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Anatomical relationships between the renal segmental arteries and kidney collecting system of camel.

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Abstract

The anatomical relationship between the segmental branches of the renal arteries and the renal collecting system of camel kidneys was studied by the corrosive casting technique. Some anatomical details that have clinical significance for urologists were observed. The arterial supply related to both and ventral groups of l renal recesses were documented.The present study has asserted that the start point of division of the renal artery was at a distal level of the renal Hilus, being about 3-5 cm beyond the renal pelvis. The total number of the segmental arteries was 14 segmental branch, including 6 dorsal and 8 ventral ones.Camel kidney has the higher numerical value among all farm animals and thus may be contributing to its bulky size as well as its broader width.The results were thoroughly matched with that mentioned in the obtained literatures.

Keywords: Renal arteries, collecting system, collateral recesses,segmental renal arteries.

Introduction

The vascular pattern of the renal arteries in relation to the collecting system has etiologic,diagnostic, and therapeutic significance.Although numerous papers were published on the segmentation of renal arteries in various species: cat (Marais, 1988; Aksoy and Ozudogru, 2003), dog (Shively, 1978; Christie, 1980; Aslan, 1995), rabbit (Sindel et al., 1990), goat and sheep (Aslan and Nazli, 2001; Aksoy et al., 2004), bovines (Jain and Singh (1987), pig (Evan et al., 1996), monkey (Horacek et al.,1987) and some wild animals (Hadziselimovic and Cus, 1975), there are no detailed reports on the segmentation of renal arteries of camel kidney.

In this study, we aimed to demonstrate the renal segments according to their arterial ramifications as it becomes essential to be a good knowledge of physicians and surgeons in their works.

The segmentation of the renal arteries was studied by Hadziselimovic and Cus, 1975; Horacek *et al.*, 1987; Jain and Singh, 1987; in some species of animals.Eachsegmentalarterywasseentosupplyitsownindependent area and there stood no significant anastomosis between segmental arteries

Material and methods

A study of the internal arterial pattern and collecting system of the camel kidney by corrosion cast technique has been carried out.Fifteen kidneys with renal arteries and ureters of camel species were collected from the Cairo slaughter house.The specimens were immersed in cold water for few hours, then the arteries and ureters were flushed with 0.9% physiological saline via an implanted Canula. With the help of disposable syringes attached to plastic kennels, the red Epoxy is injected into the renal artery and the yellow one into the ureter. The injection is continued until the vessels are completely filled by using the manual palpation. The vessels are clamped and ligated following the injection to avoid leakage. The specimens are kept at hot place for two days to allow the polymerization of the casting materials. The specimens are then immersed in a suitable glass jar containing 50% potassium hydroxide. The time taken for corrosion is 5-8 days depends on the size of the specimen. Once the corrosion process is completed, the corroded cast is washed gently and with a fine smoothed forceps all debris is removed to get an intact well-formed cast. After complete corrosion the renal tissues were taken out in running water until the cast appears thoroughly clean.

For terminology, the Nomina Anatomica Veterinaria was used (World Association of Veterinary Anatomists 2005).

Results

The excretory part of the kidney:

The excretory part of the kidney (Fig. I,II,III&IV) Comprises a narrow crescent shape renal pelvis measure about 5 cm in length, 9 cm in width, and 6 cm in thickness. Its wall has a finger like projections; collateral recesses counted 9-13 recesses in each surface and extend outward to approach the renal medulla of the kidney. These recesses are placed crosswise against the long axis of the kidney including a dorsal and ventral segments being related to the respective surface of the kidney. The polar recesses are small in length and caliber and located in the vicinity of the renal poles. Each recess of the renal pelvis has a deep inner surface surrounding the medullary part of a renal lobe, while the outer surface encloses the corresponding interlobar artery and its branches after coalescing with the adjacent one. Each pelvic recess presents two borders: a slightly convex superficial one facing the corresponding surface of the kidney, whereas the other appears smooth, slightly concave border and directed deeply.The external texture of the recesses appears more or less irregular and folded.

Renal arteries: The right and left renal arteries (Fig.III/1 , IV/1, V/1 & VI/1) arises from the respective lateral aspects of the abdominal aorta opposite to the level of the 3rd lumbar vertebra. The right renal artery was longer than the left one. Each artery proceeds caudally and laterally to emerge through the renal hilum of the corresponding kidney. The right artery is 12-15 mm in diameter and longer than the left one as the right kidney is more cranial in position. The left renal artery measures from 10-12 mm in diameter. Each renal artery is bifurcated into dorsal and ventral divisions 4-5 cm. Beyond the renal hilum. In two cases (2%) both divisions arise separately at one point from the abdominal aorta.

R.ventralis: The ventral branch (Fig. III/2 , IV/2 , V/3 , VI/2) Is a stout vessel having a larger diameter about 8 to10 mm.width .It establishes blood nutrition to the whole ventral surface of the kidney.It leaves its origin and runs laterade to gain the renal hilus then turns caudally toward the caudal extremity. It is remarkable for double curvatures that present in two different parts of its course. It occasionally has one near its origin before gaining the renal hilus with its convex flexure facing the caudal pole while the other one is performed at the base of the renal sinus and its convexity faces cranially. On reaching the medial angle of the caudal pole it terminates by two large caudal interlobar arteries, Aa interlobares caudalis (Fig. III). Along its course it gives off eight ventral segmental branches, Rr.segmentales ventralis (Fig. III/5 & V/4). These branches are arranged in a radiating manner toward the medulla.They arise independent at the level of the renal sinus ,then extend laterally, across the renal crest where each branch gives off twigs of interlobar arteries.. There is no anastomoses have been seen between the segmental branches.

R. dorsalis: The dorsal branch(Fig. III/3 , IV/3 , V/2 & VI/3) behaves the same curvatures of the ventral division but in an opposite direction. It has smaller caliber than the ventral one, measures 7-9 mm.width. It leaves the renal artery and runs laterally through the renal sinus to be distributed to the dorsal surface of the kidney . At the cranial pole it terminates by 2 cranial interlobar arteries Aa. interlobares cranialis (Fig. IV/4). Along its course it gives off 6dorsal segmental arteries; Rr. Segmentalis dorsalis (Fig.IV/5 & V/4) which simulate the ventral one in their courses and distribution .

The segmental branches extend laterally across the renal pelvis to gain the renal crest where each branch gives off 2-3 dorsal interlobar arteries (Aa. interlobares dorsalis, Fig. IV/6).

Generally speaking and according to the above mentioned description, the kidney of the camel has recives 14 segmental arteries including 6 on its dorsal surface and 8 in the ventral one, so accordingly the camel kidney could be divided into 14 segmental zones arranged as 6 segments on the dorsal surface and 8 segments on the ventral one. The large number of

segments is due to that the renal medulla in camel kidney is proportionally the largest in its thickness and width rather those of other mammalian animals.

Aa. Interlobers: The interlobar arteries (Fig. III/6 , IV/6) Are two sets ventral and dorsal arise from the ventral and dorsal segmental arteries respectively. They run laterally between the collateral recesses till reach the corticomedullary junction at which each branch splits into 2-3 smaller arcuate arteries.

Aa. arcuate (Fig. III/7 & IV/7) are two groups, dorsal and ventral and each group are 18-22 in numbers arise from the interlobar arteries. At the cortical medullary junction. They traverse the cortical substance and soon split into a variable number of the interlobular arteries (Fig.IV/8) which are directed toward the medulla. They are given off at right angles from the side of the arcuate arteries looking toward the cortical substance. The **interlobular arteries** pass directly outward between the medullary rays to reach the fibrous tunic, where they end in the capillary network of this part.again redivided to smaller branches to the renal glomeruli as well as the limbs of Henel.

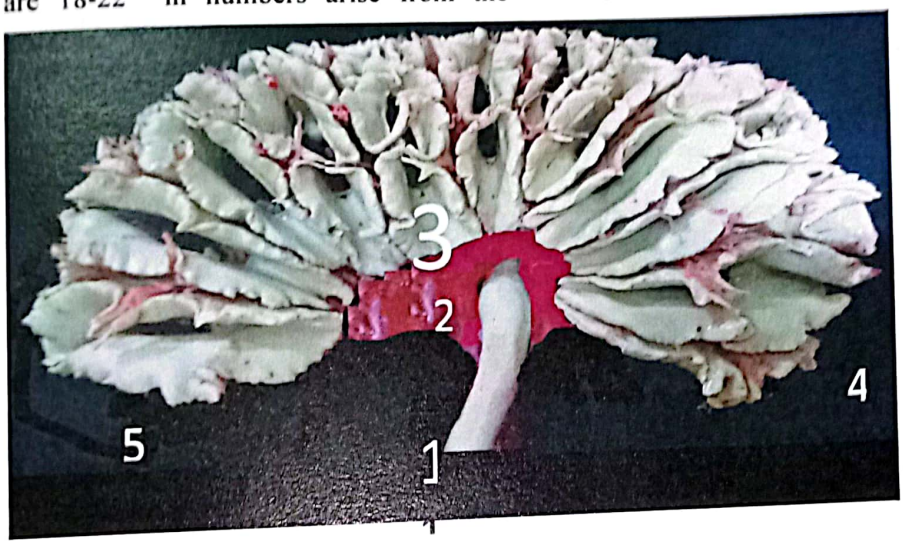

Fig. I: Endocast of the pelvirecessus system of the camel right kidney (ventral view).
1-ureter.
2- Renal pelvis.
3- dorsal collateral recesses.
4- Cranial pole.
5- caudal pole.

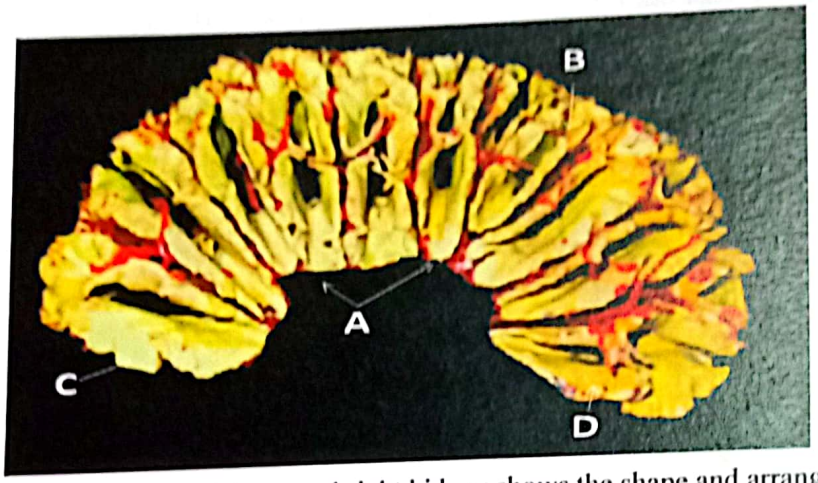

Fig. II: Endocast of the camel right kidney shows the shape and arrangement of the collateral recesses (ventral view).
A-Renal pelvis.
B- Dorsal collateral recesses.
C- Caudal pole.
D- Cranial pole.

Fig. III: A cast of camel right kidney shows the angioarchitectural pattern Of the renal artery (ventral view).
A-Ureter.
B- dorsal collateral recesses.
C-cranial pole.
D-caudal pole.
1-R. renalis.
2-R. ventralis.
3-R. dorsalis.
4-a. Interlobares caudalis.
5- RR. Segmental ventralis.
6-a. interlobaris ventralis.
7-a a. arcuatae.

Fig. IV: A cast of camel right kidney showing the angioarchitectural pattern Of the renal artery (dorsal view).

A- Ureter.
B- Renal pelvis.
C- collateral recesses.
1- A. renalis.
2- R. ventralis.
3- R. dorsalis.
4- Aa. Interlobares cranialis.
5- Rr. Segmentalis dorsalis.
6- Aa. interlobaris dorsalis.
7- Aa. Arcuatae.
8- Aa. interlobularis.

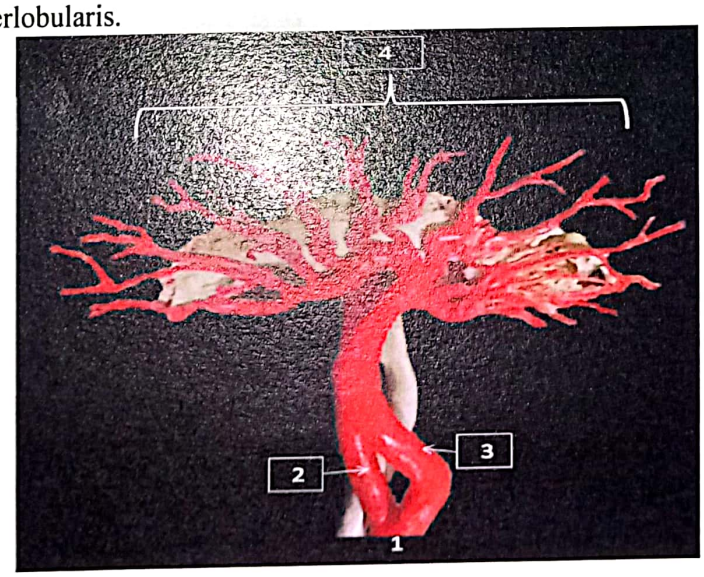

Fig. V: Endocast of the camel right kidney showing the architectural pattern of the renal artery (ventral view).

1- A.Renalissinster.
2-R.Dorsalis.
3-R.ventralis.

4. Rr.segmentalesventrales.

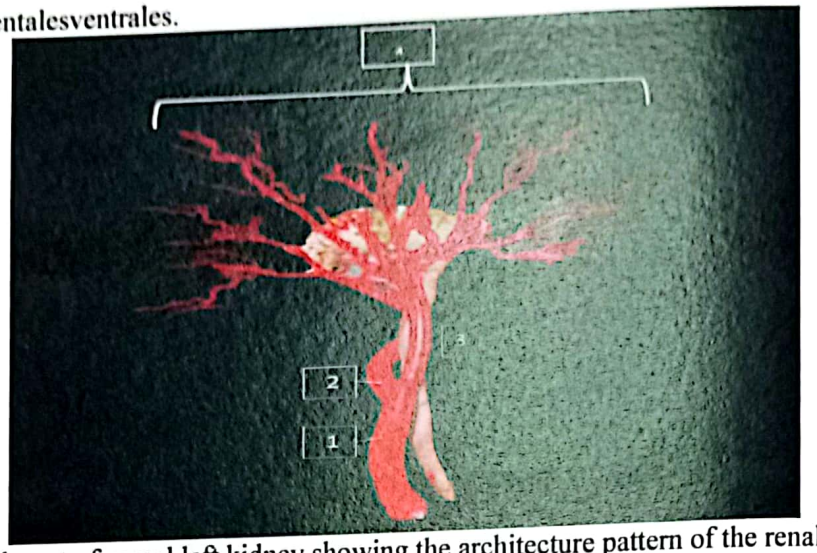

Fig. VI: Endocast of camel left kidney showing the architecture pattern of the renal artery(dorsal view).
1-A.Renalis sinster.
2-R.ventralis .
3-R.dorsalis.
4. Rr.segmentalesdorsales.

Discussion

The morphology of the renal artery has been well documented in most of domestic animals (Nickel et al; 1981) but there were few literatures, one or two that dealt with camel kidneys. Mohammad Reza, (2012) in camel.

In camel the present study revealed that the kidneys are supplied by the right and left renal arteries and both were originated from the respective side of the abdominal aorta. Similar findings were given by Nickel et al (1981)in domestic animals; Jain and Singh, (1987)in bovines; Aksoy and Ozudogru (2003) in sheep and Mohammad Reza, (2012) in camel. However, Ghoshal (1975) in dog reported their origins to be from the ventral surface ofthe aorta.

In the current study extra arterial branches were very restricted among camel and not exceeding more than 1-%, whereas the main renal artery enters the renal Hilus either from proximal or distal level without giving any accessory or aberrant branches.

The present work has shown that in all cases, the right renal artery was slightly longer than the left one (Nickel et al 1981) unlike that in some species Aksoy and Ozudogru (2003)Aksoy et al. (2004); Ramezani et al. (2008)where the left renal artery was reported to be longer than the right one.

The present study has asserted that the start point of division of the renal artery was at a distal level of the renal Hilus in camel being about 3-5 cm beyond the renal pelvis unlike, the observations of Sarfraz, Tahir and Sami, (2008) ;Daescu, Zahol, motos et al., (2012)and Budhiraja et al; (2013) as they have been reported early division of renal artery before it reaches the Hilum of the kidney.

The present work has shown that the renal artery was divided into two main branches dorsal and ventral divisions Similar observations were mentioned in camel (Mohamed Riza; 2012), in goat (Aksoy; 2004) in sheep and (Reis and Tepe, 1956) in the dog, (Fuller and Huelke 1973), Rieck and Reis, 1953) in cat and (Shively and Stump,1975) in Guinea pigs. However; Aslan, (1995) Aksoy and Ozudogru, (2003) determined that there was a third branch that was given from the renal artery in sheep. On the other hand, a controversial observation has been mentioned byRekha et al (2014) who have mentioned a cranial and caudal division of the renal artery in buffalo the result which dissimilar to our findings in which the main two divisions were dorsal and ventral division..

shown a total 5 renal segmental arteries in human. On the other hand, Akosy et al (2004) in sheep and Aslan et al (2001)in goat mentioned 3-5 branches given off the dorsal division and 4-6 branches of the ventral one the result which disagreed with our findings.

The final fundamental target of this study is to split the kidneys into segmental zones based on the segmental arteries for avoiding the surgical implications The present work has shown 14 segments in camel including 6 dorsal segments and 8 ventral ones,the result which incompatible with what have been mentioned in other species of animals.

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الملخص العربى

العلاقة التشريحية بين الفروع القطاعية الكلوية والنظام الجمعى للكلى فى الإبل

مدحت احمد العياط ،السيد فتح خليفة ،سامر محمد دغش و محمود مصطفى محمد

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تمت دراسة العلاقة التشريحية بين الفروع القطاعية للشرايين الكلوية والنظام الجمعى للكلى فى الإبل بواسطة تقنية الصب والتآكل. وقد لوحظت بعض التفاصيل التشريحية التي لها أهمية اكلينيكيةعند أطباء المسالك البولية . وقد تم تتبع ووصف الشرايين القطعية وعلاقاتها مع المجموعة الظهرية والبطنية للتجاويف الكلوية .

وأكدت الدراسة أن نقطة بداية تقسيم الشريان الكلوي كانت على مستوى اعلى من النقير الكلوي ، بحوالي 3-5 سم تحت مستوى الحوض الكلوي. وبلغ العدد الإجمالي للشرايين القطعية اربعة عشر شريان قطعي ، وزعت الى ستة فروع ظهرية و ثمانية فروع بطنية. أوضحت الدراسة ان عدد القطع فى كلى الجمل ذو قيمة عددية أعلى من بين جميع حيوانات المزرعة حيث بلغت اربعة عشرة قطعة، وقد يكون ذلك راجعى الى الحجم الضخم للكلى فى هذا الجنس علاوة على انه تمتلك نسيبى عرض كبير.

كانت النتائج مطابقة تماما مع تلك المذكورة في المراجع والآدابيات التي سبق وان تناولت نفس الدراسة فى حيواناتاخرى.