A Histological Study of the Renal Corpusclenephron Distribution in Iraqi Camels (*Camelusdromedaries*)

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Abstract

Aims: The present histological study was carried out to map the renal corpuscle nephron distribution and their histological properties in Iraqi camels(*Camelusdromedaries*).**Materials and methods**: Both kidneys from each of 10 (5 males and 5 females) adult camels were collected as soon as possible after the camels were sacrificed for human consumption purposes in a slaughterhouse. Following the preparation of tissues(cortex and medulla), the sections were slide-stained using alum hematoxylin and eosin (H&E) stain and Periodic Acid Schiff (PAS) stain. The renal corpuscle diameters (numbers and percentages) in the subcapsular area, the cortical area, andthe juxtamedullary area were measured using an ocular micrometer.**Results**:The findings demonstrated that the renal capsule in camels is thick.The numbers of the renal corpuscles were low in numbers in the subscapular region which keep increasing towards the midcorticaland the Juxtamedullary regions. Moreover, the camel kidney has high numbers of long-loops of Henle nephrons and low numbers of short-loop nephrons. No significant (p>0.05) differences in the renal corpuscle diameters were noticed between midcorticaland juxtamedullaryareas. However, a significant (p<0.05) decrease in diameters of the renal corpuscles was seen in the subcapsular region. In addition, two layers consist the renal corpuscleswith a tuft of capillaries. The proximal convoluted tubules (PCTs)showed wide lumens with the presence of cuboidal epithelial cells (CuECs)and spherical nuclei. The distal convoluted tubules(DCTs) displayedthe presence of CuECs (smaller and lighter than those in the PCTs with apical spherical nuclei(ASN).Large lumens and simple columnar epithelial cells (CoECs). Furthermore, PAS staining showed high positive results in the basement membrane of the renal corpuscles.**Conclusion**: The current histological study provides insight about the renal corpuscle nephron distribution and their histological properties in Iraqi camels(*Camelusdromedaries*).

Keywords*: Camels (Camelusdromedaries), nephron, renal corpuscles.*

Introduction

In Iraq, camels are considered as one of the main economic resources that provide the country with various forms of human needs such as meat and milk consumption and, in some areas, as a transportation method. The major cleaning-out organs in the camel body are the bean-like shaped kidneys.The kidneys provide the body with very important roles such as getting rid of the end-products of the body metabolic processes. The kidneys also enhance body balance of fluids, electrolytes, and acid versus base ratiosby changing the solute concentration and water volume in urine[(1)].

Moreover, kidneys in camels have specific anatomical characteristics that allow for hypertonic-based urine production via the camel-specialized the loop of Henle-collecting tubule distance that promotes for maximum reabsorption of water from urine[(2;3;4;5).] Interestingly in camels, the cortical layer can reach up to the half of the kidney size with a ratio of 4:1 of medulla to cortex of thickness[(6)]

Renal insufficiency, as shown by various researchers, could be due to pre-renal, renal, and post-renal causes, however, nephritis and glomerulonephritis are among rare disease conditions that affect camels with low incidence rates which had only been discovered in slaughtered camels[(7;8)] .

The present histological study was carried out to map the renal corpuscle nephron distribution

and their histological properties in Iraqi camels(*Camelusdromedaries*). Understanding those anatomical properties in camels may enhance better knowledge for developing new medicines and techniques to treat various kidney diseases in camels.

Materials and Method

Animals and samples

Both kidneys from each of 10 (5 males and 5 females) adult camels were collected as soon as possible (within 20mins) after the camels were sacrificed for human consumption purposes in slaughterhouses distributed in various regions of middle of Iraq. The kidneys were rapidly rinsed and placed in 10% buffered neutralized formalin solution for 48hrs.

Tissue and tissue section preparation

Following the preparation of tissues (cortex and medulla) that were dehydrated, cleared, and embedded in paraffin wax and cut-sectioned for pieces measured 5 to 7µmby employing a rotary microtome, the sections were slide-stained using alum hematoxylin and eosin (H&E) stain and Periodic Acid Schiff (PAS) stain. The renal corpuscle diameters (numbers and percentages) in the subcapsular area, the cortical area, andthe juxtamedullary area were measured using an ocular micrometer[9] .

Statistical Analysis

The renal corpuscle diameters (numbers and percentages) in the subcapsular area, the cortical area, andthe juxtamedullary area were measured using an ocular micrometer. Those data were analyzed using an F-test. The null hypothetical problem was refused if *p* was less or equal to 5%. The finding values were processed using SPSS software[10] .

Findings

The findings demonstrated that the renal capsule in camels is thick. The numbers of the renal corpuscles were low in the subscapular region which keep increasing towards the midcorticaland the Juxtamedullary regions. Moreover, the camel kidney has high numbers of long-loops of Henle nephrons and low numbers of short-loop nephrons. No significant ($p>0.05$) differences in the renal corpuscle diameters were noticed between midcorticaland juxtamedullaryareas. However, a significant ($p<0.05$) decrease in diameters of the renal corpuscles was seen in the subcapsular region, table 1.

Table 1: Distribution and diameters of renalcorpuscle regions in camel kidneys.

Renal corpuscle regions	Mean±SE (%)	Diameter (µm)/Mean±SE
Sub-capsular	27.5 ± 0.83 a	112.22 ± 3.354 c
Mid-cortical	41.9 ± 1.13 b	125.38 ± 2.675 d
Juxtaglomerular	31.3 ± 0.107 c	124.23 ± 2.654 d

Different letters refer to significant ($p\leq0.05$) differences.

In addition, two layers consist the renal corpuscleswith a tuft of capillaries. The proximal convoluted tubules (PCTs)showed wide lumens with the presence of cuboidal epithelial cells (CuECs) and spherical nuclei. The distal convoluted tubules(DCTs) displayedthe presence of CuECs (smaller and lighter than those in the PCTs with apical spherical nuclei(ASN). Large lumens and simple columnar epithelial cells (CoECs). Furthermore, PAS staining showed high positive results in the basement membrane of the renal corpuscles, figure 1A, B, C, and D.

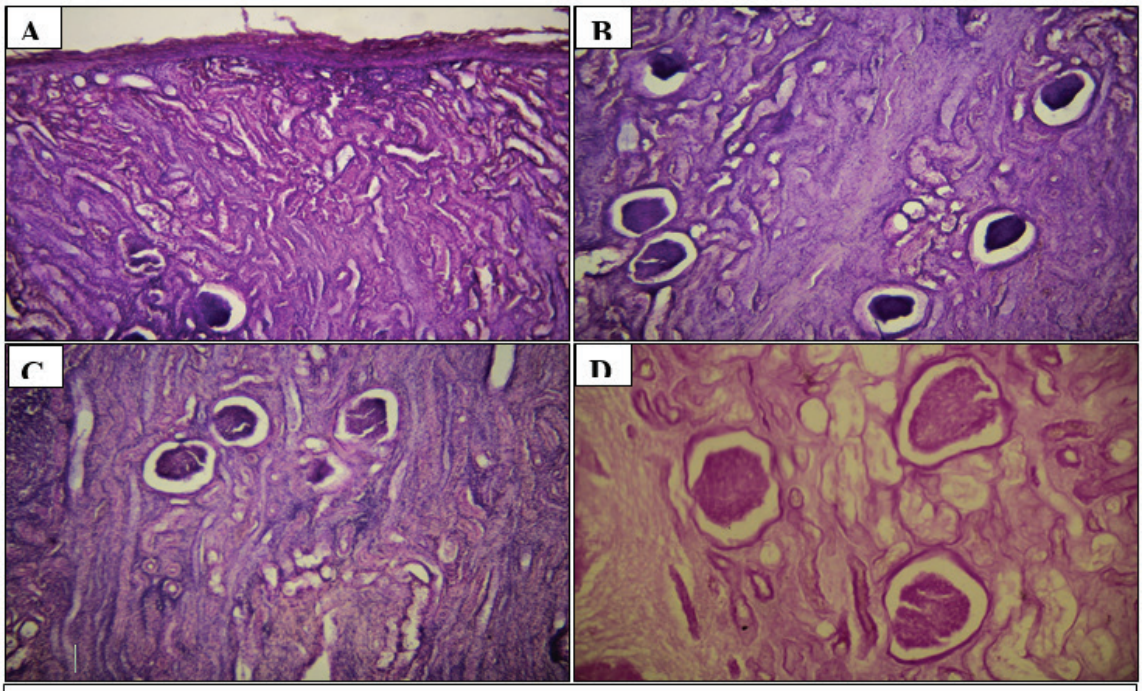

Figure 1: The renal corpuscle distribution in camel kidney. A. Subcapsular region (arrows), H&E20X. B. Midcortical region (arrows), H&E 20X. C. Juxtmedullary region (arrows), H&E 20X. D. Highly-positive PAS stain of the renal corpuscles, 40X.

Discussion

The numbers of correctly functioning renal nephrons decide the proper action of a kidney; however, kidneys may face ineffectiveness in their work if there is insufficient renal blood supply, deficient in the glomerular filtration, and defectiveness in the reabsorption of tubules. The first factor can be pre-renal initiated due to some circulatory emergency conditions such as dehydration,hemorrhage, and shock in responses to vasomotor control. While the other two factors can be induced as results to improper functions of the kidney itself [(11)] .

The current work was focused on finding the actual histological distribution of the renal corpuscles in the camel kidney which might help better understanding the functions of the kidney nephrons.

The findings demonstrated that the renal capsule in camels is thick. Interestingly in camels, the cortex can reach up to 50% of the kidney size, and this shows the huge length of the loops of Henle and vasa recta, also discovered in the current study, which adds more evidence that camel kidneys are able to concentrate their urine as part of their fulfillment of water preservation[(12)] .

A significant decrease in diameters of the renal corpuscles was seen in the subcapsular region. In addition, two layers consist the renal corpuscleswith a tuft of capillaries. The PCTsshowed wide lumens with the presence of CuECsand spherical nuclei. This piece of result agrees with the previously identified facts that renal corpuscles and glomeruli in camel kidneys are larger than those recognized in kidneys of other animals, and this is supported by the approved ideas that camels suffering dehydrationhave 73% reduction of the reabsorption of sodium from tubular lumensresulting in concentrating the camel urine and better preserving water[(13;14)]. Furthermore, PAS staining showed high positive results in the basement membrane of the renal corpuscles. This indicates highly normal glomeruli of the camel kidneys with presence of glycoprotein, glycolipid, and mucin structural components[(15)] .

Conclusion

The current histological study provides insight about the renal corpuscle nephron distribution and their histological properties in Iraqi camels(*Camelusdromedaries*).

Conflict of Interest: Non

Source of Findings: Self Findings.

Ethical Clearance: Non

References

1- Al-Ani, F. K.'Camel: management and diseases.', *Camel: management and diseases.* Faculty of Veterinary Medicine, Baghdad University. Available at: https://www.cabdirect.org/cabdirect/abstract/.2004.20043171768 .

2- Abdalla, M. A. and Abdalla, O. 'Morphometric observations on the kidney of the camel, Camelus dromedarius.', *Journal of anatomy*. Wiley-Blackwell, 129(Pt 1), pp. 45–50. Available at: http://www.ncbi.nlm.nih.gov/pubmed/511770,1979.

3- Nielsen, S. *et al.* 'Aquaporins in the Kidney: From Molecules to Medicine', *Physiological Reviews*.2002.82(1), pp. 205–244.

4- Pannabecker, T. L. *et al.* 'Role of three-dimensional architecture in the urine concentrating mechanism of the rat renal inner medulla', *American Journal of Physiology-Renal Physiology.2008.* 295(5), pp. F1271–F1285.

5- Sands, J. M. and Layton, H. E. 'The physiology of urinary concentration: an update.', *Seminars in nephrology*. NIH Public Access, 29(3), pp. 178–95. doi: 10.1016/j.semnephrol.2009.03.008.

6- Raisi, Gholam, Ali Kojouri, Hossein Nourani, Sirous Sadeghian, Hadi Imani, A. (2014) 'Veterinary research forum : an international quarterly journal.', *Veterinary Research Forum*. Urmia University Press.2014.5(3), pp. 231–235.

7- Beniwai G, Singh K, J. S.'Microscopic study of uriniferous tubules and collecting ducts of kidney in camel (Camelus dromedarius)', *J Camel Pract Res*,1998.5(1), pp. 107–109.

8- Kojouri GA, Karimi I, Jafarian M, *et al.* 'Abattoir survey on bovine kidney diseases in Shahrekord district', *Anim Sci J*, 2008.78, pp. 2–7.

9- Bancroft, J.D.S., S.K. and Christoher, L. *Bancroft's theory and practice of histological techniques*. 7th edn. Saunders Elsevier: Churchill.2013.

10- Joda, M. 'The progressive statistical analysis by using spss'. Amman, Jordon.: Wales house editions.2008.

11- Radostits OM, Gay CC, H. K.*Veterinary medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses*. 10th edn. Madrid, Spain: W.B. Saunders.2007.

12- Beniwai G, Singh K, J. S.'Microscopic study of uriniferous tubules and collecting ducts of kidney in camel (Camelus dromedarius)', *J Camel Pract Res*, 1998.5(1), pp. 107–109.

13- Ali, M. A. *et al.* 'Responses to dehydration in the one-humped camel and effects of blocking the renin-angiotensin system.', *PloS one*. Public Library of Science, 2012.7(5), p. e37299.

14- Adem, A. *et al.* 'ANP and BNP Responses to Dehydration in the One-Humped Camel and Effects of Blocking the Renin-Angiotensin System', *PLoS ONE*. 2013.Edited by T. Zakar, 8(3), p. e57806.

15- Zhou, Z.-M., Yang, F. and Cao, W. Comparison of different methods for PAS staining of renal biopsy tissue sections, *Nan fang yi ke da xue xue bao = Journal of Southern Medical University*,2012.32(3),pp.371–3.