ANATOMICAL AND HISTOLOGICAL INVISTGATION OF THE KIDNEY IN GOAT (*Capra hircus*)

Ammar Ismail Jabbar[1] **Hanaa kareem Ali**

Raad Shaalan Ibrahim **Alaa Nizaar Lateef**

Depart. of Anatomy and histology, College of Vet. Med., Diyala University-Iraq.

[1]Corresponding author: ammar_histo@yahoo.com

ABSTRACT

Thirty specimens of kidney (15 left and 15 right) from healthy adult goat were used in this study to show the morphology, the vascular architecture and histological structure of the kidney in the goat. The kidneys of goat were fixed in sub lumber region by large amount of peri renal fat as a cushion surrounding the kidneys. The right kidney placed slightly anterior to the left kidney both are bean shape, there is no significant difference in weight of two kidneys. Corrosive resin cast technique was used to investigate the blood supply and collecting system of the urine, the collecting system in the kidneys of goat was formed from several collecting tubules. Each collecting tubule opening into a larger ducts, a papillary duct, close to the apex. The papillary ducts drain into the about 10-12 renal recesses, there was no calyces.

The microscopical examination revealed a thin capsule surrounded kidney, the parietal layer of bowman capsule was simple squamous epithelium, resting on well-developed basement membrane. Well-developed juxtaglomerular apparatus. The luminal surface of the cells of proximal convoluted tubules have brush border which were positive with PAS stain. The henel loop was long. That mean the kidney of goats is maintaining to the water and need for more reabsorption of water.

Key words: anatomy, histology, kidney, goat.

INTRODUCTION

There are over 300 distinct breeds of goat (Hirst, 2008). The domestic goat *(Capra aegagrus hircus*) are one of the oldest domesticated species, and have been used for their milk, meat, hair and skins over much of the world (Coffey *et al.*, 2004).

The principal function of urinary system is maintenance of water and electrolyte homeostasis. The second major function of this system is the excretion of many toxic metabolic waste products particularly the nitrogenous compounds urea and creatinine from the body (Chauhan, 1995).

The kidneys also have endocrine function, they produce the hormone rennin, which converts the plasma protein angiotensinogen into angiotensin I. BradyKinin is another hormone produced by the kidney, which causes dilatation of blood vessels. Erythropoetin produced by kidneys, enhances erythopoesis. Selective reabsorption and conservation of useful substances, like glucose and sodium chloride occur in the kidney.

Kidney morphology varies among different classes of vertebrates (Casott, 2001). Morphological aspects of the kidney were studied by koning and Liebich (2009) in goat, Al-jebori *et al.*, (2014) in the rabbit. Liumsiricharoen *et al.*, (1997) describe the shape of swamp buffalo, (Sudhan, 2008). The kidneys of musk deer, mizo local pigs (kalita and kalita (2014), sheep (Braun *et al.*, 1992).

There are also reports of works on the kidney of fur seal (Stewardson *et al*., 1999), wistar rat (Onyeanusi *et al.*, 2009), dog (Marco *et al.*, 2009). Besides these species, Ozudogru and Ozdemir (2005) Study of the intrarenal arterial pattern of kidney in wolf; Horacek, *et al.*, (1987) in monkey (*Macaca fascicularis* and *Macaca mulatta*), Yoldas and Dayan 2014 in rat.

Microscopic aspects of the mammalian kidney were studied by Charmi *et al.*, (2010) In juvenile great sturgeon *Huso huso* and persian sturgeon (Acipenser persicus), (Laszczynska *et al*., 2012) polar fox, (Awal *et al*., 2014) in guinea pig, (Knepper *et al.*,1977) in rat and rabbit, (Young and Heath, 2000).

The Aims of this study were to investigate the anatomical feature of the kidney of goat (*Capra hircus)* the position and shape and relations to organs also the vascular architecture of the kidney in the goat, discovering the anatomy of collecting system. Then to study the histological structures of kidneys.

MATERIALS AND METHODS

Thirty specimens of kidneys (15 left and 15 right) of healthy mature goats of both sexes were collected from local commercial market in baqubah city. They used for gross observation. The specimen were collected immediately after animals slaughter and each specimen was washed after removing from the sub lumber region of abdomen cavity and kept in clean plastic container to perform the required measurement. The specimens were photoed by digital camera (Sony 12.1 mega pixels).

Ten specimens of kidneys (5 left and 5 right) were used to study the blood vessels (Arteries and Veins) also collecting duct system, by making corrosive resin cast. This technique was done by the following manner: Injection, setting, corrosion and washing.

1- Injection, washing the kidneys before injection by using 0.9% normal saline then insert the catheter entire the three vessels (Artery, Vein, Ureter) and fixed by using cotton thread to prevent discharge resin. after that injecting the colored resin through the catheters the artery were injected by red colored resin and the veins injected by blue colored resin, while the ureter were injected by yellow colored resin. The injection was done by hand pressure using plastic syringe of 20 ml. after the resin injection completed, the cannula closed by pinching it by artery forcipes.

2-leave the kidneys in room temperature for 48 hour to prepare for third stage.

3-resulting casts are shown following corrosion used concentrated Hcl to corrosion.

The cast of the blood vessels and collecting system are useful the replicating anatomical details.

4-washing by the tape water and observed the vessels and renal pelvis cast.

The anatomical parameters were taken after remove the adipose tissue from the kidney and then used it to study and record biometrical parameters. The weight was measured by sensitive electronic balance. Measured the length, width, and thick respectively used the digital vernier also used centimeter scale. All data were analyzed using SPSS version 17 (SPSS INC., Chicago, IL, USA) for windows. The results are expressed as mean ± SE. The results were regards as significant when $p<0.05$.

Histological technique was done on ten specimens of kidneys of goats were used for histological study, collected as soon as possible after slaughtering and fixed in 10% formalin for 48 hours. After tissues were washed thoroughly in running tap water dehydrated in ascending series of alcohol, cleared in xylene and embedded in paraffin wax at 58-60 ^{o}C. Sections were cut at 6µ and stained with Harris haematoxylin and eosin and Periodic acid Schiff (PAS), then mounted in Canada balsam. Photographs of examined slides were carried out with Olympus microscope supplied with digital camera (Win joe) with resolution of 2 mega pixel (luna, 1968).

RESULTS AND DISCUSSION

Position and shape

The kidneys were placed in the sublumber region, the right kidney placed slightly anterior to the left kidney. The kidney of the local goat was bean shape, smooth surface and devoid of any external lobulation. The kidneys were dark red-brown color. Both kidneys were enclosed by loosely attached capsule which

is peels easily from kidney. The goat kidneys are embedded in fatty cushion. The presence of large amount of peri renal fat in the kidneys of goat gives it more stability in location, this result in agreement with (Al-jebori *et al.*, 2014). The dorsal and ventral surface of the kidney were convex and anterior half of ventrolateral border not showed flattened surface. The kidney of goat had rounded pole. The hilus was located at middle of the medial border. This result is in agree with the result of (Al-jebori *et al.*, 2014); (Sudhan *et al.*, 2008); (Kalita and Kalita, 2014). Amount of fat was present in the hilus and it was less indented as compared to left kidney (Fig. 1).

Weight and Dimensions of kidneys

The present study was revealed that there is no significant difference in weight of both kidneys. The average weight of left kidney was (71.61±1.76 gm), while the right kidney was (71.622±3.04 gm). This result appeared that the dimensions of kidneys were slightly varied in the two kidneys (left and right). The mean length of right kidney was (68.166±2.23 mm), while the length of left kidney about (70.58±2.47 mm). The width of the cranial and caudal poles of both kidneys were varied, the width of the cranial pole of right kidney was (48.424±1.89 mm), and the caudal pole of right kidney was (48.654±2.09 mm), while the cranial pole of left kidney was (45.94±1.10 mm), and caudal pole of left kidney about (50.96±1.77 mm). Also the present result showed thickness difference in both kidneys, the thickness of cranial pole of right kidney (34.562± 1.26 mm) and caudal pole about (33.688±1.4 mm), while the thickness of cranial pole of left kidney about (32.72±.99 mm) and caudal pole about (34.93±1.22 mm) (Tab. 1).

The longitudinal section of kidney (macroscopic organization) show that the parenchyma of the kidney is consist of outer dark cortex beneath the capsule and inner paler striated appearance medulla (Fig. 2), the easy distinguish the cortex and medulla of goat kidney in present result is in agree with the result of Sudhan *et al* (2008). The renal parenchyma of the goat consist of fused pyramids, the renal pyramids were distinct and renal columns were present between the pyramids, also the interlobular arteries are present among the fused pyramid (Fig. 2). These findings of the recent investigation were in accordance with the finding of (Kalita and Kalita, 2014).

The renal sinus was well developed and give the appearance of butter fly on longitudinal section. There is a renal crest formed from fusion of 10-12 pyramids. The renal pelvis was half-moon shaped, narrow and less developed (Fig. 2).

Collecting system and pelvis

This study was done by using cast with risen (Acrylic cold) technique performed in freshly kidneys to provide three dimensional cast pattern of collecting system and its blood supply, also the recesses of renal pelvis. The collecting system in the kidneys of goat was formed from several collecting tubules. Each collecting tubule, which serves many nephrons, runs through the medulla before opening into a larger ducts, a papillary duct, close to the apex. The papillary ducts can be clearly demonstrated in resin-injection specimens. The perforated (cribriform) areas where they discharge are confined to the apices of independent papillae or to specific regions of a common crest Several score of papillary ducts drain into the about 10-12 renal recesses which formed the renal pelvic which was moderately developed and led to the ureter (Fig. 3 and 4). There was no calyces. This result is in agree with the result of Marco *et al*., (2009) in dog and disagree with the result of Liumsiricharoen *et al.*, (1997) in buffalo.

Blood supply

The right and left renal arteries supplying the kidneys raised from abdominal aorta, but the right renal artery slightly cranial to the left renal artery. Both were divided into dorsal and ventral branches, but the right renal artery was branched before entering the hilius, while the left one was branched after entering the hilus. Both dorsal and ventral branches in each side right and left were divided into 4-5 subbranches interlober arteries (Fig. 4). This result disagree with the results of Horacek *et al.*, (1987) and Yoldas *et al.*, (2014). These interlober arteries turn to archuate arteries which gave several interlobular arteries which were spread over the entire kidney.

Histological results

The present study showed that the capsule of goat kidney was thin layer of collagen fiber (Fig. 5). This result in agree with Al-jebori *et al.*, (2014) in rabbit and disagree with Hussin (2003) who mention that the capsule of kidney was thick in camel. The microscopical examination of goat kidney reveled that composed cortex and medulla. The cortex mainly consists of renal corpuscles, convoluted tubules and cortical loops of henle. The medulla in cross section appeared consist of straight tubules, collecting ducts and network of capillaries which were parallel to the collecting tubules like the result of Laszczynska *et al.*, (2012) in polar fox.

The renal corpuscle consist of tuft of capillaries, the glomerulus, originated from afferent arterioles, surrounded by a double layer capsule (Bowman's

capsule). The parietal layer of bowman capsule was simple squamous epithelium, resting on well-developed basement membrane, which is well distinguished by Periodic acid schiff reagents. The inner (visceral) layer consist of modifies cells present as a global cells, tightly fitted over the glomerulus represented by podocytes. The space between the two layers of bowman capsule called bowman space or renal space, which at one pole of renal corpuscle (renal pole) lead to the proximal tubule (Fig. 6). This result is similar to the result of Samuelson (2007) and Al-jebori (2014). Other pole of renal corpuscle was vascular pole when the afferent and efferent arterioles were present, also the mesangial cells were present near this pole. One of the distal convoluted tube near the vascular pole had a moderate wall cells known as macula densa which were tightly adhering together, Fig. 6. This result in agreement with the result of Samuelson (2007). This cells mesangial cells had important roles like vasoconstrictor, phagocytic role, also macula densa.

The present study showed that the proximal convoluted tubule in goat were lined by tall cuboidal acidophilic epithelium with spherical to oval nucleus, the luminal surface of this cells have brush border which were positive with PAS stain (Fig. 6) This result is disagree with the result of Al-jebori *et al.*, (2014) in rabbit who mention that the brush border is not clear and this cells were less acidophilic, and in agree with the result of Samuelson (2007), so this may be due to the difference in the activity of this tubules in different animals and the condition of this animals with the quality of water.

The present study confirms that the henel loop consist of the thick and thin ascending and ascending segments and more evident in medulla, the henel loop was long. The thick limb was lined by simple cuboidal cells while the thin were lined by low cuboidal to simple sequamous epithelia (Fig. 6 and 7). This result coinciding with the result of Samuelson (2007) and in contrast with the observations of Al-jebori *et al.*, (2014) in rabbit, that mean the kidney of goats is maintaining to the water and need for more reabsorption of water.

Distal convoluted tubule of goat was lined by low cuboial epithelium, with spherical nucleus. The lumen was wider than that in proximal convoluted tubules (Fig. 6). This result in agree with Samuelson (2007).

The distal convoluted tubules is lead to collecting tubules then joined the collecting ducts to reach the renal pelvis. The collecting tubules is lined by cuboidal epithelium with spherical large nucleus which occupied most of the cell (Fig.7) This result in agree with observations of Al-jebori *et al.*, (2014) in

the rabbit. The collectin duct continues from collecting tubules. The collecting duct convey the urine in to renal papillae to empty it in to the renal pelvis.

Table 1. The parameters of kidneys in goat

		Left kidney	Right kidney	
Length (mm)		70.58± 2.47	68.166 ± 2.23	
Weight (gm)		71.61 ± 1.76	71.622 ± 3.04	
Width (mm)	cranial	45.94 ± 1.10	48.424 ± 1.89	
Width (mm)	caudal	50.96 ± 1.77	48.654 ± 2.09	
Thickness (mm)	cranial	32.72 ± .99	34.562 ± 1.26	
Thickness (mm)	caudal	34.93 ± 1.22	33.688 ± 1.41	
Values represent mean ± S.E (P≤0.05)				

Figure 1. Photograph of right and left kidney of goat, illustrated the left and right ureters (U), renal artery (A), renal vein (V) enter and exit the hilus of kidney

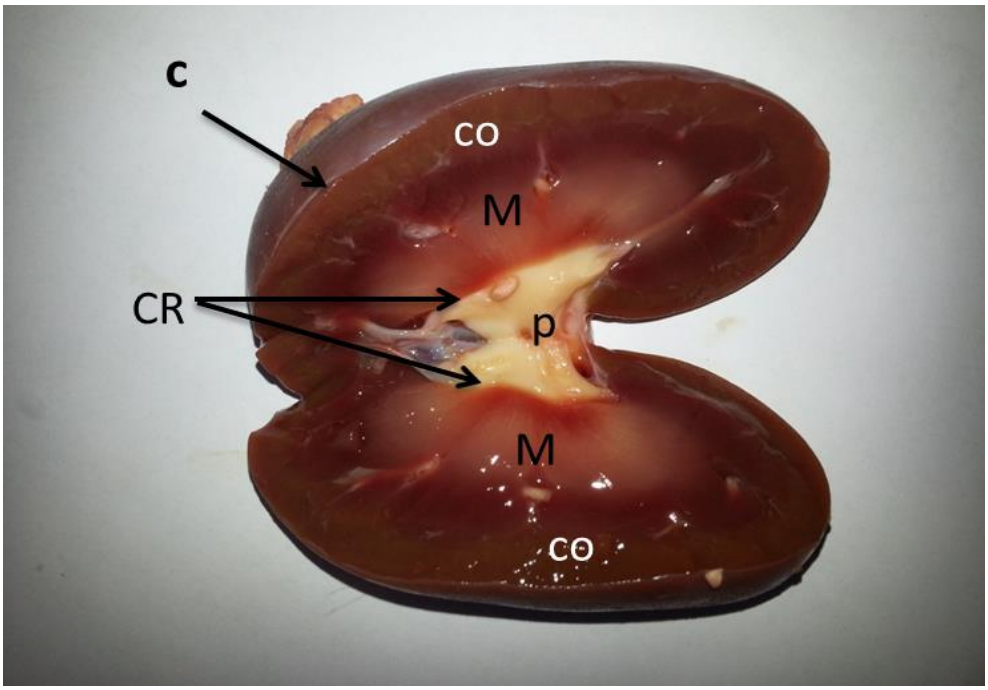

Figure 2. Photograph of kidney of the goat, illustrated the renal pelvis (p), renal crest (Cr), cortex (co), medulla(m), capsul (c)

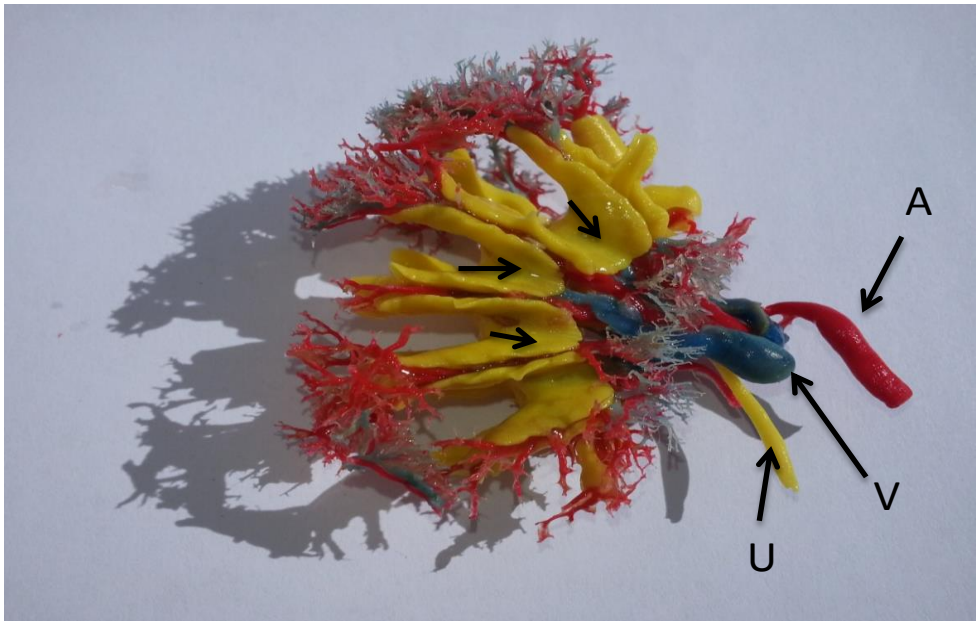

Figure 3. Photograph of Corrosion cast of renal pelvis (yellow), renal artery (A) (red), renal veins (V) (blue) and ureter (u) of goat. The depressions of the ridges of the renal papillae are clearly visible (arrows, renal recesses (yellow))

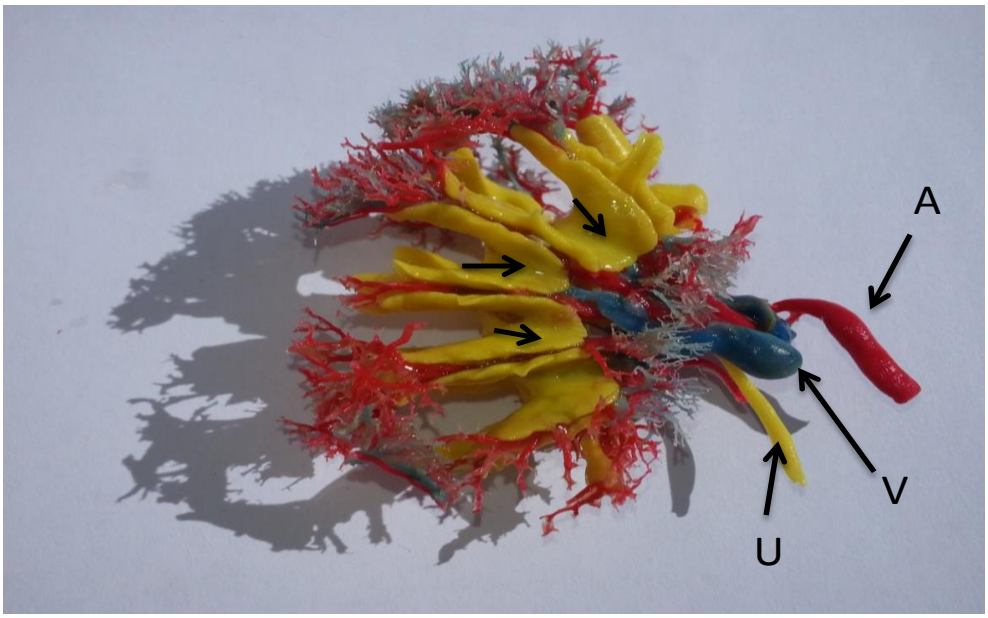

Figure 4. Corrosion cast of goat kidney show the renal pelvis and ureter (u) are filled yellow. Notice the indentations in the pelvis corresponding with the crests of the renal papillae. The ramifications of the renal artery (red) are clearly visible. dorsal and ventral branch (arrow), subbranch, renal veins (blue)

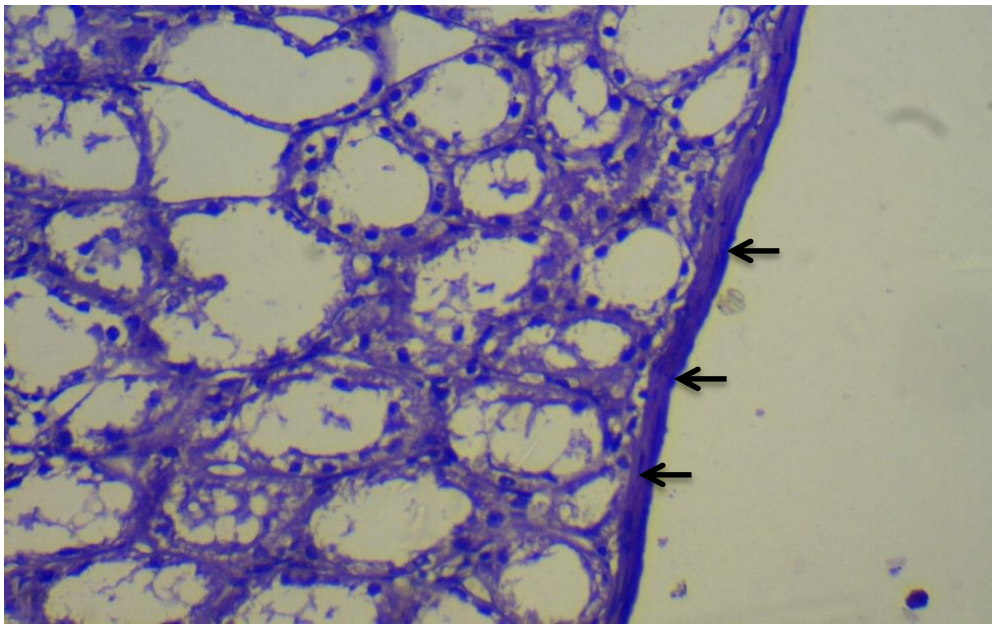

Figure 5. Photomicrograph of cross section of Goat kidney, illustrated, thin capsule (arrow). (PAS stain X 10)

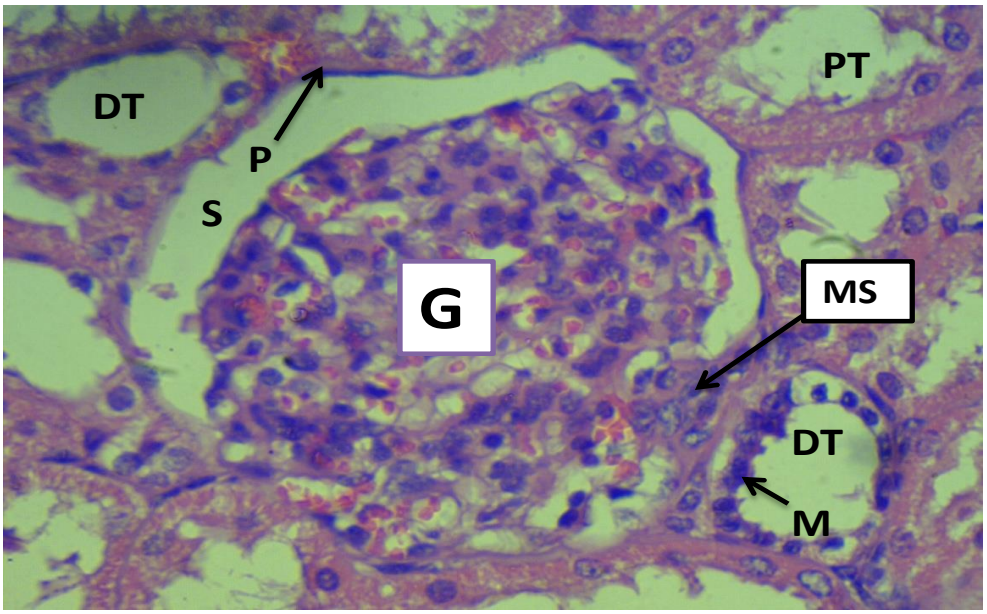

Figure 6. Photomicrograph of cross section of goat kidney, illustrated renal corpuscle, glomerulus (G), parietal layer of bowman capsule (P.), proximal tubule (PT) distal convoluted tubule (DT), Macula densa (M), mesangial cells (MS), bowman space (S) (H&E stain X40)

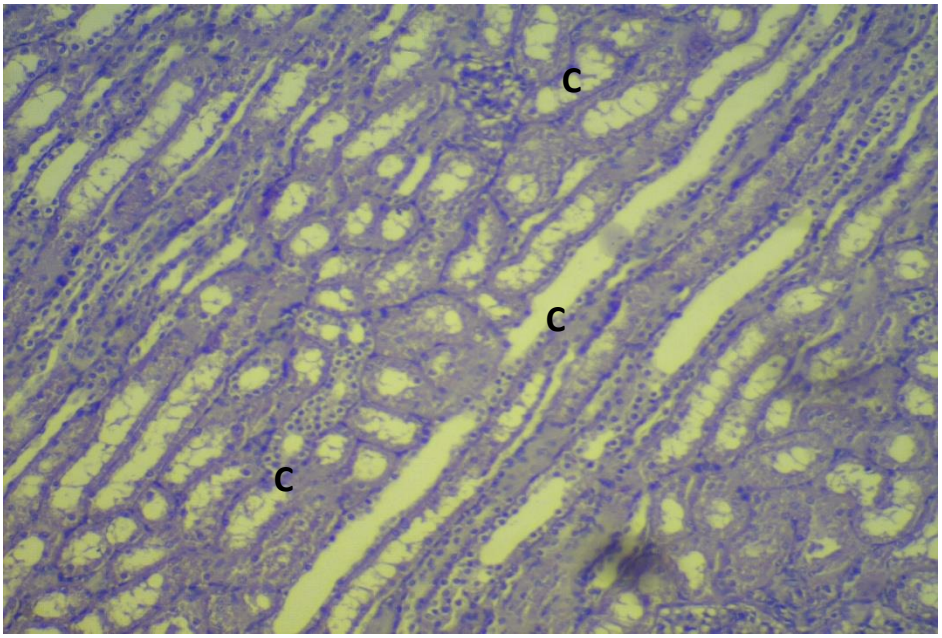

Figure 7. Photomicrograph of cross section of goat kidney, illustrated collecting tubules (C) (H&E stain X4)

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دراسة تشريحية ونسيجية للكلية في الماعز

عمار اسماعيل جبار[1] هناء كريم علي رعد شعلان ابراهيم علاء نزار لطيف

قسم التشريح والانسجة، كلية الطب البيطري، جامعة ديالى، العراق.

[1] المسؤول عن النشر: ammar_histo@yahoo.com

المستخلص

استخدم في هذه الدراسة ثلاثين عينة من الكلى (15 يمنى و15 يسرى) من الماعز البالغة والسليمة لإظهار شكليائية والتنظيم الوعائي والبنية النسيجية للكلية في الماعز. تثبت الكلى في الماعز في منطقة تحت القطنية بوساطة وسادة من كمية كبيرة من الدهون حول الكلى. تتقدم الكلية اليمنى بشكل طفيف عن الكلية اليسرى، وكلاهما على شكل حبة الفاصوليا، ولا يوجد فرق معنوي كبير في وزن الكليتين. تم استخدام تقنية تآكل قالب الراتنج لاظهار التغذية الدمية والنظام القنوي البولي، ويتكون النظام القنوي في كلى الماعز من عدة نبيبات جامعة، تفتح كل واحدة منها الى قنوات اكبر، ثم الى القنوات الحليمية بالقرب من قمة الحليمة. تصريف القنوات الحليمية إلى حوالي 10-12 ردب كلوي، ولم يلاحظ هناك كؤوس كلوية. وقد اظهر الفحص المجهري وجود حافظة رقيقة تحيط بالكلية، وكانت الطبقة الجدارية من كبسولة بومان ظهارة حرشفية بسيطة، ترتكز على غشاء قاعدي متطور. جهاز مجاور الكبيبة مطور جيدًا. يحتوي السطح التجويفي لخلايا النبيبات الملتفة الدانية على حافة الفرشاة التي اظهرت تفاعلا ايجابيا مع كاشف شف الدوري، وكانت عروة هنلي طويلة، وهذا يعني أن كلية الماعز تحافظ على الماء وتحتاج إلى مزيد من إعادة امتصاص الماء.

الكلمات المفتاحية: تشريح، علم الانسجة، كلية، ماعز.