Histomorphological and Radiology study of the Kidney of One Humped Camels Camelus dromedarius

By

Amna Ibrahim Mohammed

Supervised by

Dr. Abdulrazzaq baqer

2018

بسم الله الرحمن الرحيم

فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلَا تَعْجَلْ بِالْقُرْآنِ مِن قَبْلِ أَن يُقْضَى

إِلَيْكَ وَحْيُهُ وَقُل رَّبِّ زِدْنِي عِلْماً

صدق الله العظيم

سورة طه الآية ١١٤

Dedication

To reap the thorns out of my way for me to pave the way to the flag ... Big Heart

(my father)

To breastfed of love and compassion..into a symbol of love and healing balm.. to the heart brilliant in white

(my mother)

To pure hearts and souls innocent

(brothers and sisters)

Amna

Acknowledgments

In the name of Allah, Most Gracious, Most Merciful Praise to be God, Lord of the universe, and peace and prayers be Upon our Prophet Muhammad, his family, and all of his companions Now and then.... we would like to express my special appreciation and thanks to my suporvisor **Assist. lecture. Abdulrazzaq baqer** for providing me with valuable advices and necessary observation research work.we would like to express my gratitude to all my friends, for providing me with many helpful comments, we would like to express my sincere gratitude to all my friends, nevertheless their names and who I was not remember .

Amna

Summary

Morphological characteristics of the kidneys in the one-humped camels were investigated using the anatomical and histological methods. The 2 kidneys in the camel contributed about 0.6% of the body weight. The ratio of the thickness of the renal medulla to the cortex was 4:1, which indicated that Henle's loops in camels kidneys were very long. In cortex, there were more juxtamedullary nephrons and mid-cortical nephrons which had longer Henle's loops. Proximal convoluted tubules were far longer than the distal ones.In the outer medullary zone, the vasa recta were grouped obviously into specific vascular bundles which alternated with the bundles of Henle's loops and collecting tubules. The inner medullary zone was thicker than the outer one. Specialized fences were formed by projecting on either side of the pelvis and extended between renal pyramids to the medullary outer zone where second pyramids clearly occurred. The characteristics above showed that the kidneys in camels possessed a strong reabsorption and hence promoting the production of high concentrated urine.

Introduction :

A camels are a large animal that lives in deserts with a harsh environment. In addition to lack of food and water, camel treats the food that cannot be used by other animals. The function of urinary organs, especially the kidney is to excrete the waste and nitrogenous substances, excess of blood added to the organization of fluids and maintain the balance of salts of the body and thus maintain the pressure in the blood and tissues and the kidney is also manufacturing some hormones such as rennin and arthropyutin. Barret *et al*,. (1978). The kidneys are exogenous pairs that have a shape resembling a bean. The kidneys are located in the lumbar area so that the right kidney is adjacent to the caudal vena cava while the left kidney is related to the abdominal aorta. The right kidney is superior to the left kidney and this is evident in horses and dogs and less in cats and pigs. Jones and Morchoe, (1983).The kidneys are outside the peritoneal cavity and surrounded by a large amount of fat in most mammals. Blood supply of kidney come from the renal artery, which is inter of the kidney via hill us. One-humped camel of the largest ruminant animals, which has the ability to withstand the thirst of the desert due to some physiological and morphological characteristics of the urinary system. Kidneys in camels typically play a main function in the preservation of biological activity through the production of concentrated urine due to the periodic differentiation of the cortex and medulla. So that necessary study these morphological, anatomical and histological characteristic kidney in a one -hump camel. Angiography is main, The blood vessels of the kidney are coursed during in all directions of the kidney are detected by using radioactive material such as barium sulfate, which is injected directly into the arteries, this method useful for diagnosis more the disease in blood vessels Tian, (1993) ; Cheng, (1994).

Material method

Six pairs of kidneys collected from the animal massacre in Diwaniya were used from healthy male and female animals for anatomical, histological and radiological studies.

Anatomical study: The anatomical study included 6 kidneys where the topical relationship of the kidneys was recorded in the situation. After removal of the kidneys from the animal, the anatomical measurements and measurements of the kidney were recorded, including weight, color, height and thickness. Offset in graduate cylinder. The number of renal pyramids and renal columns was calculated. Two kidneys (left and right) were used to study the blood length of the kidney through the use of zinc resin. Resin selected and which has been used in this study (fast fix Pyrex) should not show any change in size during its placement (soledivacation) and have a suitable viscosity at room temperature similar to that of blood. Dealing after cleansing (Thompson, 1970). We chose (Pyrax Quick Fix), liquid and powder product by Pyramax Polymers, RURKI 247667 India.

Cast: The appropriate plastic cannula (10mm) was inserted into the diameter through the renal artery and fixed by silk surgical suture to prevent the discharge resin during injection. The resin was prepared to set after 10 minutes. The hands were injected by hand-squeezing using a plastic syringe of 100ml, injections start 5 minutes before the previously determined setup time. The samples were injected by 01ml of the resin, leaving a wet injection sample overnight at room temperature (25-30 c^{o}) to complete the setting and hardening of the resin. After complete solidification each sample was transferred to the next step which was bleach. And then each sample of a separate plastic jar is taken from a suitable size of 1000 ml of 40% COH for 4-5 days after the completion of the disinfection occurs completely washed with tap water for at least one hour, then cast through hot air To be ready for examination either by Nick's eye or dissecting the microscope.

Histological study: 2 kidneys (left and right) were used. The sample was taken as soon as possible. These samples were installed in 10% formalin and the solution should be 1:10 of the size of the sample and left for 48 hours (Luna, 1968). After the installation, the tissue was trimmed and the samples were washed with tap water for 4-6 hours to remove the formalin solution and the steps began to complete the tissue processing and use two types of staining hematoxlyine and eosin (HαE) and periodic acide suffte (PAS).

Radiological study: 2 kidneys were used, this is done by inserting a canola into the renal artery and wash the kidney well with a worm normal saline fluid and then injecting the radio opaque suspension (barium sulfate) 40 KVP and by stable digital pressure, after satisfactory filling, the radiographs are radically scanned for radiographic imaging depict the branching prototype of the artery.

Results:

Anatomical result:

The kidneys in camels are similar to the bean plant, they form an unallocated form of brown or red color and are surrounded by a portfolio of fibrous tissue that is less transparent. When a longitudinal section of the kidney is found, there are two different layers of the capsule attaches firmly to the outside of the kidney except the hillus. Tow the surface. Dorsal and ventral surface. Two borders one lateral, medial edge. The left kidney is less elongated than the right kidney. (Fig.1).The right kidney is located under the transverse vertebrae of lumbar vertebrae 2, 3 and 4. The anterior pole is round and corresponds to the parietal lobe of the liver. The posterior pole in the dorsal abdominal area is flat. The left kidney is located below the transverse vertebrae of the lumbar vertebrae 5,6,7, and its location is unstable depending on the rumen saturation ratio of the fodder or the uterus may contain a fetus.(Fig.2). On the medial edge of both kidneys there is a drop called Hilus, where it ends with a central ventricle called the sinus that includes the renal pelvis. Each kidney has a blood supply by the renal artery, which is a branch of the aorta. The renal artery is divided into 2-3 branches before entering the renal pelvis, which corresponds to the renal artery in the renal vein(Fig.3).

The crust is defined as the outer layer of the kidney and is soft, granular and has a brown color. Renal medulla represents the inner layer of the kidney, consisting of cone parts called the renal pyramids where the pyramids' bases go to the outer perimeter of the kidney and head toward the renal artery. These nipples combine to form one nipple called the general renal papillae (Fig.4) At results mean weight , length , volume , length of medial border ,length of lateral border , thickness of cranial ,middle and caudal regions respectively , width of cranial, middle and caudal regions respectively, thickness of cortex ,thickness of medulla, thickness of renal pelvis ,numbers of of renal pyramid and numbers renal column of right kidney was 1555± 120gm , 18.033±0.7cm , 4.79±0.188ml , 20.13±1.2 cm , 60.11±3.6 cm , 110.02±4.6 cm, 83.0.7±5.6 cm , 110.11±5.6 cm , 65.18±3.6 cm , 65.11±3.3 cm, 100 ±8.6 cm, 18.07±1.6 cm, 50.14±1.2 cm, 30.11±1.1 cm, 15 and 12 . While the left kidney was 1450± 113gm. 15.033±0.5cm, 3.70±0.175ml, 16.11±0.8 cm, 33.05±2.1 cm, 114.01±9.6 cm, 83.05±6.6 cm, 125.11±7.3 cm, 60.11±3.6 cm, 61.09±3.1 cm, 80.01±4.6 cm, 15.11±0.6 cm, 33.11±1.2 cm, 20.11±1.3 cm, 15 ,12 (Table1).

The fibrous capsule surrounds the kidney from the outside, but is penetrated by the blood vessels passing from the cortex to the fibroblast at the kidney's navel, so that they are connected to the parietal layer of the renal pelvis, ureter and blood vessels. The kidney is divided into an outer shell and inner marrow. With a thickness of cortex 18.07±1.6 cm in the right kidney while in the left kidney is 15.11±0.6 cm . The cortex is surrounded by a pyramidal part of the medulla so that the cortex is fully bound and parts of it extend between each adjacent renal pyramidal Kidney column, which number in both kidneys 12 columns consists of cone-shaped and planned blocks and their number in both kidneys is 15 pyramids. The renal pyramids of the kidney are separate from each other. The base of each pyramid is in the direction of the cortex while the top of the pyramid ends with the renal papilla. The renal papillae combine with each other, forming a general renal papilla and a form called renal crest(Fig.4). There is a large part of the ureter called the renal pelvis found in the renal sinus is the thickness of the right kidney 30.11±1.1 cm while the 20.11±1.3 cm in the left kidney

Radiology study: Contrast is rapidly injected into blood vessels and a series of images are taken rapidly to follow the flow of contrast in the blood vessel. kidney gets a lot of blood through the renal blood vessels the interlobar arteries, reaches the arteries a few distance to the pinnacle of the renal pyramid and connects the renal pyramids through the renal columns is located between the renal pyramids located between the renal pyramids and even reaches the sub-cortical zone and gives the arched artery (arcuate arteries) which ended up sprouting many of the radioactive arteries and a link to the renal cortex by interlobular arteries (Fig.5).

Blood supply by cast: The renal artery is entrance the kidney from hilus . are drived from renal artery ,trajectoried toword medulla of the kidney ,give the arched branches named arcuate arteries in the corticomedullary junction (fig.6) The arcuate arteries are coursed curvally in right angles directally distinct 2-4 branches and separated in to 2-5 terminal branches which is called interlobular arteries as radiating

manner and give afferent arteries while the efferent arteries come from glomerulus .The interlobar arteries are divded in to several small branches in medulla of kidney called arterioles recta vera. The vena cava gives a branch to the kidney called the renal vein that makes its way to the kidney through Helium parallel to the renal artery is divided into 2-3 segment veins at the entrance from helium to renal cortex. After the entrance of helium the renal vein continues for a very short distance of the kidney artery so that it reaches the top of the renal pyramid and through the columns renal extends the name of the vein between the lobes and thus forms the outer limit of the renal pyramid and gives the arched vein and thus giving the branches of radial vein in the direction of the renal cortex (fig.7).

Histology: The kidney is surrounded by thick and large, dense irregular connective tissue with fine, smooth muscle fibers called renal capsule. The renal cortex was poised in a cortical maze and medullary radiation(fig.8). In the cortical maze, amount of the proximal convoluted was more than the distal convoluted tubule.The proximal convoluted tubule has development microvilli are formed brush border in contrast distal convoluted tubule(fig.8).The cortex in the center has consisted of numerous renal corpse which is the different size and have a Bowman s capsule and nephrons, the latter is divided into three parts, the juxtamedullary nephrons and the intermediate nephrons was much more than that of the superficial nephrons(fig.9). Medullary beams widened out progressively from the case to the cortico-medullary intersection, continuing the parallel uriniferous tubule and a lot of vessels(fig.9). The blood vessels in the cortex were reserved firmly near the renal tubules and the conveyance was exceptionally rich among them, and it possessed the majority of renal interstitium.The medulla could be separated into medulla externa and medulla interna. In the medulla externa the vasa recta was well developed. Under the cortical maze, it expanded and shaped wide vasa rectae packs. The last was masterminded on the other hand, with the uriniferous tubule packs of the cortical medullary beams(fig.10). The vascular bundle was nearly equal to that of the uriniferous tubule bundle. Inside the vascular bundle, the thin segment of the renal tubule was not seen. The dissepiment of Vasa recta was very thin. The difference in the basic cuboidal epithelium coating the diving appendage into straightforward squamous epithelium covering the thin portion of the dropping appendage of Henle's circle was clear. In an irritated section of the medulla interna, collecting tubule, skinny sections of the dropping limbs, pars rectae and additionally many blood vessels between them could be watched. The tubal wall of pars recta was shaped of low simple cuboidal epithelium, the cytoplasm was addicted to eosin and the boundary was unsharpened. The mass of the gathering tubule is work of normal straightforward cuboidal epithelium. Its cell cytoplasm was brilliant and the limit was clear(fig.10) .The renal corpsules are give positive reaction with periodic acid Schiff (fig.11).

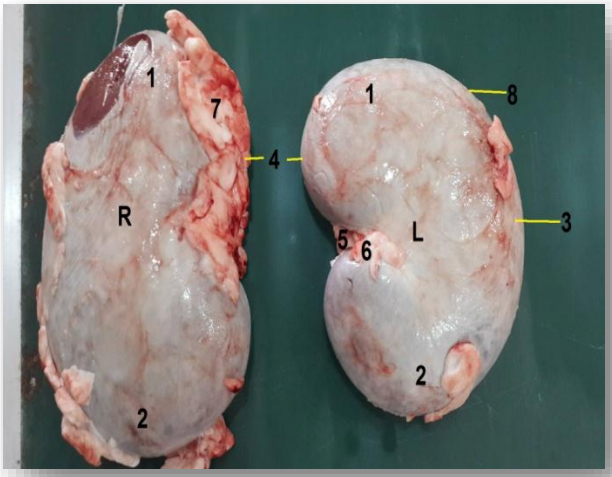

Fig.1:Macroanatomical view show:R-right kidney L-left kidney 1-crainal pole 2-caudal pole 3-lateral border 4-medial border 5-hillus 6-renal artery 7-fat 8-capsule

Fig.2 :Topographic section show : R-right kidney L-left kidney .

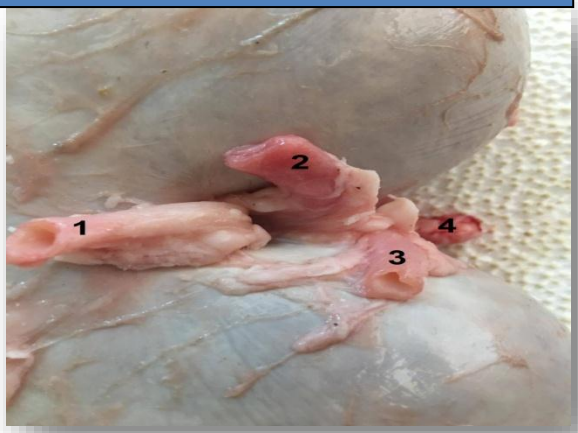

Fig.3: Macroanatomical view show:1,2,3 renal artery branches 4- renal vein

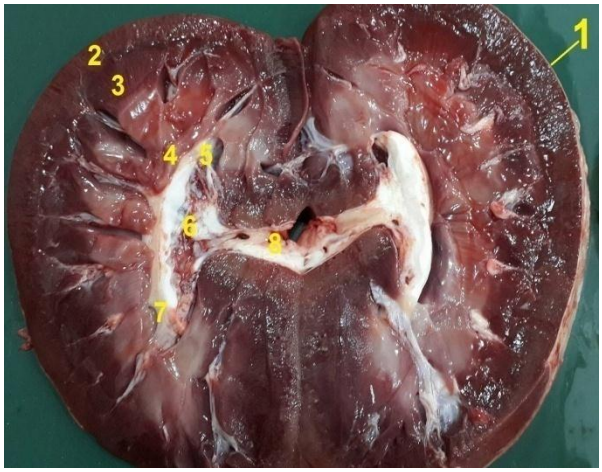

Fig .4:Macroanatomical view of kidney show:1-renal capsule 2-cortex 3-madulla 4,7-renal papilea 5- renal crest 6-renal pelvis 8-hillus

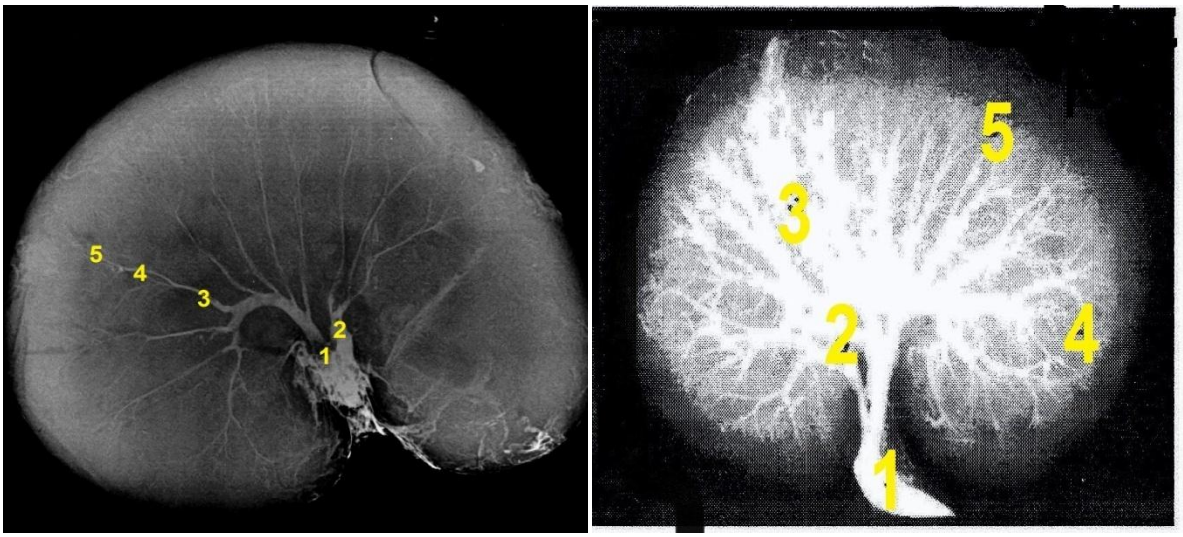

Fig.5: Radiological view of right and left kidney show 1,2-renal artery 3- interlobar artery 4- arcuate arteries 5-interlobular arteries.

Fig.6. Renal artery branches cast show :1-renal artery 2-interlobar arteries 3-arcuate arteries 4-interlobular arteries 5-terminal branches

Fig.7 Blood vessels artery(red) and vein (yellow) cast of kidney show:1,2-renal artery and renal vein 3,4-interlobar 5,6-aruate 7,8 –interlobular 9,10-terminal vessels

Table 1: morphmetric dimension of right and left kidneys in adult camels. **Me±se**

Parameters	**Right Kidney**			**Left Kidney**		
Weight	1555± 120gm			1450± 113gm		
Length	18.033±0.7cm			15.033±0.5cm		
Volume	4.79±0.188ml			3.70±0.175ml		
Length of medial border	20.13±1.2 cm			16.11±0.8 cm		
Length of lateral border	60.11±3.6 cm			33.05±2.1 cm		
Thickness of ‘cranial	**Cranial**	**Middle**	**Caudal**	**Cranial**	**Middle**	**Caudal**
middle and caudal regions respectively	110.02±4.6 cm	3.0.7±5.6 cm	110.11±5.6 cm	114.01±9.6 cm	83.05±6.6 cm	125.11±7.3 cm
Width of cranial, middle	**Cranial**	**Middle**	**Caudal**	**Cranial**	**Middle**	**Caudal**
and caudal regions respectively	65.18±3.6 cm	65.11±3.3 cm	100 ±8.6 cm	60.11±3.6 cm	61.09±3.1 cm	80.01±4.6 cm
Thickness of cortex	18.07±1.6 cm			15.11±0.6 cm		
Thickness of medulla	50.14±1.2 cm			33.11±1.2 cm		
Thickness of renal pelvis	30.11±1.1 cm			20.11±1.3 cm		
Number of renal pyramid	15			15		
Number of renal column	12			12		

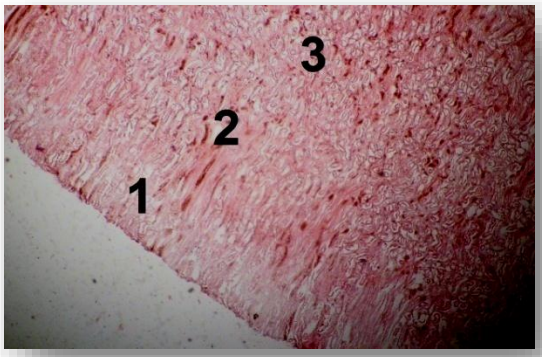

Fig.8. histological view of kidney show 1- renal capsule 2-outer area of cortex 3- urinferous tubules .(HαE) (100X)

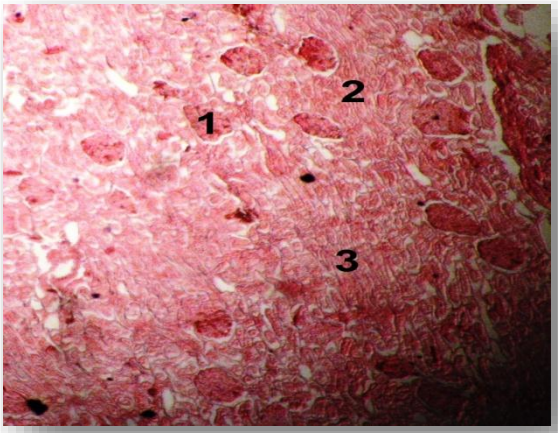

Fig.9. Kidney cortex 1-renal corpsules 2-urinferous tubules 3- medullary ray . .(HαE) (100X)

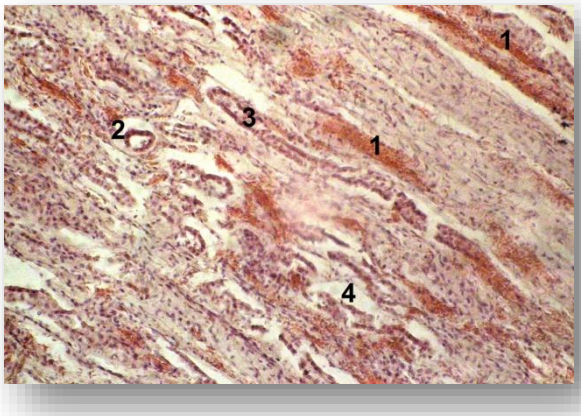

Fig.10.Kidney medulla 1-blood vessels 2-collecting tubules 3-proximal convulated tubules 4- distal convulated tubules .(HαE) (100X)

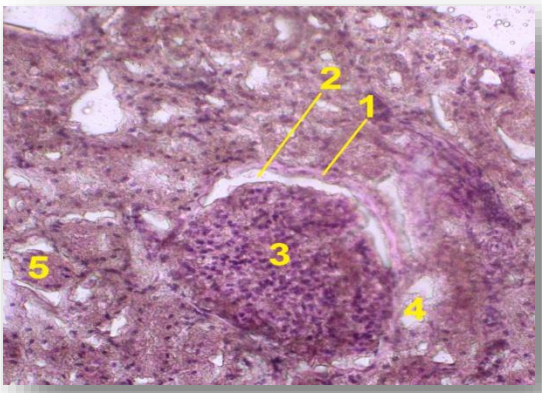

Fig.11 .Renal corpsules 1-powman capsule 2- capsular space 3- glomerula 4- distal convulated tubules with macula densa 5- proximal convulated tubules (PAS) 400X

Discussion:

Animals (such as marinas unguiculataMacropus, African wild donkey, desert goat and sheepetc.) which inhabit the arid or environments with water shortage for a long time, or were accustomed to drink salty water or eat high salty food, have the ability of excreting high concentrated urine. However, animals)such as Sus scrofa domestica, Wildebeest and bedfordiae etc.) which inhabit the moist climate or the regions with adequate water supply, generally, excrete more diluted urine. These properties must be relevant with the thickness of kidney medulla. The proportion of the thickness of the medulla and cortex was 5:1 in Meriones unguiculate, Macropus, African wild donkey, and it was 3:1 in desert goat and sheep, where the medullary portion was broad. However the roportion of the thickness of the medulla and cortex was ١:٥in Sus scrofa domestica and bedfordiae and 1:1 in Wildebeest. The medullas of these animals were relatively narrow (Mbassa, 1988thickness of the medulla and cortex was directly proportional to the relative length of Henle's loop, the larger the proportion, the longer the Henle's loop; and vice versa. Long Henle's loop was helpful for establishing higher osmotic pressure gradient in the medulla, then forming high urinary concentration, and also it could reduce the loss of water in urine. The proportion of the thickness of the medulla to cortex was ٤:١ in the two-humped camel. This could be speculated that the Henle's loop was longer in the former.Moreover, this confirms that the medulla of the one-humped camel have a morphological basis to form a high osmotic pressure gradient.The distribution of the renal corpuscles could not be observed till a distance of 1000 to 1500 µm beneath the renal capsule of two-humped camel in the present study. Nephrons in the central and deepest cortices were distributed widely, but in the medulla interna and renal papilla we could see plenty of thin

segment sections. This indicated that short loop nephrons of the one-humped camel were very few, the majorities were juxtamedullary nephrons and long loop middle nephrons, and its thin segment was long too. Animals which come from the arid region (such as meriones unguiculata and small meriones unguiculata etc.) had more juxtamedullary nephrons and middle nephrons‹Henle's loop and its thin segment was longer, and normally they excrete highly concentrated urine Valtin, 1977. The surface of proximal convoluted tubule had . Increased the absorptive surface area largely achieved with brush border (microvilli). About 70-80% of moisture in the original urine was reabsorbed again here. Beliveau and Bruneter (1984) guessed that animals inhabiting the arid area should have longer proximal convoluted tubule, and it was shorter comparatively in animals inhabiting abundant water source. However, there was no enough morphological evidence to support this view. In the present study, the most of renal tubule sections in the renal cortex were proximal convoluted tubule with well grown brush borders, and distal convoluted tubules were seldom. This demonstrated that proximal convoluted tubule of two-humped camel was long enough, so it has more power than other animals to absorb original urine.The renal vein of the camel is unique and is different from other domestic animals, it could be related to high concentrated urine production. Saber (1987). In the present study, in was observed that the blood supply of one-humped camel kidneys, was abundant, and the relationship between the uriniferous tubules and blood vessels is very close. It might be helpful to promote the movement of substance contained in urine between uriniferous tubule and blood vessel. Stephenson *et al*., (1976) emphasized that the uriniferous tubules and blood vessels were integrated functionality, instead of treating them as 2 isolated sections. After the exit of the efferent glomerular arterioles of the juxtamedullary nephrons from the renal corpuscle, it formed straight arterioles and descended into the medulla in different depths,and returned into interlobular veins or arcuate veins.Therefore, it would form a lot of "U" shape blood vessel loops in the medulla. In some of the animal's kidney which could produce highly concentrated urine, the vasa recta assembled and formed special blood vessel bundles out of the medulla externa. These blood vessel bundles were arranged alternatively in the uriniferous tubule bundles formed by the straight segments of the Henle's loop and collecting ducts.Kaissling *et al,*. (1975) believed that the short loop nephron, kind of structure. In the present study, we observed that the arrangement of the vasa recta in the two-humped camel's kidney was very special, which assembled and formed obvious vascular bundles in the medulla, and arranged alternately with the uriniferous tubule bundles. In the medulla externa, this kind of vascular bundles was particularly broad. Being different from mixed with thin segment of vasa recta was a typical structure of small desert animal kidneys.Moreover, they pointed out that macrofauna living in the arid environment with few water supply lacks this small-sized desert animals, and in contrary to the standpoint of Kaissling *et al*., (1975), the distribution of the thin segment could not be seen in the vasa rectae of the one-humped camel's kidney. The alternative arrangement mode of rectiserial Henle's loop and uriniferous tubule was the important factor for reabsorbing the moisture in original urine and exchanging the other substance, and then producing high concentrated urine .Jones and Morchoe, (1983).However; in one-humped camel kidney, the medulla interna

was well grown. The renal pelvis gave off mucous prominences from the ventro-dorso and stretched to the medulla externa, and formed distinct secondary pyramid. This demonstrated that the renal pelvis of the one-humped camel belongs to the model-II renal pelvis, and is responsible for the ability of producing highly concentrated urine. The appearance of the advanced medulla interna, renal pelvis projections and secondary pyramids was helpful to produce the highest concentration gradient in the medulla, and then concentrated urine in desert rodent.Barret *et al*,. (1978).The kidney weight and its ratio of the body weight were different in different species. The kidney weight of rabbits, pigs, humans, horses and oxen was 18-24g, 400-500g, 300g, 900-1500g and 1200-1400g,respectively. The percentage of the kidney's weight to the body weight was 0.6%-0.7%, 0.5%-0.6%, 0.4%,0.29%-0.39% and 0.2%, respectively .Tian, (1993) ; Cheng, (1994). Generally, the bigger the animal's physique, the smaller the ratio, and vice versa. There was an inverse proportion between the physique and the percentage. However, the physique of the one- humped camel was bigger and its percentage was nearly the biggest (0.6%). It points to the ability of kidney of one-humped camel in handling urine.

References :

Barrett JM, Kriz W, Kaissling B and de Rouffignac C (1978).The ultrastructure of the nephrons of the desert rodent (Psammomys obesus) kidney. II. The thin limbs of Henle f long-looped nephrons. American Journal of Anatomy 151:499-514.

Beliveau R and Brunette MG (1984). The renal brush border membrane in man, protein pattern, inorganic phosphate binding and transport: comparison with other species.Renal Physiology 7(2):65-71.

Chen QS and Liu Y (2000). Distribution of the renal artery in the kidney of two-humped camels, bactrian camel.Chinese Journal of Veterinary Science 20(6):565-568.

Cheng LZ (1994). Histology (2nd Edn.), Beijing: People's Wealth Press, PR China. pp 1282-1339.

He YQ, Wu G, Liu ZX and Zhang YQ (1999).The dynamic study of antidiuretic hormone (ADH) and aldosterone (Aldo) contents in blood serum under the different conditions of water drinking on bactrian camels. Acta Veterinaria et Zootechnica Sinica 30(2):117-120.

Jones WR and O'Morchoe CC (1983). Ultrastructural evidence for a reabsorptive role by intrarenal veins. The Anatomical Record 207(2):253-262.

Kaissling B, de Rouffignac C, Barrett JM and Kriz W (1975).The structural organization of the kidney of the desert rodent (Psammomys obesus). Anatomy and Embryology 148:121-143.

Mbassa GK (1988). Mammallian renal modifications in dry environments. Veterinary Research 12:1-18.

Shui SR (1990). Primary discuss on thirsty-resistant of camels.Journal of Inner Mongolia Institute and Animal Husbandry 11:55-59.

Saber AS (1987) : Distribution of the renal vein in the kidney of the dromedary (Camelus dromedarius). Acta Morphology Neerl. Scand 25:173 185.

Stephenson JL, Mejia R, Tewarson RP (1976)., Model of solute and water movement in the kidney. Proceedings of National Academy of Sciences of the United States of America, National Academy of Sciences. pp 252-256.

Tian JC (1993). Anatomy and Histology and Embryology of Livestock and Poultry. Higher Education Press, Beijing.pp 299-302.

Valtin H (1977). Structural and functional heterogeneity of mammalian nephrons. American Journal of Physiology 233:F491-F501.

Xiang GH and Wu AG (1997). Dynamic relationship between the water metablism and the concentrations of blood inorganic ions in the two-humped camel (Camelus bactrianus). Chinese Journal of Veterinary Science 17:490-494.

Zhao XX (1995). Ecophysiology and Reproduction of the Camelidae. Gansu Science and Technology Press,Lanzhou. pp 76-78.

الخلاصة:

تم التحقق من الخصائص المورفولوجية للكلى في الإبل ذات الحبل الواحد باستخدام الأساليب التشريحية والنسيجية. ساهمت الكليتان في الجمل بنحو ٠,٦٪ من وزن الجسم. وكانت نسبة سمك النخاع الكلوي إلى القشرة ٤: ١، والتي أشارت إلى أن حلقات هينلي في الكلى الإبل كانت طويلة جدا. في القشرة، كان هناك المزيد من نيفرون جوكستامدولاري والنيفرونات منتصف القشرية التي كان لها حلقات هينل أطول. كانت الأنابيب الملتوية القريبة أطول بكثير من تلك البعيدة.في منطقة النخاع الخارجي، تم تجميع المستقيم فاسا بوضوح في حزم الأوعية الدموية المحددة التي تناوبت مع حزم من الحلقات هنلي وجمع النبيبات. كانت المنطقة النخاعية الداخلية أكثر سمكا من المنطقة الخارجية. وقد شكلت الأسوار المتخصصة من خلال الإسقاط على جانبي الحوض ومددت بين الأهرامات الكلوية إلى المنطقة الخارجية النخاعية حيث وقعت .الأهرامات الثانية بشكل واضح. أظهرت الخصائص أعلاه أن الكلى في الجمال تمتلك استيعاب قوي وبالتالي تعزيز إنتاج البول المركزة عالية

دراسة شكلية نسجية وصورية في كلى الجمل ذو السنام الواحد

من قبل

امنه ابراهيم محمد

بأشراف

مدرس المساعد

عبد الرزاق باقر كاظم

٢٠١٨