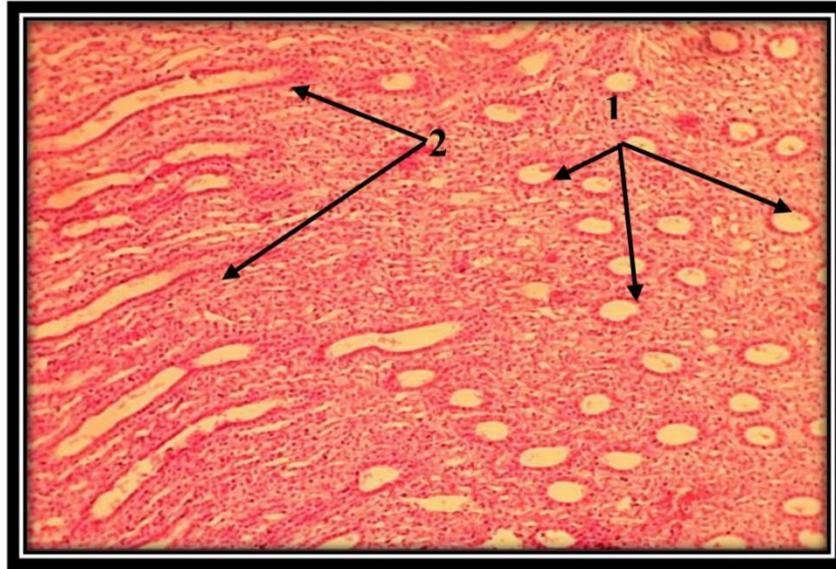


Fig. [5] cross section in medulla show thick loop of Henle[1], collecting tubules[2], low power magnification 10x. Stained with H&E.



Fig. [6] cross section in medulla show collecting duct with cuboidal epithelium, high magnification 40x. Stained with H&E.

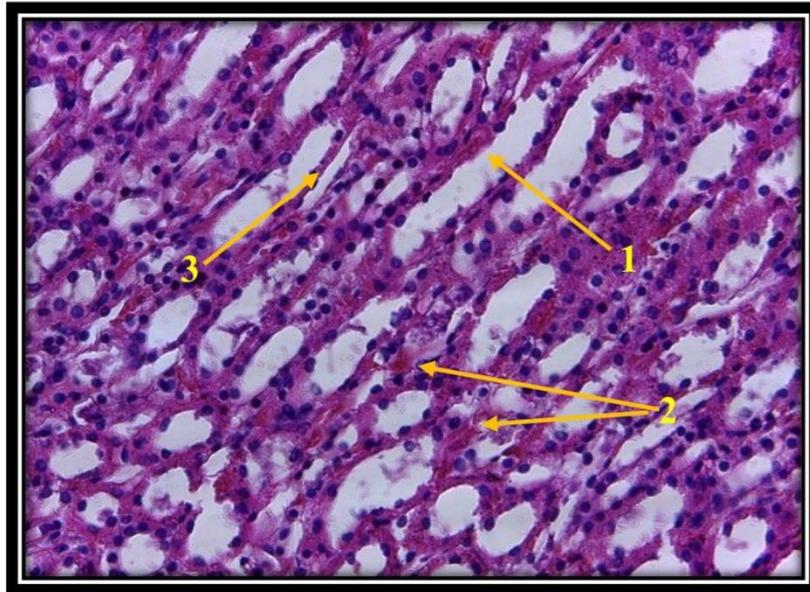


Fig.[7] cross section in medulla show collecting tubule [1], vasa recta [2, thin loop of Henel [3], high power magnification 40x. Stained with Mallory.

processes of the cells of the body and surround an oval to irregular shape nucleus. The pedicels lack organelles, having cytoskeletal elements. In proximal convoluted tubule[fig 10] each cell has numerous mitochondria, many of which are elongated and oriented api – basally within the cell. In addition, the nucleus is round and positioned toward the base of the cell. Proximal convoluted tubules of camel have thick basal lamina. The cuboidal cells of the distal convoluted tubules[fig 11] contain round apically located nuclei and cytoplasm that contains numerous elongated and sometimes branching mitochondria that are often partitioned within long basal

Ultrastructural results

Ultrastructurally, each glomerulus is surrounded by thickened capsule (Bowman's capsule) composed of two layers [fig 8]: The visceral layer of the glomerular capsule is composed of simple squamous epithelium, it is tightly associated with the glomerular rete on one side, it is free of any contact on its other side, exposed to the urinary space that exists between the glomerular epithelium and the rest of the glomerular capsule. The outermost portion of the glomerular capsule which remains free, is the parietal layer. This layer consist of simple squamous epithelium cells of this epithelium are podocytes. The podocyte [fig 9] has the organelles that are scattered within the large

infoldings and scattered rough and smooth endoplasmic reticulum.

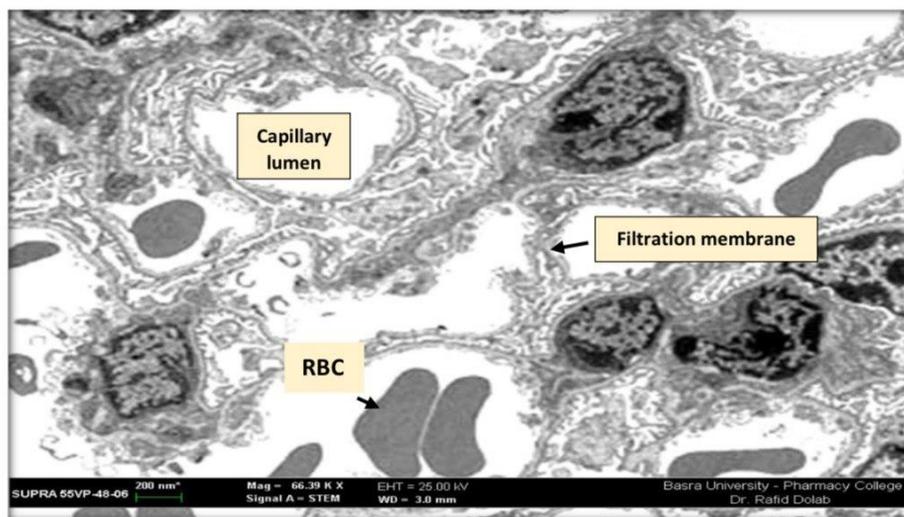


Figure [8] transmission electron micrograph of glomerular capillary loop show, capillary lumen, filtration membrane and RBC, Mag. 34.85 k x.

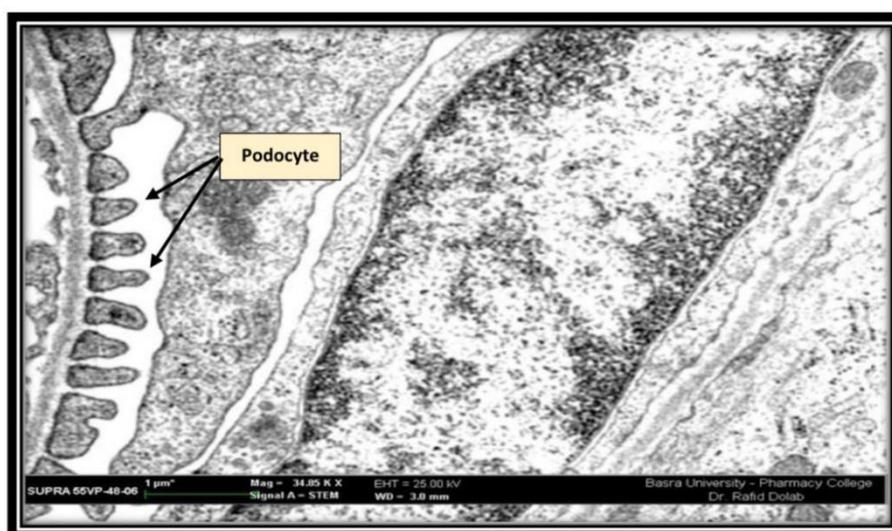


Figure [9] transmission electron micrograph of capillary glomerulus show, podocyte of basement membrane, Mag. 66.39 k x.

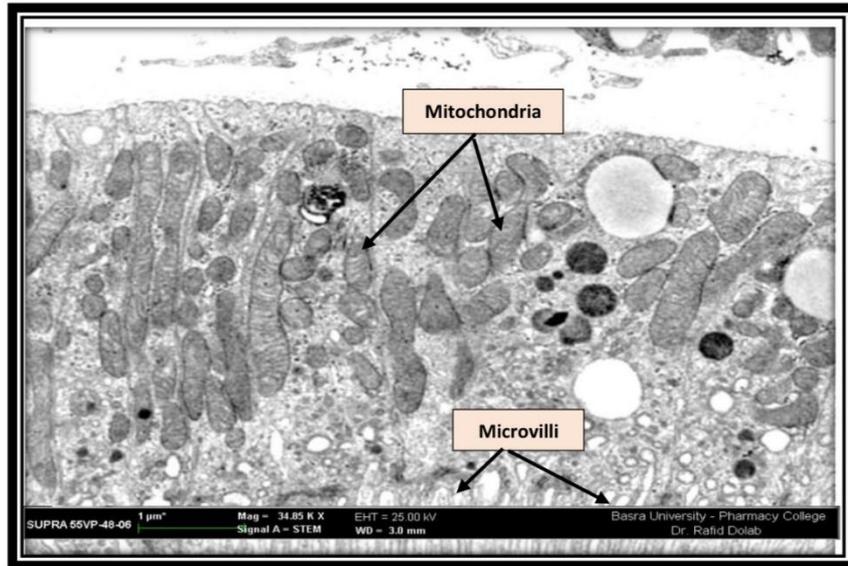


Figure [10] transmission electron micrograph show various size of mitochondria and microvilli [brush border] of the proximal convoluted tubule, Mag. 34.85 k x.

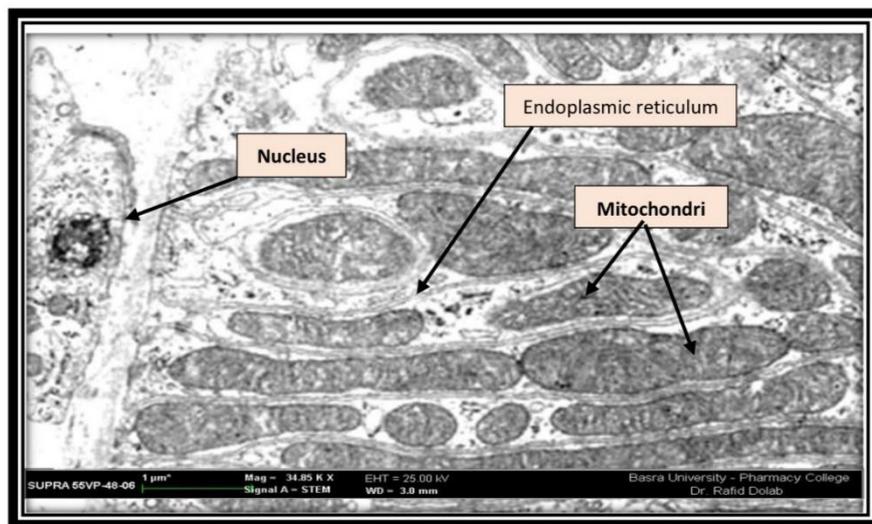


Figure [11] transmission electron micrograph of the distal convoluted tubule show nucleus, mitochondria and endoplasmic reticulum. Mag. 34.85 k x.

modifications which helped the animals to adept with water shortage. A close attachment between the collecting ducts and loops of Henle and blood vessels. The flat lining epithelia play very important role to facilitated the transports of water and electrolytes. These leads to excrete a very concentrated urine, this fact was explained by [13] found that the endothelia thickness fenestrated blood capillaries and the internal veins are capable of sustaining passive transport between plasma and the renal interstitial connective tissue. The ability of kidney to concentrate urine was depended on the extensive length of the inner and concentrate urine was depended on the extensive length of the inner and outer medulla [14]. All what was mention proved that the camel kidney had a good ability to conserve water and produce high concentrated urine. Camel has a thick basal lamina of blood capillaries endothelium of the glomerulus, a large number of podocytes pedicels which support the glomerular capillaries this result agree with [15] and will help the camel kidney in water retention and producing hypertonic urine. proximal tubule cells have vertical mitochondria located adjacent to deep infoldings of

Discussion

In the current study that the renal capsule of one camel composed of collagen fibers and smooth muscles fibers distributed deeply. This result was mentioned by [6] who found that the renal capsule of pig composed of dense fibrous connective tissue and smooth muscle fibers present in inner layer. In comparsion with renal capsule of dog was contained collagen fibers. [7] Showed that the renal capsule in rat sand rodent was devoid of smooth muscle fibers, this result disagreement with our result. Its conclude that the thickness of the capsule may play important role in the reabsorption function of the camel's kidney, this result was agreement with [8, 9, 10]. They mentioned that the decapsulated kidney lost the ability of filitration blood and the parenchyma of kidney was easily to be damaged. In the middle region of the renal cortex, large diameter of the renal corpuscles were distributed. In camel, renal corpuscles had longer loops of Henle and high number. In desert animals, the microvilli of proximal convoluted tubules, cells were increased the water reabsorption. This mentioned by [10, 11, 12] who enumerated many

4. Zuleta, C. ; Caviedes- Vidal, E. and Garland, T. Kidney Mass and Relative Medullary Thickness of Rodents in Relation to Habitat, Body size, and Phylogeny, *Physiological and Biochemical Zoology*.2004; 77(3):346-365.5.
5. Luna, L.G. *Manual of Histological Staining Methods of the Armed Forces Institute of Pathology*. 3rd edn, McGraw Hill Book Company, New York. 1968.
6. Seema Sikarwar, Rakesh Mathur, Sanjeev Joshi, Geeta Beniwal Ruhil and Vikas Khichar. *Histological Study on capsule of the kidney in large white Yorkshire Pig (Sus scrofa)*; *Indian Journal of Veterinary Anatomy*.2017; 28(2):29-30.
7. Dellmann, H. D. and Brown, J. *Textbook of histology* 3rd Ed. Lea and febiger, Philadelphia. 1993;Pp: 210- 220.
8. Hebert, L. A.; Stuart, K. A. and Stemper, J. A. Effect of renal decapsulation on renal function. *Is J Physiol*. 1975; 229 (3):632-639.
9. Khraibi, A. A.; Knox, F. G. Effect of renal decapsulation on renal interstitial hydrostatic pressure and

the basolateral plasma membrane this result agrees with [16]. But in distal tubule, mitochondria is located basal to the apically situated nucleus the similar result is observed by [17]. The significant reduction in the number of mitochondria and microvilli reflects the diminished reabsorptive role played by the distal tubule as compared with proximal tubule [18].

References

1. Abbas B, Tilley P. Pastoral management for protecting ecological balance in Halaib District, Red Sea Province, Sudan. *Nomadic Peoples*. (1990);29: 77-86.
2. Barrett JM, Kriz W, Kaissling B and de Rouffignac C. The ultrastructure of the nephrons of the desert rodent (*Psammomys obesus*) kidney. II. The thin limbs of Henle of long- looped nephrons. *American Journal of Anatomy*. 1978; 151:499- 514.
3. Dyce, K. M.; Sack, W. O. and Wensing, C. J. G. *Textbook of veterinary anatomy (The Urogenital Apparatus)*. 4th Edition by Saunders animprine of Elsevier Inc. Philadelphia. London. New York. 2010.

- heteromyid (*Perognathus Penicillatus*). Am J Anat. 1981;161(1):33-47.
15. Elger, M.; Kriz, W. and Hosser. H. How does podocyte damage result in tubular damage? Kidney Blood Press Res. 1998; 22: 26- 36.
 16. Baragooth, A.F.; Al-Aaragi, A.S. and Medakel, M. S. A Histology Study of Renal Corpusclenephron Distribution in Iraqi Camels (*Camelus dromedarius*). Indian Journal of Forrensic Medicine and Toxicology. 2020;Pp: 2482-2483.
 17. Hussin, A. M. Seasonal Histological changes in kidney of one humped camel *Camelus dromedarius* in middle of Iraq. A thesis Vet. Medicine College, University Baghdad. 2003;Pp: 29-32.
 18. Jill, W. Verlander. Normal Ultrastructure of the kidney and Lower Urinary Tract. SAGE Journals. 1998.
 - natriuresis. Am J Physiol. 1989; 257(2): 44-48.
 10. Valtin. H. Structural and Functional heterogeneity of mammalian nephron. Am J Physiol. 1977;233(6): F491-501.
 11. Villa-Belosta,R.; Ravera, S.; Sorribas, V.; Stange, G.;Levi, M.; Murer, H.;Biber, J. and Forster, I. C. The Na-Pi cotransporter PIT-2 (SLC20A2)is expressed in the apical membrane of rat renal proximal tubules and regulated by dietary Pi Am J Renal Physiol. 2009; 296-699.
 12. Mbassa, G. K. Mammalian Rrenal Modifications in Dry Enviroments. Veterinary Research Communications. 1988;12:1-18.
 13. Jones, W. R. and O'Morchoe, C.C. Ultrastructural evidence for a reabsorptive role by intrarenal veins. Anat Rec. 1983;207(2):253-62.
 14. Nagle, R.B.; Altschuler, E.M.; Dobyen, D.C.; S. andBulger, R.E. The ultrastructure of the thin limbs of Henle in Kidneys of the desert

دراسة نسيجية – وتركيبية دقيقة لكلية الجمل وحيد السنم

بان كاظم يوسف¹ ، عادل جبار حسين²

الخلاصة

اجريت الدراسة الحالية في كلية الطب البيطري جامعة البصرة لغرض الدراسة النسيجية والتركيبية الدقيقة للجمل ذو السنم الواحد استخدمت في الدراسة عشر نماذج من الكلى من المجازر في السماوة بعمر (2-3) سنوات في صيف (2020). في الدراسة النسيجية تم تثبيت العينات بمحلول الفورمالين بتركيز 10% وعمل عدد من الشرائح الزجاجية من اعلى ووسط القشرة من منتصف الكلية بحجم 8مم * 7مم * 2مم حيث تم صبغ المقاطع بصبغة الهيماتوكسلين ايسين، صبغة كاشف شف الدوري وصبغة ماسون ثلاثي الكروم. عدد من العينات بحجم (1سم3) تم جمعها من القشرة واللح حيث حضرت العينات باستخدام تقنية المجهر الالكتروني. بينت الدراسة في كلية الجمل وجود فروق معنوية في انتشار الكليونات في القشرة حيث كان انتشارها اكثر في المنطقة القشرية الوسطى واقل منه باتجاه اللب الداخلي وان قطر الكبيبة في المنطقة القشرية الوسطى مشابه لما هو عليه في اللب الداخلي. اكدت نتائج الدراسة باستخدام المجهر الالكتروني امتلاك الجمل غشاء قاعديا سميكاً في بعض اجزاء الكليون خاصة الطبقة الجدارية لمحفظه بومان والقطعة الرقيقة لعروة هنلي. نستنتج مما ذكر اعلاه ان كلية الجمل تمتاز بقدرة عالية على اعادة امتصاص الماء وزيادة تركيز البول.

مفتاح الكلمات: الكلية، الجمل، علم الانسجة، الكبيبة، المجهر الالكتروني النافذ.