Study the Anatomical Descriptions and Histological Observations of the Kidney in Golden Eagles (*Aquila Chrysaetos*)

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Summary

The present study is preliminary investigate of the kidney gross morphology and some histological observations was studied in golden eagle (*Aquila Chrysaetus*). The anatomical descriptions of the kidneys had revealed a paired kidney and ureters were protrude, flattened and extra-peritoneal organs. The kidney tissue is transverse by major nerve trunks and blood vessels, securing the kidneys tightly in place. Each kidney consists of three lobes: cranial, middle and caudal lobes. The cranial lobe was the largest and wider than the other two lobes and the caudal lobe was appeared similar to middle lobe but little smaller than it. There is no line of demarcation between cortex and medulla as in mammals. The glomerulus consisted of a tightly packed central core of mesangial cells, surrounded by capillary loops. The cytoplasm of the proximal convoluted tubules cells contains condensing vesicles and a large apically situated nucleus. The distal convoluted tubules and collecting ducts were distinguished on a topographical basis revealed that varied slightly in their reactions with PAS stain and appeared as vacuoles or look like vesicles contains secretion from lining epithelial cells of distal convoluted and collecting tubules which appeared diffused in cross section. The cells of distal convoluted tubules and collecting tubules possessed vesicles with a clearly defined coated outer membrane and some had small blebs invaginated membrane. However in this study found vesicles or vacuoles in the lumen of collecting tubules revealed the secreting cells had margins that were often incompletely membrane –bound and continuous with the apical cell margin as if discharging their contents to the tubular lumen.

Keywords: kidney, Golden eagle, glomeruli, vesicles.

دراسة تشريحية وصفية ورؤى نسيجية للكلية في العقاب الذهبي *Aquila Chrysaetos*

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الخلاصة

أظهرت الدراسة الحالية في نتائجها الأولية حول شكل الكلية وبعض الرؤى النسيجية التي تم دراستها في العقاب الذهبي golden eagle .تشريحيا وصفت بأنها تتكون من زوج من الكلى والحالب وتكون بارزة ومسطحة تقع خارج غشاء الخلب. يمر خلال نسيج الكلية العديد من الأوعية الدموية والأعصاب الرئيسية والتي تعمل على تامين ثبات وتماسك الكلية في مكانها. كل كلية تتكون من ثلاثة فصوص أو أقسام : فص أمامي, وسط وخلفي. لوحظ بان الفص الأمامي اكبر وأوسع من بقية الفصوص بينما الفص الخلفي يكون مشابه للفص الوسطي لكن اصغر منه بقليل. ليس هناك خط فاصل بين منطقة القشرة واللب كما في اللبائن. يتكون مركز الكبيبة من الخلايا المرصوصة تسمى mesangial cells تقع في مركز الكبيبة ومحاطة بالأوعية الدموية الشعرية. يحتوي سايتوبلازم خلايا النبيب الداني على حويصلات مكثفة ومتمو ضعه على قمة النواة. النبيب القاصي والقنوات ألجامعه تتموضع على أساس طبوغرافيا وتظهر اختلاف تدريجي في مدى تفاعلها مع صبغة PAS . يلاحظ ظهور فجوات وحويصلات تحتوي على إفراز الخلايا الظهارية المبطنة للنبيب الداني والنبيبات ألجامعه حيث لوحظ انتشارها خلال المقطع العرضي النسيجي. الخلايا ألمبطنه للنبيب الداني والنبيبات ألجامعه لوحظ امتلاكها حويصلات تظهر بوضوح مغطية للسطح الخارجي للخلية مع ظهور بعض الفقاعات الغشائية المنبعجة. على كل حال الدراسة الحالية بينت وجود حويصلات أو فجوات في داخل تجويف النبيبات ألجامعه مبينتا أن الخلايا الإفرازية تحتوي على حافة الخلية في الغالب مكونة غشاء غير مرتبط كليا ومستمر مع قمة حافة الخلية بارز على شكل إفراز لمحتويات الخلية إلى تجويف النبيب.

الكلمات المفاتحية : الكلية، العقاب الذهبي، الكبيبة، حويصلات.

Introduction

The macro and fine anatomical structure of the avian kidney has been scantily documented and most of the published observations have been concerned with the domestic fowl (*Gallus domesticus*); these include the reports of (1, 2, 3, 4, 5, 6, 7, 8 and 9). One of the few studies was described the general histology of the other avian species (10) in honeyeaters; in Anna's humming birds (11and 12); in sparrows (13); in passerine birds (14); in wild ducks (15); in dove and owl (16) and in racing pigeon (17). While this study focus on the golden eagle because this type of birds fly for long time and eating meat only and neglecting studies on the kidney of golden eagles. To demonstrate the anatomy, histological structures and functions of the kidney. In many studies that previously talked about avian kidney demonstrated as uniqueness in structures among vertebrate kidney in having two types of nephrons: those with and without a loop of Henle (looped and loop less respectively) (13, 18 and 19). The loopless nephrons stays in the cortex while looped nephrons extend from the cortex into descript medullary areas called cones. Birds and mammals are the only classes of vertebrate that are consistently able to produce hyperosmotic urine. In birds, this ability to produce hyperosmotic urine is limited compared to that of mammals (13 and 20). In fact, the avian kidney contains a mixture of nephrons. Most nephrons resemble reptilian nephrons with simple proximal and distal convoluted tubules without loops of Henle and empty at right angles into collecting ducts (18). Moreover Sutterlim, (21) found there were considerable heterogeneity in nephron structure, ranging from very short, cortical nephrons, which lack loops of Henle to deeper, transitional nephrons and, finally, to looped mammalian-type nephrons.

Materials and Methods

Four birds of golden eagles (*Aquila Chrysaetos*), (Fig. 1). Were hunted in the afternoon in northeast Baquba city in February. The body weight of each bird was estimated by aspiring balance. Dissection was begun immediately after the animal was killed. The viscera were not damaged. All measurements were taken at the same location for all kidneys and the other organs were taken for unrelated experiments and for gross morphology. Length measurements of the kidneys were taken from the anterior tip of the cranial division to the most posterior tip of the caudal division and width measurements were taken from the lateral to the medial side of the cranial division because this division showed the maximum width of the kidneys. After that kidneys were dissected from the synsacrum bone and weighed then. Transverse parallel interrupted sections were taken at equal intervals along the length of the kidney and immediately placed into the fixative 10% formalin solution for 24h to ensure optimum fixation (22). Kidneys were processed routinely through a series of alcohol solutions and transferred to xylole and finally into paraffin wax. Transverse serial sections were taken at 5 µm thickness. The sections were stained with Haematoxylin and Eosin stains (H and E) and Periodic Acid Schiff reagent (PAS). The latter stain was necessary to distinguish the mucopolysaccarides which presence in lumen of tubules and ducts (16).

Results and Discussions

The present study investigated the gross morphology of the kidney of golden eagle (*Aquila Chrysaetus*) shot in wild (Fig. 1). Anatomical descriptions of the kidneys revealed that they had a pair of kidneys and ureters. They were prominent, flattened and retroperitoneal organs with red brown color which situated deeply into recesses of the bony synsacrum. The kidney tissue is traverse by major nerve trunks and blood vessels, securing the kidneys tightly in place (Fig.1 and 2). This is agreement with studied performed by (16) in owl and dove and another researcher (17) in racing pigeon. Each kidney consists of three divisions: cranial, middle and caudal, they reach the caudal border of the lungs and extended caudally to the end

of the synsacrum bones. The cranial lobe was the largest and wider than the other two lobes and the caudal lobe was appeared similar to middle lobe but little smaller than it (Fig. 3 and 4) this findings in disagreement with Al-Agele, (17) in racing pigeon that showed the caudal division is the largest lobe and the middle lobe was similar to caudal lobe (23). Found that the kidney in canary as in budgerigars showed that the right and the left kidneys were fused caudally. On the histological section of the kidney of golden eagles revealed that there were no line of demarcation between cortex and medulla as in mammals (Fig.5). The some findings was seen by (17) in racing pigeon. The current study showed that most nephron tubules in cortex were distributed randomly, except for the glomeruli which occurred most commonly in the peripheral cortex and the majority of distal tubules which were clustered around the intralobular veins (Fig. 6, 7 and 8). This results enhanced with (10) in honeyeaters were explained in their results that the medulla nephron tubules had orderly distribution along the entire length of the cone and appeared randomly distributed in the cortex.

The medullary units of the kidney of golden eagles exhibited a more compact arrangement of structures; distinctly concentric rings of thick limb enclose collecting ducts that are circularly arranged about a much larger vascular core (Fig. 6). This is supported with the previous study by Casotti and Braun, (13) in sparrow from different environment were found that the medullary cone of all birds in their studied display an outer ring of thick limbs of Henle which surround an inner ring of collecting ducts, which in turn surround a central core of thin limbs of Henle. On the other hand McLelland, (23) found that the thick limbs were restricted to the periphery of the medullary cone and surrounded a ring of collecting ducts, which in turn surrounded a few number of thin limbs. The renal corpuscle observed consisted of a centrally located glomerulus encapsulated within Bowman's capsule. The glomerulus consisted of a tightly packed central core of mesangial cells, surrounded by capillary loops (Fig.9). These results are agreement with the suggestions from previous published studies by (10) in honeyeater and (16) in owl and dove. Moreover Casotti and Braun, (19) in their results indicate that the avian glomerular capillaries are less complex than those of mammals. Reasons may be that either avian blood is more viscous than that of mammals or that avian erythrocytes may be unable to fit physiologically through a tight intertwining network of capillaries due to the presence of nucleus, which limits the tank-treading ability of avian erythrocytes. The proximal convoluted tubules were attached directly to the urinary pole of the glomerulus and consisted of a cuboidal epithelium, narrow and wide intercellular spaces were appeared between cell membranes (Fig.10). This result agreement with the (10 and 24) explain the occurrence of this type of intercellular space varied between honeyeater species. The cytoplasm of the proximal tubules cells contains condensing vesicles and a large apically situated nucleus. The apical surface of the proximal tubule cells is enhanced by a prominent microvilli brush border (Fig.10).

The transition from the proximal straight tubule to the thin descending limb of Henle is abrupt. The apical surface of the cells is relatively undifferentiated (Fig.10). The distal convoluted tubule observed have cells possess infoldings of basal membrane and narrow intercellular spaces and the apical surface of the cells is covered with the short, thinly dispersed layer (Fig. 10). In cross section, the tubules of the medulla display an order arrangement which appeared at an outer ring of thick limb of Henle surround a ring of collecting ducts, that intern surrounds a central core of thin limbs of Henle. The cortical collecting duct continues into the medulla as the medullary collecting duct, and the apical of the cells changes (Fig. 6). This result enhanced with (13) found that the medullary ducts ran parallel to each other were bound by fine connective tissue sheaths. All cells in the medullary ducts were tall columnar and mucin secreting type. The nuclei of such cells were larger (Fig.11). The largest medullary ducts, near where they joined the primary branches of the ureter, possessed a pseudostratified columnar epithelium with a very weak staining PAS stain (Fig.11) This result disagreement with (25) in starling kidney found the cells of the collecting

tubules and duct were very intensely staining positive surface and suggested that the avian kidney produces copious amounts of mucin which is believed to be secreted by the collecting duct system and ureter and this fact supported by (17) in racing pigeon who said that the collecting tubules and duct appear PAS positive due to secreted mucin materials to prevent sloughing of surface epithelium of tubules and ducts.

The current study found that the distal convoluted tubules and collecting ducts were distinguished on a topographical basis revealed showed varied slightly in their reactions with PAS stain and appeared as vacuoles or look like vesicles contains secretion from lining epithelial cells of distal convoluted and collecting tubules which appeared diffused in cross section. The cells of distal convoluted tubules and collecting tubules possessed vesicles with a clearly defined coated outer membrane and some had small blebs invaginated membrane(Fig.10 and 11). This result was not similar to that described in other avian species like (2 and 25) were explain that the vesicles which present in the distal convoluted tubules did not appear to have a coat. The mucin-secreting cells had limited that were indistinct by light microscope which revealed the presence of numerous subapical large vacuoles containing finely fibrillar material and these were often incompletely binding and continuous with the apical cell margin as if secreted their contents to the center of tubular region and vacuoles were strongly PAS and Alcian blue positive which that the presence of similarly staining material in the lumen indicated the a copious discharge of mucin was taking place. This result enhance with (17). In kidney of racing pigeon were strongly positive reaction with PAS stain in proximal convoluted tubules and in ureter and suggested that the present of this reaction due to muco and glycoproteins –acidmucopoly saccarides including sulpher bearing carbohydrates in different tubules especially intensity material starting in the cytoplasm of the collecting duct, ureteral branches and ureter. In previous studies have found that both the principal and intercalated cells secrete potassium and reabsorb water, sodium and other ions (26 and 27). It therefore seems likely that there is some interspecific variation in this property. Whatever Casotti, and Richardson, (10) in Meliphagid honeyeaters observed that the infoldings in the cell membrane of the cortical collecting tubules potential for substantial ion and water reabsorption which that the cells secrete mucous to prevent uric acid precipitation, hence preventing blockage along the tubules of the distal nephron. However in the current study we found vesicles or vacuoles in the lumen of collecting tubules revealed the secreting cells had margins that were often incompletely membrane –bound and continuous with the apical cell margin as if discharging their contents to the tubular lumen(Fig. 11 and 12). This situation differs from the pattern of arrangement of mucus materials reported in racing pigeon (17 and 25) in starling birds were found that the end of the distal tubule was marked by the appearance of scattered dark cells and occasional mucin-secreting cells and these usually possessed many microvesicles in the subapical regions there were also numerous, stubby apical microprocessors in many cases. Other workers have stated that the distribution and types of the mucoids materials are consistent with idea that the stabilize colloidal urates and act as physical lubricants in facilitating uric acid elimination and dietary protein content does not affect the sites of mucoid secretion or the types of mucoids secreted(25 and 28). Not mention in previous studies that enhance about the birds feeding on grains whilst in current study tacked type of birds eaten meat only and there is no carbohydrates burn.

Fig. 1: photograph of healthy mature golden eagle.

Fig. 2: photograph illustrates anatomical position (ventral view).

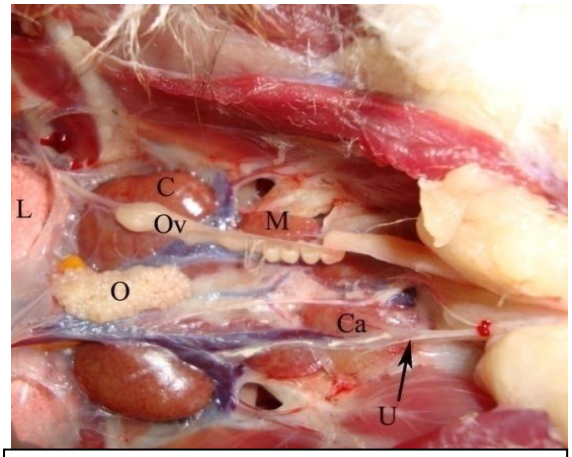

Fig. 3: photograph illustrates anatomical position, shape and color of kidney (ventral view). O. ovary, L. lung, Ov. Oviduct, Uureter, C. cranial, M. middle and Ca. caudal lobe.

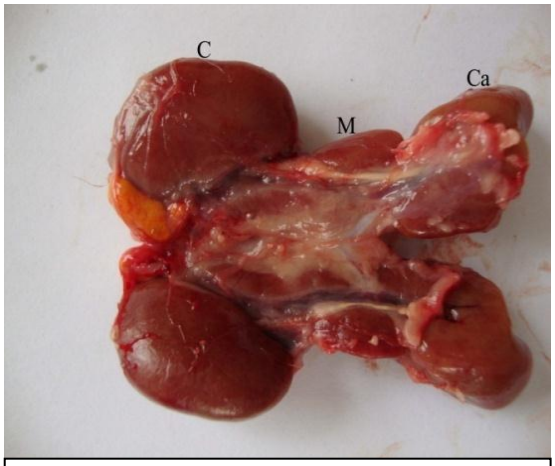

Fig. 4: photograph illustrates lobation kidney (visceral surface).C. cranial, M. middle and Ca. caudal lobe.

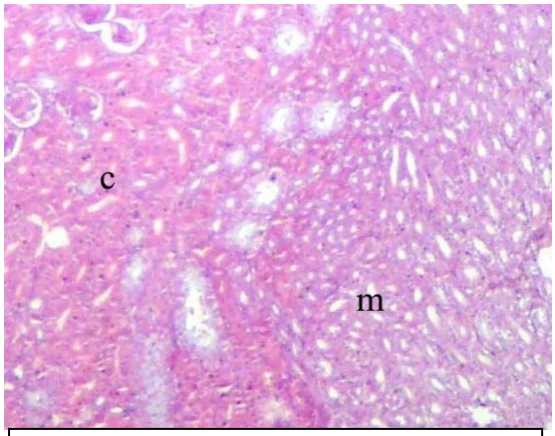

Fig. 5: photomicroscope illustrate, there was no line of demarcation between c. cortex and m. medulla. (HandE, X10)

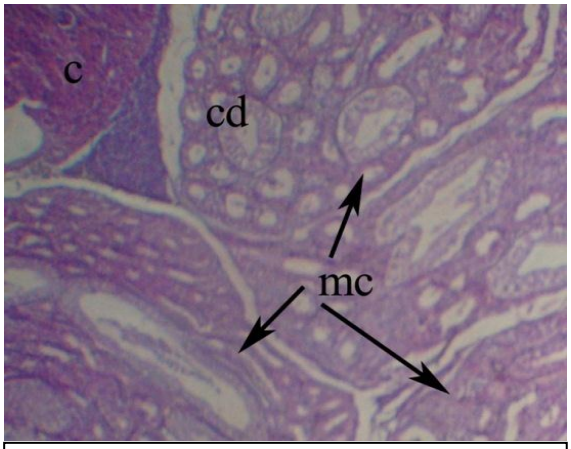

Fig.6: photomicroscope illustrate mc. medullary cone, cd. Collecting ducts and c. cortex. (HandE, X10)

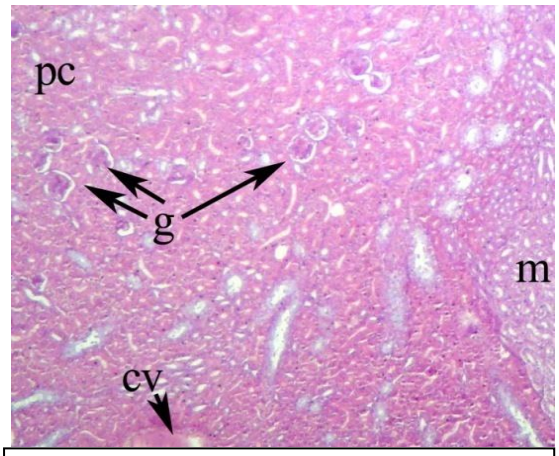

Fig.7:photomicroscope illustrate g. glomeruli which located in the pc. peripheral cortex , cv. Central vein and m. medulla. (HandE, X10)

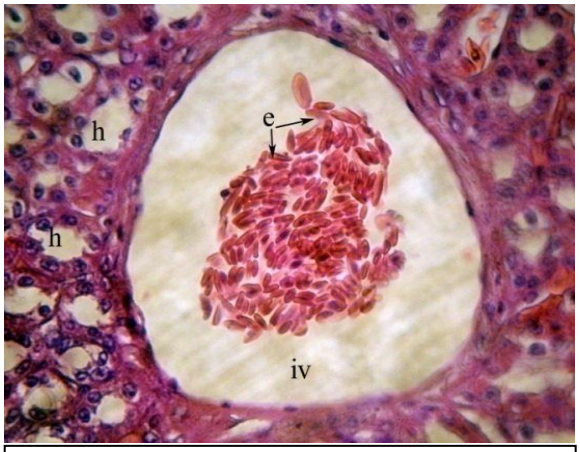

Fig. 8: photomicroscope illustrate iv. interlobular vein contain e. erythrocyte and neighbor to h. Henle's loop(HandE, X40).

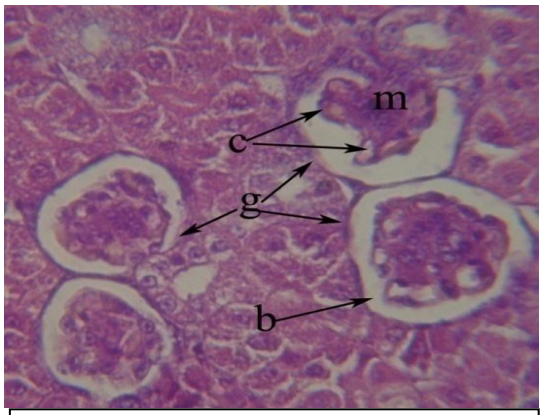

Fig. 9: photomicroscope illustrate m. mesangial cell g. glomeruli c. capillary lope b. Bowman's capsule and space. (HandE, X40).

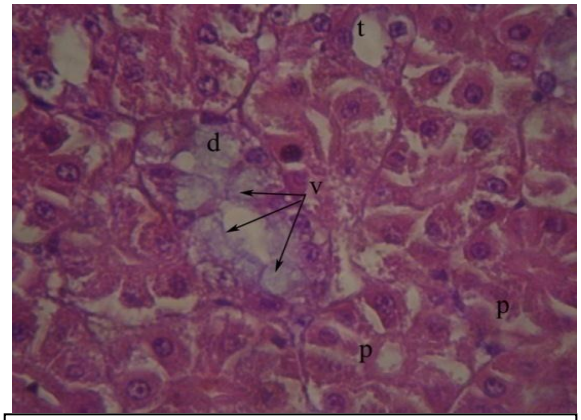

Fig.10:photomicroscope illustrate the p. proximal convoluted tubules d. distal convoluted tubules v. vesicles or vacuoles t. thin limb of Henle. (HandE, X40)

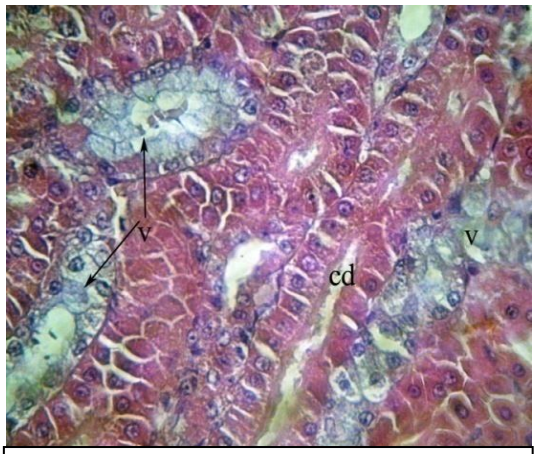

Fig.11: photomicroscope illustrate v. vacuoles in side cd. collecting ducts .(H and E, X40).

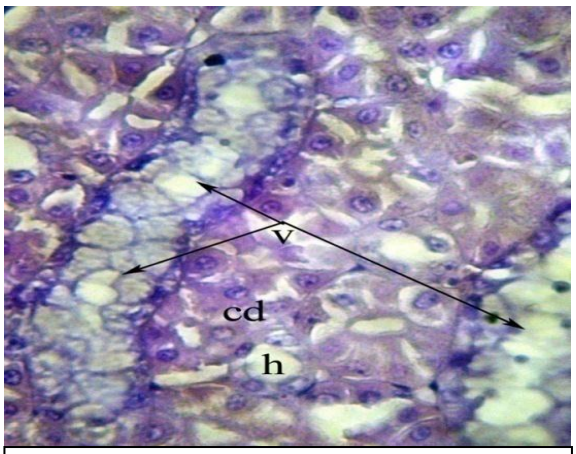

Fig.12: photomicroscope illustrate v. vacuoles in side cd. collecting ducts and Henles appeared (PAS) negative.(X40)

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