

A MACROSCOPICAL INVESTIGATION ON THE INTRARENAL SEGMENTATION OF THE RENAL ARTERIES IN THE VAN CAT

Gürsoy AKSOY* Zekeriya ÖZÜDOĞRU**

Geliş Tarihi : 24.02.2003

Summary: The aim of the present study was to explore the branching patterns of the arterial blood vessels of the kidney of Van cat. For this purpose, intrarenal arterial pattern of the renal arteries was investigated macroscopically by the corrosion cast in 12 kidneys. The left renal artery was longer than the right one. The renal arteries divided into the dorsal and ventral branches, and both of those gave off the interlobar arteries within the substance of the kidney. They then gave off the arcuate and the interlobular arteries, respectively. The right dorsal branch divided into 3 to 5 interlobar branches, and the right ventral branch 4 to 6 interlobar branches. The left dorsal branch gave off 3 to 6 interlobar branches, and the left ventral branch 3 to 4 interlobar branches. The right renal artery was double in 1 kidney. In this kidney, there were no dorsal and ventral branches, and the interlobar arteries originated from the right renal artery directly.

Key words: Cat, intrarenal ramification, renal artery.

Van Kedisinde Aa. Renales'in Intrarenal Segmentasyonu Üzerinde Makroskopik Bir Araştırma

Özet: Bu çalışma, Van kedisi böbreğinde arterial kan damarlarının dallanma modelini ortaya çıkarmak için yapıldı. Bu amaçla, 12 adet böbrekte aa. renales'in intrarenal dallanma modeli korozyon kast metodu ile makroskopik olarak incelendi. Sol a. renalis'in, sağ a. renalis'ten uzun olduğu belirlendi. Aa. renales'in, aa. interlobares'i veren r. dorsalis ve r. ventralis'e ayrıldığı gözlemlendi. Sonra, aa. interlobares'ten sırasıyla aa. arcuata ve aa. interlobulares'in çıktığı saptandı. Sağ r. dorsalis'in 3-5, sağ r. ventralis'in 4-6 aa. interlobares'e ayrıldığı görüldü. Sol r. dorsalis'in 3-6, sol r. ventralis'in ise 3-4 aa. interlobares'e bölündüğü tespit edildi. Sağ a. renalis'in 1 böbrekte çift olduğu belirlendi. Bu böbrekte r. dorsalis ve r. ventralis'in bulunmadığı ve aa. interlobares'in doğrudan aa. renales'ten başlangıç aldığı gözlemlendi.

Anahtar sözcükler: A. renalis, intrarenal dallanma, kedi.

INTRODUCTION

The kidneys are supplied by the right and left renal arteries originating from the abdominal aorta¹⁻⁴. The right renal artery leaves the abdominal aorta before the left renal artery^{3,4}. The right renal artery is longer than left one^{1,5}. The renal arteries divide into the dorsal and ventral branches where they enter the hilus of the kidney^{1,2,6,7}. On the other hand, there are references expressing that the renal arteries divide into 2 or more branches in the dog^{1,3,8} and in the cat³. Fuller and Huelke² have demonstrated that the dorsal and ventral branches divide into 4 branches in the cat and 2 branches in the dog. The dorsal and ventral branches divide into the interlobar, arcuate, and interlobular arteries, respectively^{1,5,6}. The afferent arterioles originating from the interlobular arteries enter the renal corpuscle^{1,3,5}.

It has been reported in many kidney diseases that it is essential to know about the ramification of the renal artery when the partial or segmental resection is to be required⁹⁻¹². This leads the researchers to have studied the segmentation of the renal arteries on various species¹³⁻¹⁸.

The Van cat is a middle-long-haired species

originating in Van, Turkey. It has usually white color patches on head, legs and tail. It is known as odd-eyed cat in the region, which has one eye blue and other eye orange in color¹⁹. Many studies have demonstrated that the Van cat has morphologically different peculiarities¹⁹⁻²³. These data also emphasize the importance of the present study. However, due to lack of literature about the intrarenal segmentation of the renal artery in the Van cat, this investigation aimed at demonstrating the intrarenal segmentation of the renal arteries, which might contribute to the clinical and other experimental researches.

MATERIALS and METHODS

In this study, arteries of the kidneys of six adult Van cats, weighing 2.5 ± 0.25 kg and regardless of their sex, were investigated by the originally described corrosion cast method^{18,24,25}. To begin with, animals were first bled through the abdominal aorta by opening the abdomen under deep anesthesia with xylazin hydrochloride (Rompun, Bayer; Istanbul, Turkey) & ketamin hydrochloride (Ketalar, Parke-Davis; Istanbul, Turkey). Heparin (5000 IU/ml) was also injected intravenously to prevent coagulation. Secondly, the vessels were cleaned with 0.9 % serum physiologic via a cannula placed into the

* Department of Anatomy, Faculty of Veterinary Medicine, University of Kafkas, Kars-TURKEY

** Department of Anatomy, Faculty of Veterinary Medicine, University of Atatürk, Erzurum-TURKEY

abdominal aorta. The kidneys were thirdly removed along with the renal arteries, and takilon prepared in 20 % powder monomethyl-methacrylate and 80 % liquid polymethyl-methacrylate was infused through the renal arteries. The kidneys were then kept at room temperature for 24 hours for polymerization. Finally, they were put into an oven at 60 °C for 24 hours in 30 % KOH for maceration, were washed with water, and were photographed.

The Nomina Anatomica Veterinaria²⁶ was used for terminology.

RESULTS

The right renal artery (figs 1,2,3,4b) emerged from the abdominal aorta (figs 1,2,3,4,5a), slightly cranial to the left renal artery (figs 1,3g,2,4h,5f). The left renal artery was longer than the right renal artery. These arteries originated from the both sides of the abdominal aorta and ran towards the hilus of the kidneys. The right renal artery approximately 0.4 cm far and the left one nearly 1 cm far from the hilus the kidney divided into the dorsal and ventral branches. The right dorsal branch (figs 1,2,4c) gave off 3 to 5 right interlobar arteries (figs 1,2,4e,3,5d). The right ventral branch (figs 1,2,4d,3c) ramified as 4 to 6 right interlobar arteries. The left dorsal branch (figs 1,5h,2,4i) gave off 3 to 6 left interlobar arteries (figs 1,2j,3,5i,4k). The left ventral branch (figs 1i,3h,4j,5g) gave off 3 to 4 interlobar arteries. Many right arcuate arteries (figs 2,4f,3e) and the left ones (figs 1,2k,3j,4l) which ran towards the lateral margin arose from the interlobar arteries nearly at the corticomedullary junction. The arcuate arteries gave rise to a number of right interlobular arteries (figs 1,3f,2,4g,5e) and the left ones (figs 1,2l,3k,4m,5j) with larger number than the arcuate arteries, and they were distributed to all over the kidney. There were no anastomoses among the interlobular extension of the renal arteries. Measurements on the arteries were given in table 1.

In one material, there were 2 right renal arteries, the right dorsal renal artery (fig. 5b) and the right ventral one (fig. 5c). They sprang from the ventral aspect of the abdominal aorta, and gave off no dorsal and ventral branches. 4 interlobar arteries originated from the each right renal artery directly. 2 interlobar arteries emerged from the both left dorsal and left ventral branches of the left renal artery.

DISCUSSION

It was observed that the right and left renal arteries gave off the dorsal and ventral branches before entering the hilus of the kidney. These data confirm

the previous studies in the dog^{1,2,6,7} and in the cat². However, it has been reported that renal arteries have divided into 2 or more branches in the dog^{1,3,8} and in the cat³.

In the present study, it was found that there were two right renal arteries in 1 kidney and they had no dorsal and ventral branches. In this kidney, the interlobar arteries originated from the right renal artery directly. On the other hand, according to Aslan⁶ the interlobar arteries originated from the dorsal and ventral branches directly, and 1 interlobar artery arose from the renal artery in 1 kidney of 15 dogs. Some others^{7,8} reported the right renal artery to be double in some kidneys of the total of 500 dogs investigated on.

Fuller and Huelke² demonstrated that 4 segmental arteries emerged from both the dorsal and ventral branches in the cat. In the present study, it was observed that the right dorsal branch gave off 3 to 5 segmental arteries, the right ventral branch 4 to 6 segmental arteries, the left dorsal branch 3 to 6 segmental arteries, and the left ventral branch 3 to 4 segmental arteries.

In this investigation, the left renal artery was also longer than the right one while previous data reported the opposite¹.

REFERENCES

- 1 Christensen GC: Circulation of blood through the canine kidney. *Am J Vet Res*, 13: 236-245, 1952.
- 2 Fuller PM, Huelke DF: Kidney vascular supply in the rat, cat and dog. *Acta Anat*, 84: 516-522, 1973.
- 3 Nickel R, Schummer A, Seiferle E: The viscera of the domestic mammals. 282-302, Verlag Paul Parey, Berlin and Hamburg, 1973.
- 4 Singh AP, Singh GR, Sharma DN, Nigam JM, Bhargava AK: Arteriographic anatomy of the abdominal aorta in the goat, dog, pig and rabbit. *Vet Radiol*, 23(6): 279-281, 1982.
- 5 Dursun N: Veteriner anatomi II. 128-134, Medisan Yayınevi, Ankara, 1994.
- 6 Aslan K: Köpekte a. renalis'in intrarenal segmentasyonu üzerinde makroanatomik çalışmalar. *Vet Bil Derg*, 11(2): 149-154, 1995.
- 7 Shively MJ: Origin and branching of renal arteries in the dog. *J Am Vet Med Assoc*, 173(8): 986-989, 1978.
- 8 Reis RH, Tepe P: Variations in the pattern of renal vessels and their relation to the type of posterior vena cava in the dog (*Canis familiaris*). *Am J Anat*, 99(1): 1-15, 1956.
- 9 Graves FT: The anatomy of the intrarenal arteries and its application to segmental resection of the kidney. *Br J Surg*, 42: 132-139, 1954.
- 10 Graves FT: Anatomical studies for renal and intrarenal surgery. IOP Publishing Lt, Techno House, Redcliffe Way, Bristol BS1 6NX, England, 1986.
- 11 Lopukhin YM: Experimental surgery. Mir Publishers, 130 Moscow, 1976.
- 12 Motwani K, Harneja NK: A comparative anatomy of renal arterial segments in common mammals and man. *Indian J Vet Surg*, 3(1): 27-31, 1982.

- 13 **Aslan K, Nazli M:** A comparative macroanatomic investigation on the intrarenal segmentation of the renal artery in goats and Morkaraman sheep. *Indian Vet J*, 78: 139-143, 2001.
- 14 **Aycan K:** Plastik enjeksiyon metodu ile böbrek damar anatomisinin araştırılması. Doktora Tezi, Erciyes Üniv Tıp Fak, Kayseri, 1984.
- 15 **Hadziselimovic H, Cus M:** Blood vessels and excretory apparatus of the kidney in some wild animals. *Acta Anat*, 91: 71-82, 1975.
- 16 **Horacek MJ, Earle AM, Gilmore JP:** The renal vascular system of the monkey: A gross anatomical description. *J Anat*, 153: 123-137, 1987.
- 17 **Jain RK, Singh Y:** Vascularization of kidneys in bovine calves. *Indian Vet J*, 64: 1059-1062, 1987.
- 18 **Sindel M, Uçar Y, Özkan O:** Renal arterial system of the domestic rabbits (*Oryctolagus cuniculus*): Corrosion cast study. *J Indian Anat Soc*, 39: 31-40, 1990.
- 19 **Odabaşoğlu F, Ateş CT:** Van kedisi. 9-33, 1. baskı. Selçuk Üniversitesi Baskısı, Konya, 2000.
- 20 **Ateş CT:** Van kedilerinin morfolojik ve fizyolojik özellikleri ile göz renklerinin dağılımı üzerinde bir araştırma. Doktora Tezi, Sağlık Bil Enst, Yüzüncü Yıl Üniv, Van, 2000.
- 21 **Karadağ H, Soygüder Z, Özüdoğru Z:** Van kedilerinde arteria axillaris, brachialis ve mediana'nın kolları üzerinde makroanatomik bir çalışma. *Fırat Üniv Sağlık Bil Derg*, 15 (2): 241-245, 2001.
- 22 **Nur İH, Aksoy G:** Van kedisinin koroner arterleri üzerinde makroanatomik ve subgros bir araştırma. *Yüzüncü Yıl Üniv Vet Fak Derg*, 11(1): 83-92, 2000.
- 23 **Nur İH, Arı HH:** Van kedilerinde ön kolun arterial donanımı üzerinde makroanatomik ve subgros bir çalışma. *Yüzüncü Yıl Üniv Vet Fak Derg*, 11(1): 93-103, 2000.
- 24 **Nerantsız C, Antonakis E, Avgaustakis D:** A new corrosion casting technique. *Anat Rec*, 191: 321-325, 1978.
- 25 **Tompset DH:** Anatomical techniques. 2nd ed. E and S Livingstone, Edinburg and London, 1970.
- 26 **International Committee on Veterinary Gross Anatomical Nomenclature:** Nomina Anatomica Veterinaria, 4th ed. Gent, 1994.

Table 1. The number and lengths of the renal arteries and their branches.

Tablo 1. Renal arterlerin ve dallarının sayı ve uzunlukları.

N	1 ld	2 ls	3 2d	4 2s	5 3d	6 3s	7 4d	8 4s	9 5d	10 5s	11 6d	12 6s	M
D	0.7	0.5	0.6	0.5	0.4	0.6	0.7	0.5	0.6	0.5	0.6	0.4	0.55
V	0.5	0.2	0.5	0.3	0.6	0.5	0.6	0.4	0.4	0.2	0.3	0.2	0.39
L	1.5	1.9	1.6	1.7	1.4	1.7	1.3	1.5	1.5	1.8	1.6	1.8	1.75
Dn	5	4	4	3	5	6	3	5	4	4	4	5	4.33
Vn	4	3	5	4	6	4	4	4	4	3	4	3	4

N: number of kidney, D: Length of the dorsal branch before giving the first interlobar artery (cm), V: Length of the ventral branch before giving the first interlobar artery (cm), L: Length of renal artery from its origination to the hilus of the kidney (cm), Dn: Number of interlobar artery originating from the dorsal branch, Vn: Number of interlobar artery originating from the ventral branch, M: Mean value, d: Right, s: Left.

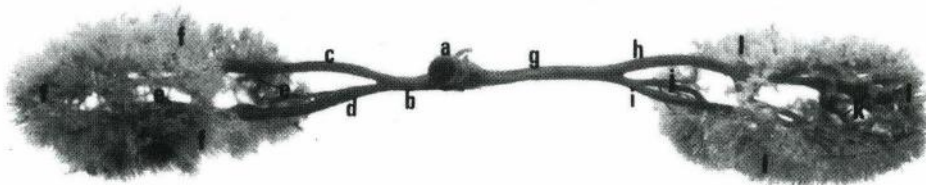


Figure 1. Cranial view of the intrarenal branches of the renal arteries.

Resim 1. Renal arterlerin intrarenal dallarının cranial görünümü.

a: abdominal aorta, b: right renal artery, c: right dorsal branch, d: right ventral branch, e: right interlobar arteries, f: right interlobular arteries, g: left renal artery, h: left dorsal branch, i: left ventral branch, j: left interlobar arteries, k: left arcuate arteries, l: left interlobular arteries.

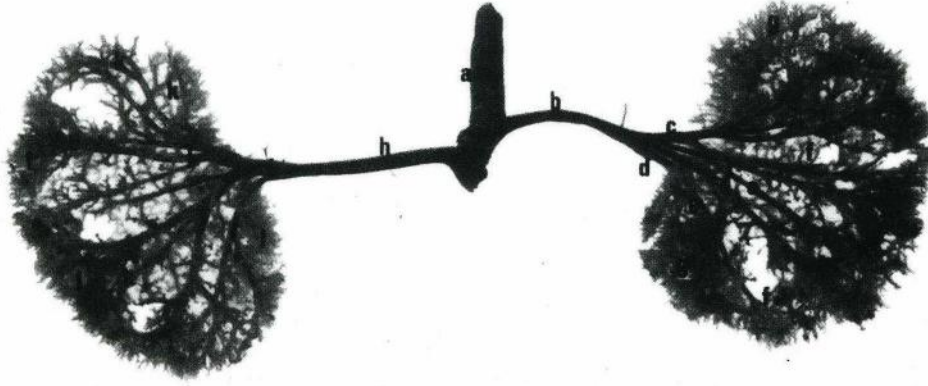


Figure 2. Dorsal view of the intrarenal branches of the renal arteries.

Resim 2. Renal arterlerin intrarenal dallarının dorsal görünümü.

a: abdominal aorta, b: right renal artery, c: right dorsal branch, d: right ventral branch, e: right interlobar arteries, f: right arcuate arteries, g: right interlobular arteries, h: left renal artery, i: left dorsal branch, j: left interlobar arteries, k: left arcuate arteries, l: left interlobular arteries.

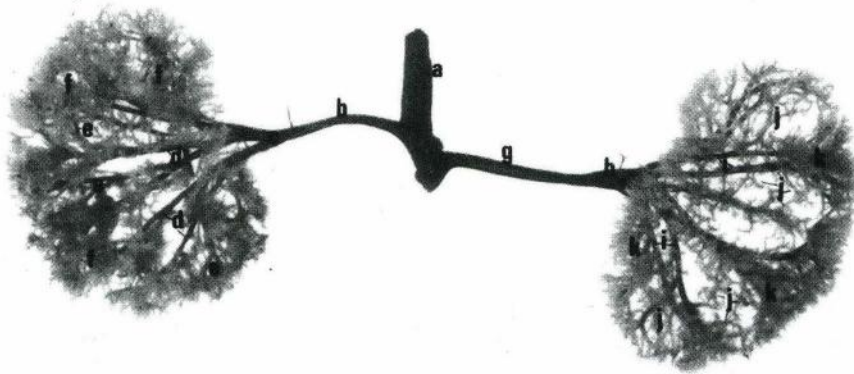


Figure 3. Ventral view of the intrarenal branches of the renal arteries.

Resim 3. Renal arterlerin intrarenal dallarının ventral görünümü.

a: abdominal aorta, b: right renal artery, c: right ventral branch, d: right interlobar arteries, e: right arcuate arteries, f: right interlobular arteries, g: left renal artery, h: left ventral branch, i: left interlobular arteries, j: left arcuate arteries, k: left interlobular arteries.

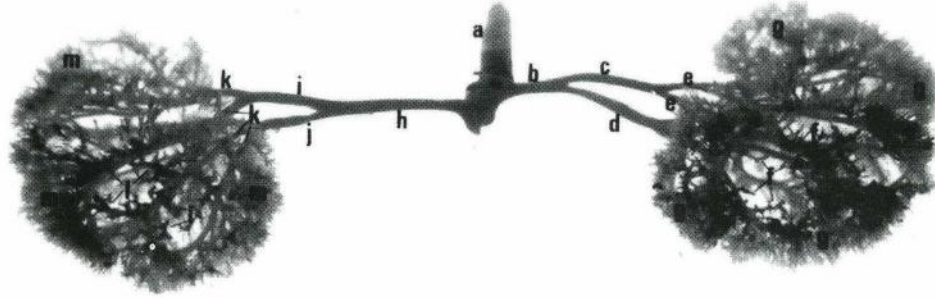


Figure 4. Caudal view of the intrarenal branches of the renal arteries.

Resim 4. Renal arterlerin intrarenal dallarının caudal görünümü.

a: abdominal aorta, b: right renal artery, c: right dorsal branch, d: right ventral branch, e: right interlobular arteries, f: right arcuate arteries, g: right interlobular arteries, h: left renal artery, i: left dorsal branch, j: left ventral branch, k: left interlobular arteries, l: left arcuate arteries, m: left interlobular arteries.

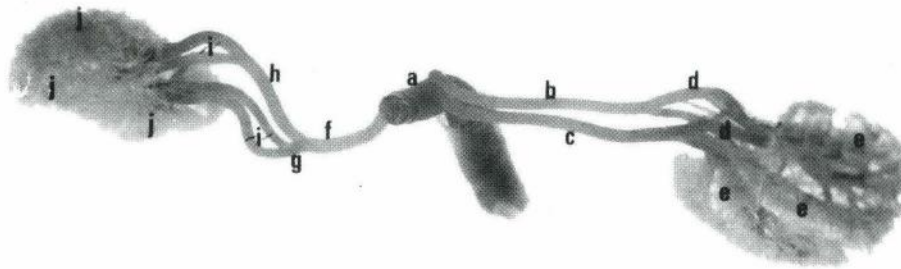


Figure 5. Caudal view of the intrarenal branches of the renal arteries.

Resim 5. Renal arterlerin intrarenal dallarının caudal görünümü.

a: abdominal aorta, b: right dorsal renal artery, c: right ventral renal artery, d: right interlobular arteries, e: right interlobular arteries, f: left renal artery, g: left ventral branch, h: left dorsal branch, i: left interlobular arteries, j: left interlobular arteries.