IDENTIFICATION THE GROSS STRUCTURE OF THE ADULT OX KIDNEY BY USING CORROSION CAST TECHNIQUE.

Nabeel Abd Murad AL-Mamoori*,Saffia Kareem Wally Alumeri*
Hazem Kareem Naser Almhanna**
*Department Of Anatomy and Histology, College Of Veterinary Medicine,University of AL-Qadisiyah, AL- Qadisiyah, Iraq
Department Of Anatomy and Histology, College of Veterinary Medicine, University of Kufa Kufa,Iraq

(Received 29 September 2016,,Accepted 15December 2016)
Keywords: Kidney, Corrosion cast, Ox.

ABSTRACT

In the current study, ten specimens of the adult ox kidneys have been used to identity morphology and blood supply features by using corrosion cast technique. The mean body weight of ox was 180±10kg. The external surface of the kidneys was elongated oval to pyramid, lobulated flattened ventrodorsally, and light-brown in color. The right kidney is weighted 299± 24gm as well as it had two surfaces (ventral and dorsal), two borders (lateral and medial) and two poles (cranial and caudal), while the left kidney is weighted 333± 27gm and had three surfaces (right &left ventral and dorsal), in addition it had two borders and two poles.
The renal artery and vein have the same course and each one divided into 2-3 segmental blood vessels. The segmental artery and vein are divided in to interlobular artery and vein which supply medulla and cortex. The interlobular artery & vein were passed through the renal columns and branched into arcuate and finally gave off cortical artery and vein.
The aim of this study, to exposure the normal gross internal appearance of blood vessels and ureter of ox kidneys by using corrosion cast technique.

INTRODUCTION

The urinary system of mammalian consists of paired kidneys (right and left) that secreted the urine after blood filtration. Each kidney drained in to ureter and convey the urine from the pelvis of kidney to single bladder where urine is stored. Urine would be drained by single urethra into the exterior (1). The kidneys play very an importance role in maintenance homeostasis and excretion of metabolic waste products and other functions such as syntheses and secretions hormones renin and erythropoietin (2 and 3).

Left and right kidneys are located in the abdominal cavity and embedded in dorsal part of body of bovine, related nearly on each side of the caudal vena cava and abdominal aorta. However, in the mammalian the left kidney backward more slightly than the right kidney.

Generally, in the cattle the kidney revealed externally lobulated with rough surface, while in the other species had smooth surface (1,2 and 3).

MATERIALS AND METHODS

1- **Morphological and biometrical study**

Ten specimens of the kidneys of adult ox. The mean body weight of ox was 180±10kg has been used in this study. Fresh samples were collected from AL-Diwaniyah's abattoir immediately after animals slaughtering. To collect the kidneys, oxen were dissected at thoracic inlet into the pelvic cavity and removed the internal organs and take off the kidney. Kidneys had dissected with the ureter and renal artery & vein (Major blood vessels which supply the kidney). Adipose tissue was removed which covered the kidneys and washing the kidneys by tap water. Finally, the length, width, weight and thickness of kidneys are measured.

2- Corrosion cast technique

This technique is used to detect the internal course of blood vessels inside kidney and ureter in relation to kidney structure. Samples prepared as followed steps:

1-Warm normal saline solution 0.9 % inject in the renal artery, vein and ureter to clean and remove all clots and sediment which may be found in the blood vessels and ureter.

After that inject the renal blood vessels and ureter by mixture of self-cure denture material set (Powder and liquid 1 to 4), and it is consisted of 20% monomethyl-methacrylate powder and 80% polymethyl-methacrylate liquid and adding the suitable dyes (Red, blue and yellow ink) to differentiate the blood vessels and the ureter (4).

2-Samples are incubated at room temperature for 24 hours for polymerization.

3-Samples put in drain opener which consist of a mixture of NaOH, Na2CO3 and NaClO) and prepared by dissolved 1 kg in 5 liters distilled water) and left 72–96 hour to corrosion casted at the room temperature.

4-Finally samples were washed with normal tap water, and snap image.

RESULTS

1- Morphology of kidney

A- External appearance of the kidney: Right and left kidney were embedded in sub lumbar fossa at dorsal part of the body and surrounded capsule which are very rich in fat and adipose tissue, moreover, kidney was light-brown in color and externally lobulated due to present of

groove which separated each lobe from other, and this grooves filled with adipose tissue. On the other hand, right and left kidneys differ in shape, weight and dimensions.

The right kidney was pyramidal in shape and has 21±2 lobes are small and large in shape. It consists of two surfaces (dorsal and ventral), two borders (lateral and medial) and two poles (cranial and caudal). additionally, the dorsal surface was strongly convex and curved toward the vertebral columns, while the ventral surface was irregular convex and contain the hilum which against the abdominal viscera.

The medial border of right kidney was approximately straight and in related on the caudal vena cava, while the medial border of the left kidney was directed toward the abdominal aorta and extremities of border convex, also this border was engaged in the hilum which via it the renal artery with nerve renal vein and ureter to enter and leave the kidney. The lateral border was convex from side to side (Fig.1& 2). At result, the mean of weight, length, widest area, thickest area, length medial and lateral borders of the right kidney was 299± 24 gm, 15.033±0.5cm, 6.45±0.75cm, 6.75± 0.8cm, 14.133± 0.9cm and 21.333±0.88cm.

The left kidney was oval in shape and has 18.5± 1.5 lobes which differ in size. It comprised of three surfaces (dorsal, right & left ventral), two borders (lateral and medial) and two poles (cranial and caudal). The dorsal surface was strongly convex and the curved toward the vertebral columns, while the ventral surface consists of two parts right and left. It is irregular convex and contain the hilum which tend toward the abdominal viscera. The medial border was approximately straight and tend toward the abdominal aorta, in the middle region is contained the hilum that attached into blood and nerves supply. Furthermore, the lateral border was convex from side to side (Fig.1). The mean of weight, length, widest area, thickest area, length medial & lateral borders of the left kidney is 333± 27gm,16.56±0.7cm, 7.45±0.56cm, 5.2± 0.44cm, 16.5± 0.06cm & 17.6± 0.77 respectively (Table.1). The hilum of kidney revealed as depression area which occupied the middle region of ventral surface and extend toward the proximal third of the medial border. It refers to entrance of the ureter, artery, vein, nerves and lymph vessels.

B- Internal Appearance of the Kidney:

After making a longitudinal incision of the kidney to describe the internal structure showed three regions that differ in the color and texture, involves in capsule, cortex and medulla. The capsule was a transparent strong fibrous membrane layer, cover the outer surface of the kidney and it is easily dislocation resembling nylon bag (Fig.3). The cortex is directly located under the capsule and brown in color, rough texture and reveals radiate appearance. In addition the cortex is extended toward the medulla between the renal pyramid to form the renal columns.

The medulla divided into many regions pyramidal in shape called renal pyramid. It is divided into two regions according to the color. The first region was a dark- brown and form the margin of renal pyramid, while the second region was a light-brown in color located inside of the medulla and direct toward the renal calix. (Fig. 3).

The renal pyramid consists of two parts: base and apex, the apex was tending toward the renal calix, while the base toward the cortex. The apex of pyramid form is ended with renal papillae which refer to apical portion of the pyramid which was opened in the minor calyces (Fig. 3,4&5).

The ureter is opened at the hilum and extended more and branched into 7-8 ducts called major calix. Each major calix divided into 19-21 collecting ducts which are funnel shape structure called minor calix. This minor calix was surrounded by adipose tissue, and it resaved the urine which discharge from renal papillae (Fig9&10).

2- Blood Supply Of Kidney By Using Corrosion Cast Technique

After injecting the blood vessels of the kidneys with corrosion cast technique, the renal artery was very clear and it was originated from the ventral side of the abdominal aorta, which supply the kidneys through the hilum (Fig.2). The renal artery at entrance of the hilum of kidney was divided into 2-3 segmental arteries. This segmental artery after short distance reached into the apex of the renal pyramid and divided into interlobular artery which supply medulla (Fig.4,6 & 8). Likewise, it is run course of interlobular through the renal columns between the renal pyramid, when it reaches into the base of the renal pyramid gave branch called arcuate artery which extend along the base of pyramid (Fig. 8).

The arcuate artery gives of several branches called cortical radiate artery which are extended toward the cortex region (Fig. 4,5,6,7 and 8).

The renal vein was originated from the ventral side of the caudal vena cava, which enter the kidney through the hilum of kidney (Fig.1&2). The renal vein courses same and parallel of the renal artery. The renal vein divided into 2-3 of segmental veins at entrance of the hilum of kidney (Fig.4,). The segmental vein extended into short distance with segmental artery in the same course into the apex of the renal pyramid then would be branched into interlobular vein. The interlobular vein and with interlobular artery have the same course. It is passed through the renal columns and form the external boundaries of the renal pyramid. it is branched into arcuate vein when reaches at the base of the renal pyramid. The arcuate vein had same course of the arcuate arteries and give off several branches of cortical radiate vein that extend toward the cortex take radiate shape (Fig.4,5,6 and7).

Table 1: Biometrical measurement of left and right kidneys in adult Ox. Mean and stander error

The parameter	Right kidney			Left kidney		
Weight	299± 24gm			333± 27gm		
Length of kidney	15.033±0.5cm			16.566± 0.7cm		
Length of medial boarder	14.133±0.9 cm			16.5±0.66 cm		
Length of lateral border	21.333±0.88 cm			17.6±0.77 cm		
Thickness of cranial, middle and caudal regions respectively	3.5±0.6 cm	5.95±0.4 cm	6.75±0.8 cm	5±0.7 cm	5.2±0.44 cm	5±0.9 cm
Width of cranial, middle and caudal regions respectively	4.05±0.66 cm	6.45±0.75 cm	5.55±0.34 cm	5.05±0.87 cm	7.45±0.56 cm	5.65±0.34 cm
Number of lobe	21± 2			18.5± 1.5		

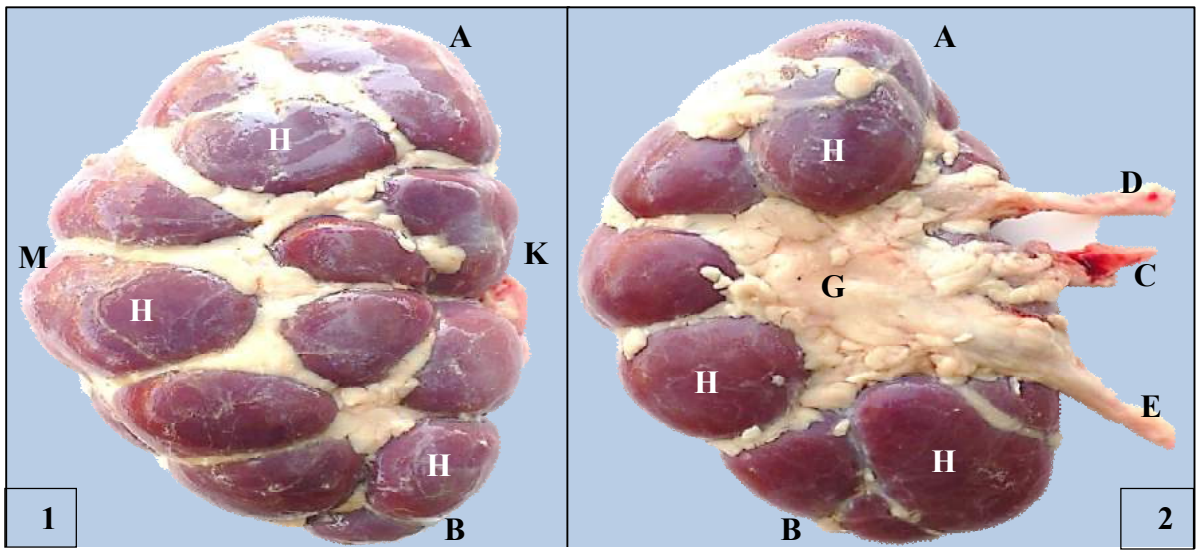

Fig 1. Ventral 1 and dorsal 2 view of the right kidney of ox show:

A-Cranial pole. B-Caudal pole. C-Renal vein. D- Renal artery. E-Ureter. G- Adipose tissue in hilum. H-Renal lobule. K- Lateral surface. M- Medial surface.

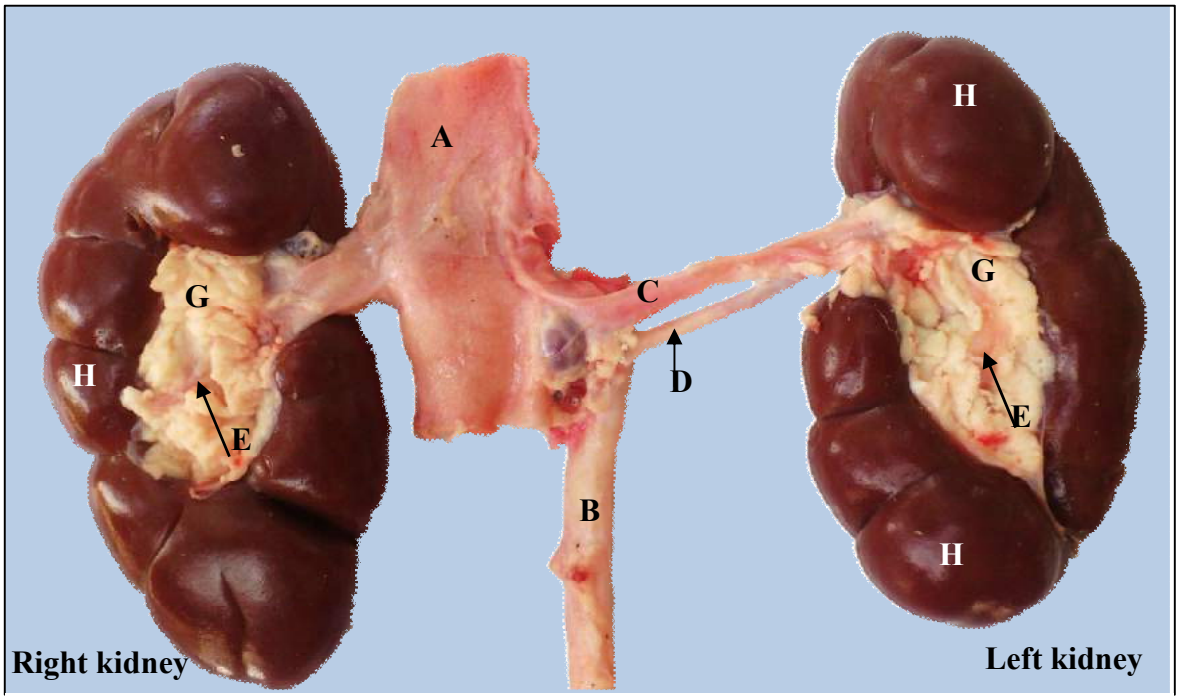

Fig2. Ventral view of the right and left kidneys of ox after remove capsule show: A-Caudal vena cava. B-Abdominal aorta. C-Renal vein. D- Renal artery E-Ureter. G- Adipose tissue in hilum. H-Renal lobule.

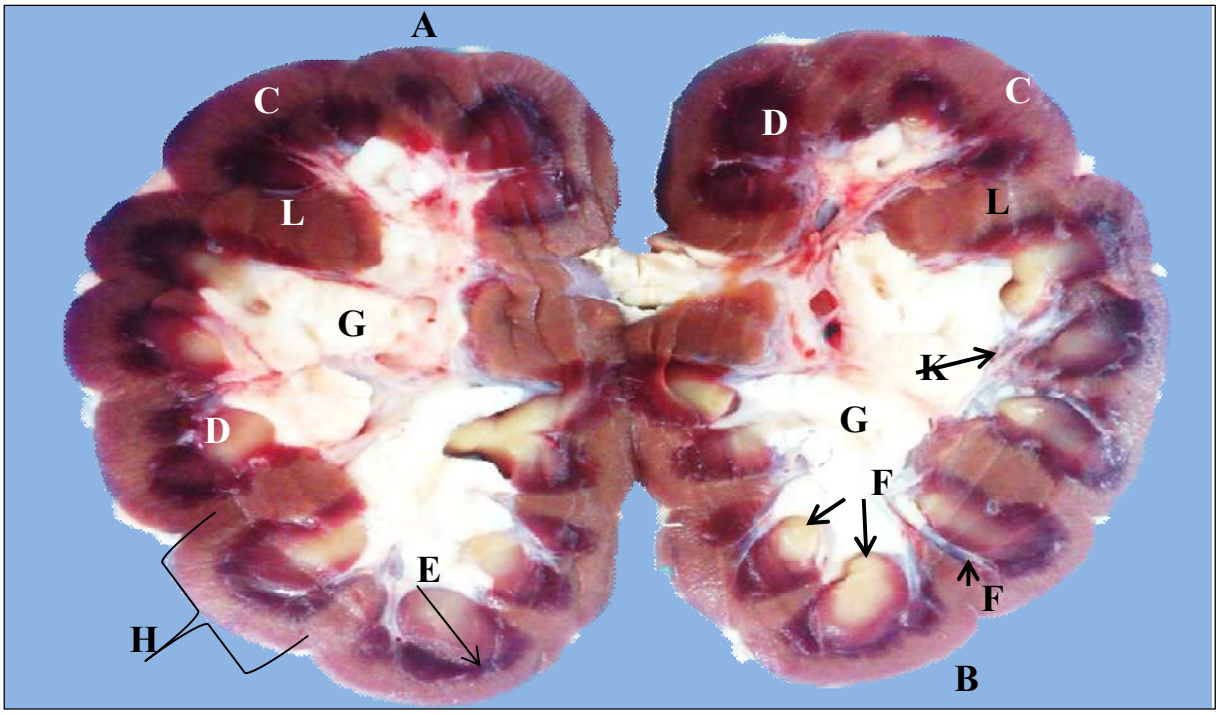

Fig 3. Midlongitudinal section of the right kidney of ox show: A-Cranial pole. B-Caudal pole. C- Cortex. D- Medulla. E- Renal pyramid. F- Renal papillae. G-Adipose tissue. H-Renal lobule. K- Minor calyx. L- Renal column. M- Interlobular artery.

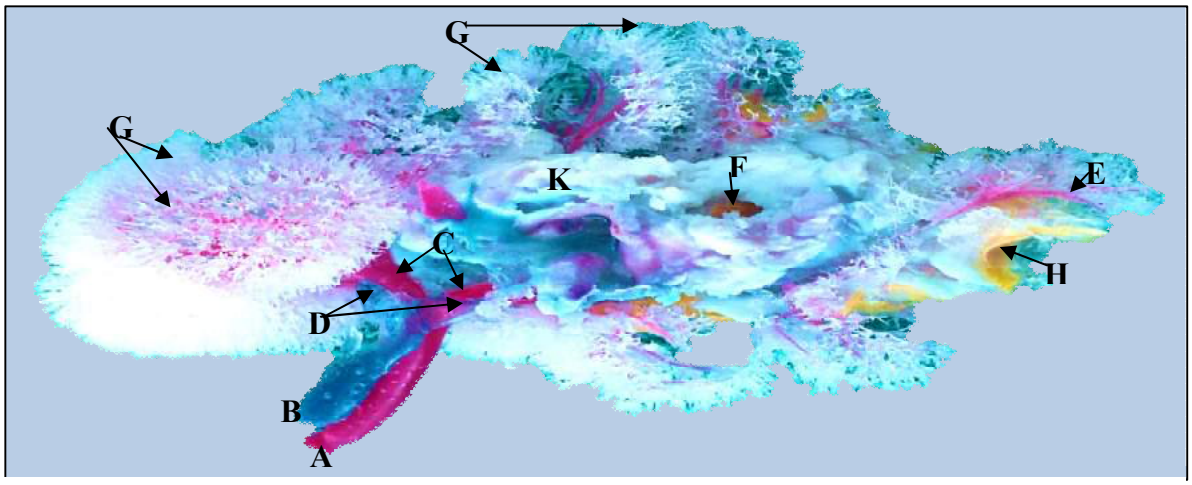

Fig 4. Ventral view of the arterial, venous supply and ureter of the kidney in ox by using corrosion cast show: A- Renal artery. B- Renal vein. C- Segmental artery. D- Segmental vein. E- Arcuate artery. G- Cortical artery and vein. F- Ureter. H- Minor calyx. K- Adipose tissue.

Fig 5. Dorsal view of the blood supply and calyx of the kidney in ox by using corrosion cast show: A- Renal artery. B- Renal vein. C- Minor calyx. D- adipose tissue around minor calyx. G- Cortical artery & vein.

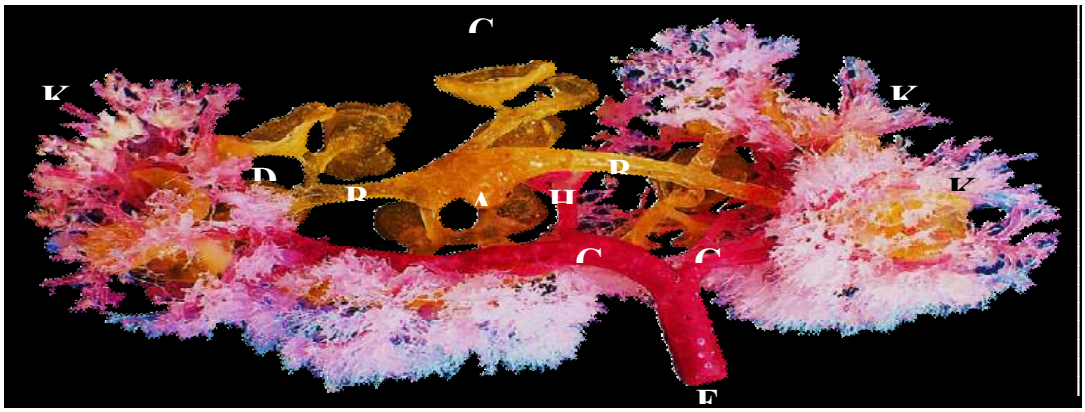

Fig 6. Ventral view of the arterial supply and ureter of the kidney in ox by using corrosion cast show:A- Ureter. B- Major calyx. C- Minor calyx. D-

Fig 7. Dorsal view of the arterial, venous supply and ureter of the kidney in ox by using corrosion cast show: A- Renal artery. B- Major calyx. C-

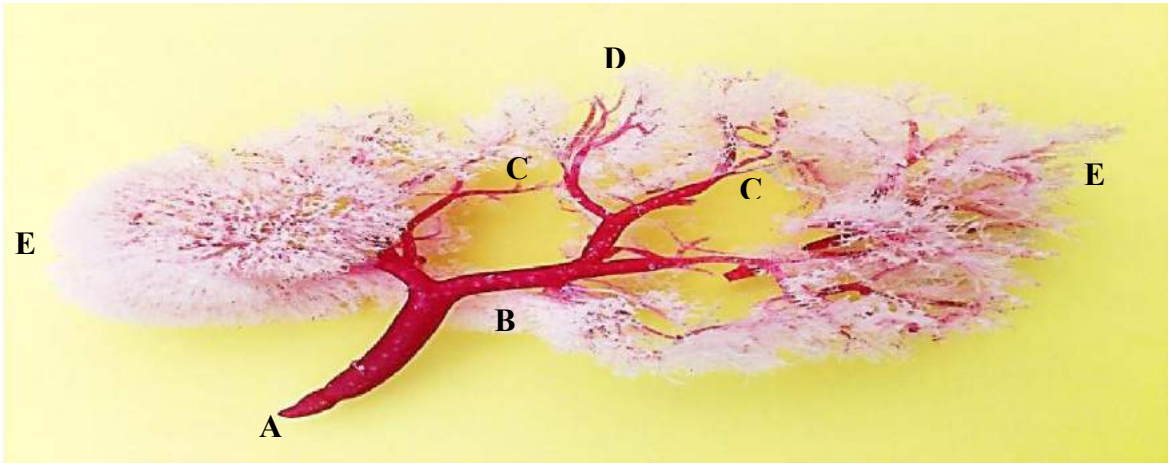

Fig 8. Ventral view of the arterial supply of the kidney ox by using corrosion cast show: A- Renal artery. B- Segmental artery. C- Interlobar artery. D- Arcuate artery. E- Cortical artery.

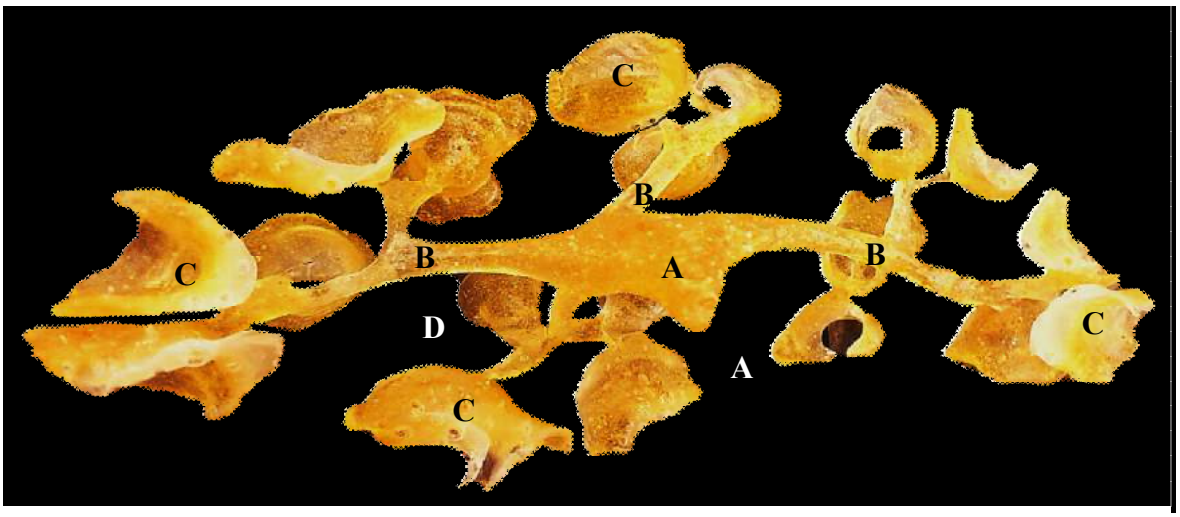

Fig 10. Dorsal view of the ureter and calyces of the kidney in ox by using corrosion cast show: A- Ureter. B- Major calyx. C- Minor calyx. D- Papillary duct

DISCUSSION

Morphology of Kidney

The kidney was light-brown in color and lobulated but, the right and left kidneys differ in shape, weight and dimensions and this result agreement with 2 and 3 in bovine that showed the kidney is lobulated ovoid in shape, and disagreement with (2,3,4,5,6,7,8,9 and 10) in small ruminants, horse, camel, pig, dog & cat, the kidney has smooth surface bean–shaped, this difference due to different species.

The mean of weight, length, widest area, thickest area, length medial and lateral borders of the right kidney was 299± 24 gm, 15.033±0.5cm, 6.45±0.75cm, 6.75± 0.8cm, 14.133± 0.9cm and 21.333±0.88cm , while the mean of weight, length, widest area, thickest area, length medial and lateral borders of the left kidney was 333± 27gm, 16.566±0.7cm, 7.45±0.56cm, 5.2± 0.44cm , 16.5± 0.06cm and 17.6± 0.77 respectively and this result disagreement with (11) show the mean of weight, length, width, thickness of the right kidney was 1300±31.885gm, 21.32±0.46cm, 13.33±0.42cm and 8.475±0.085cm while the mean of weight, length, width, of the left kidney was 952.5±52.5gm, 23.3±0.587cm, 10.45±0.42cm and 7.675±0.165cm respectively in buffalo, this differ may be due to species of animal.

There was no renal pelvis and the major calyx connect directly with the ureter, this result agrees with (2,3,8,11,12 and 13) show in the large ruminant that the major calices are directly attached to the ureter.

Blood supply of kidney

The renal artery originated from the ventral side of the abdominal aorta, to supply the kidneys through the hilum and divided into segmental artery, this result agreed with (8,11,12,13,14, 15 and 16) in sheep, buffalo, dog and horse, but then again disagree with (17) which found the accessory renal arteries originating directly from aorta.

The renal artery and vein had the same course and each one divided into 2-3 segmental arteries and veins. The segmental artery and vein after short distance reached into the apex of the renal pyramid and divided interlobular artery and vein which supply medulla, this result agreed with (13,14,15,16, 18) show the segmental artery and vein divided into interlobular artery & vein. The interlobular artery & vein pass through the renal columns and branched into arcuate, this result agreed with (19) in pig.

In conclusion, this study asserted that during using Corrosion Cast Technique would be helped to show internal structure of oxen kidney, in particular, veins and arteries supply better than without this technique in gross study.

التعرف على البنية المظهرية لكلى العجول البالغة باستخدام تقنية القالب التأكلي.

نبيل عبد مراد المعموري*، صفية كريم والي العمري*،حازم كريم ناصر المحنة**.

*فرع التشريح والانسجة، كلية الطب البيطري، جامعة القادسية ،القادسيه ،العراق.

**فرع التشريح والانسجة ، كلية الطب البيطري، جامعة الكوفة،الكوفه ،العراق.

الخلاصة

شملت الدارسة الحالية عشرة عينات من كلية العجول البالغة للتعرف على المواصفات المظهرية والمدد الدموي باستخدام تقنية القالب التأكلي .حيث كان معدل وزن جسم الحيوان 180كغم وكان المظهر الخارجي للكلية بين البيضوي الطولي والهرمي الشكل مفصصه، مسطحة بطنيا ظهريا، ذات لون بني فاتح .حيث كان وزن الكلية اليمنى 24±299 و لها سطحين بطني وظهري وحافتين وحشية وانسية وقطبين امامي وخلفي، بينما كان وزن الكلية اليسرى 27±333 غم ولها ثلاثة اسطح بطني ايمن وايسر وظهري وحافتين وقطبين.

ان المدد الدموي للكلية متمثل بالشريان والوريد الكلوي حيث كان يسيران نفس المسار. كل واحد منهما يتفرع الى 2–3 فروع من الشريان والوريد القطعي. ان الشريان والوريد القطعي ينقسم الى عدة فروع من الشريان او الوريد بين الفصوص لتغذية

منطقة اللب والقشرة. اما الشريان والوريد بين الفصوص يتفرع الى الفروع الزاوية والتي بدورها تعطي فروع اخيرة تعرف بالفروع القشرية .

REFERENCES

1- Shively M J (1984).Veterinary anatomy ,Basic comparative and clinical anatomy college station Texas. University of Bristol UK. CABI publishing. Pp: 1-4.

2- Frandson R D, Wilke W L and Fails A D(2009). Anatomy and Physiology of Farm Animals. Wiley Blackwell. (7th ed). Ch. 23. Pp: 383.

3- Dyce K M, Sack W O and Wensing C J (2010). Textbook of Veterinary Anatomy. W.B. Saunders Company, Philadelphia. London. New York. (4 th Ed) Pp: 104-106, 489, 636 – 637.

4- Mishra GP, Bhatnagar S. and Singh B. (2014). Anatomical Variations In Arterial Pattern Of Lower Segmental Artery And It Relation With Collecting System. International Journal of Anatomy and Research, Vol 2(2)Pp:403-405.

5- Zguigal H and Ouhsine A (2004). Functional Anatomy of the Renal Pelvis in the OneHumped Camel. J. camel science.1.Pp: 81-85.

6- Lazo P, Vlatko I, Florina P P, Nikola A, Dobrila T L(2013). Morphometrical Evaluation Of Some Anatomical Features In Pig Kidneys: Are They Different From Human Kidneys. Mac Vet Rev. 35 (1): 35 –42.

7- Dowelmadina I M, Elhashmi YH and Bakhiet S (2013). Morphometric Studies Of Kidneys In One Humped Camel *(Camelus Dromedarius)* In Sudan. ISCCRP. Pp:109-111.

8- Sisson S S B (1911). A Text Book Of Veterinary Anatomy. W.B. Saunders Company, Philadelphia. London. New York. Pp: 469-483.

9- Al-Asadi F S (2006). Some Morphological Studies On The Kidney Of The Sheep With Technique To Its Arterial Segmentation. Basrah. J. Vet. Res.Vol.5,No.1.PP:44-46.

10- H, Rind M M, Ahmad R, Ahmad N, and Shah G (2003). Gross Anatomical Study on Normal Kidneys of Adult Goat. Journal of animal and veterinary advances. 2(9): 539-541.

11- Al- Kinanny A F (2006). Anatomical, Histological and Radiological study of the kidney and the ureter of Buffalo "*Bubalus bubalis*" in Iraq. A Thesis University of Baghdad.

12- Getty R (1975).The Anatomy Of Domestic Animal. 5th ed .W.B.Sanders,Co.Vol.1.

13- Sawad A A (2006). Functional Anatomy Of The Kidney In Buffaloes. Bas.J.Vet.Res. Vol. 5.No.Pp: 76-82.

14- Nagato A C, Rocha C L J, Bandeira A C B, Oliveira R M S and Bezerra F S (2013). Morphometric and quantitative analysis of the afferent renal artery variation. J. Morphol. Sci. Vol. 30, No. 2, Pp: 82-85.

15- Beatriz P S, Sampaio A P, Henry R W, Favorito L A and Francisco J B (2007) . Dog Kidney: Anatomical Relationships Between Intrarenal Arteries and Kidney Collecting System. The Anatomical Record Pp:1017–1022.

16- Ozdemir D, Zekeriya O and Ismail M (2009). Intrarenal Segmentation of the Renal Arteries in the Kangal Dog. Kafkas -niv Vet Fak Derg 15 (1) Pp: 41-44,

17- Chandragirish S, Nanjaiah C M, Suhas YS, Saheb S H(2014). Study On Accessory Renal Artery. Int. J. Anat Res 2014, Vol 2(4):712-15.

18- Gahlot R, Pahuja K and Gahlot N K (2014). Study of renal arterial segmentation in mammals by corrosion cast. Asian J. Pharm. Hea. Sci. Vol(4). 1154-1157.

19- Farag F M M (2012). The Intrarenal Venous Architecture of the Pig Kidney (Sus scrofa). J. Vet. Anat. Vol 6 No 1, (2013) 31 – 45.