Intrarenal arteries and their patterns in the Tuj sheep

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ABSTRACT: Ten kidneys were investigated by corrosion cast in this study. The renal arteries divided into the dorsal and ventral branches. The dorsal and ventral branches gave off the interlobar, arcuate and interlobular arteries, respectively. No anastomoses were seen between the renal arteries and their branches. A third branch originated from the junction of the dorsal and ventral branches in one right kidney. A dorsal branch gave off an interlobar artery supplying the ventral surface of one left kidney. An interlobar artery did not arise from the ventral branch at this part.

Keywords: intrarenal segmentation; sheep; anatomy

Kidneys are supplied by the right and left renal arteries in mammals (Nickel *et al*., 1981; Dursun, 1994). They both originate from the related side of the abdominal aorta (Nickel *et al*., 1981; Jain and Singh, 1987). They might also arise from the ventral aspect of the abdominal aorta (Ghoshal, 1975). The renal arteries give rise to the dorsal and ventral branches before entering the hilus of the kidney (Aslan and Nazli, 2001). The dorsal and ventral branches divide in turn into the interlobar, arcuatae and interlobular arteries (Nickel *et al*., 1981; Jain and Singh, 1987; Aslan and Nazli, 2001).

Tuj sheep, a local breed known as Kars and Cildir sheep, is confined particularly to northeast of Turkey. It is also called Tuchin in south of Russia, and Caucasus. Its skin is covered with usual white color wool (Akcapinar, 2000).

Being essential to be known in many kidney diseases, knowledge of the ramification of the renal arteries is required on the process of partial or segmental resection (Graves, 1954; Motwani and Harneja, 1982; Graves, 1986). This has focused the researchers onto the segmentation of the renal arteries on various species (Hadziselimovic and Cus, 1975; Horacek *et al*., 1987; Jain and Singh, 1987; Aslan and Nazli, 2001). This paper, thus, aims at observing the intrarenal segmentation of the renal arteries, which might be a valuable contribution to the literature.

MATERIAL AND METHODS

In this study, the kidneys of five adult Tuj sheep, regardless of their sex, were used. The originally described corrosion cast method (Tompset, 1970; Nerantsiz *et al*., 1978; Sindel *et al*., 1990) was applied to the materials. Animals were anesthetized with xylazin hydrochloride (Rompun, Bayer; Istanbul, Turkey) and ketamin hydrochloride (Ketalar, Parke-Davis; Istanbul, Turkey). The abdominal aorta was bled by opening the abdomen under deep anesthesia. Heparin (5 000 IU/ml) was also injected intravenously to prevent coagulation. The vessels were washed with 0.9% saline. The kidneys were obtained along with the renal arteries, followed by the injection of the takilon prepared in 20% powder monomethyl-methacrylate and 80% liquid polymethyl-methacrylate. They were kept at room temperature for 24 hours for polymerization. Finally, they were corrosion casted in 30% KOH at 60°C for 24–48 hours, washed with tap water, and photographed. The Nomina Anatomica Veterinaria (1992) was used for the terminology.

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

n	1	2	3	4	5	6	7	8	9	10	M
	1d	1s	2d	2s	3d	3s	4d	4s	5d	5s	
D	0.8	0.8	0.3	1.5	0.5	0.6	0.8	0.7	0.6	0.6	0.72
V	1	1.1	0.5	0.5	0.6	0.7	1.1	1	0.4	0.6	0.75
L	2.2	1.9	2.4	2.1	2.8	2.4	2.5	2.2	2.6	2.3	2.34
Dn	5	4	4	3	5	6	3	5	4	4	4.33
Vn	4	3	5	4	6	4	4	4	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 toward 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

RESULTS AND DISCUSSION

The right (Figures 1 and 3/a) and left (Figures 2 and 4/a) renal arteries supplying the kidneys descended from each side of the abdominal aorta. The right renal artery arose slightly cranial to the left one and was longer. Both divided into the dorsal and ventral branches before arriving at the hilus. The right renal artery gave rise to the dorsal and ventral branches 1–1.4 cm far from the hilus, and the left renal artery 1.3–1.7 cm. The right dorsal branch (Figures 1/b and 3/f) divided into three-five interlobar subbranches (Figures 1/c and 3/g) while the right ventral one (Figures 1/f and 3/b) gave off four-six interlobar ones (Figures 1/g and 3/c). The left dorsal branch (Figure 2/b), on the other hand, branched out three-six (Figure 2/c) and the left ventral branch (Figure 4/b) three-four (Figure 4/c) interlobar arteries. In one of the right kidneys, a third branch (Figure 3/j) emerged from the junction of the dorsal and ventral branches, supplying the dorsal surface of the kidney. There was also an interlobar artery (Figure 2/f) in one of the left kidneys, originating from the dorsal branch. It nourished the ventrocaudal surface because of the lack of the counterpart interlobar artery aris-

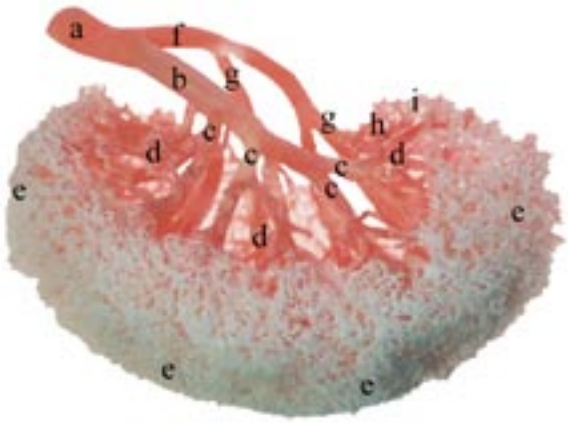

Figure 1. Dorsal view of the right renal artery. a = right renal artery, b = right dorsal branch, c = right dorsal interlobar artery, d = right dorsal arcuate artery, e = right dorsal interlobular artery, f = right ventral branch, g = right ventral interlobar artery, h = right ventral arcuate artery, i = right ventral interlobular artery

Figure 2. Dorsal view of the left renal artery. a = left renal artery, b = left dorsal branch, c = left dorsal interlobar artery, d = left dorsal arcuate artery, e = left dorsal interlobular artery, f = the interlobar artery originating from the dorsal branch and nourishing the ventro-caudal surface

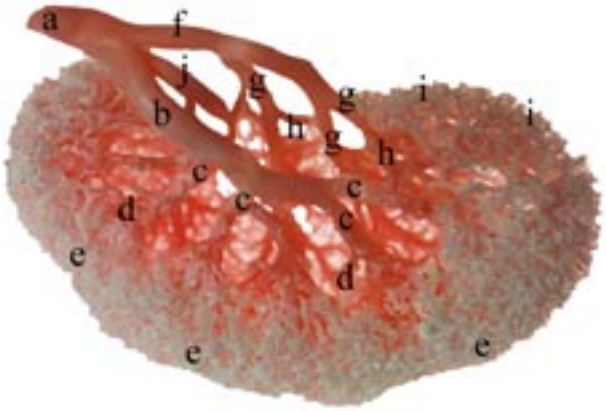

Figure 3. Ventral view of the right renal artery. a = right renal artery, b = right ventral branch, c = right ventral interlobar artery, d = right ventral arcuate artery, e = right ventral interlobular artery, f = right dorsal branch, g = right dorsal interlobar artery, h = right dorsal arcuate artery, i = right dorsal interlobular artery, j = the third branch emerged from the junction of the dorsal and ventral branches

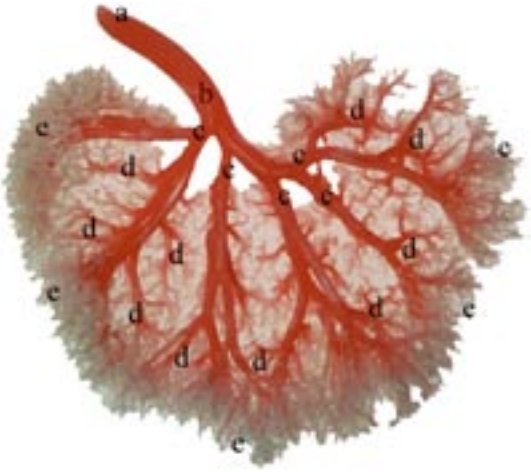

Figure 4. Ventral view of the left renal artery. a = left renal artery, b = left ventral branch, c = left ventral interlobar artery, d = left ventral arcuate artery, e = left ventral interlobular artery

ing from the ventral branch. All the interlobar arteries observed gave off several arcuate arteries (Figures 1–4/d, 1 and 3/h). From the arcuate arteries, in turn, were originated the interlobular arteries (Figures 1–4/e, 1 and 3/i) spreading the entire surface of the kidney. No anastomosis was present between any of the subbranches of the renal arteries. The various measurements on the renal arteries were given table one.

The renal arteries observed in this study originated from each side of the abdominal aorta, in relation with the literature (Nickel *et al*., 1981; Jain and Singh, 1987). On the other hand, Ghoshal (1975) determined their origins to be from the ventral surface of the aorta. According to Aslan and Nazli (2001) and Jain and Singh (1987), the renal arteries divide into the dorsal and ventral branches. Observations in the present study support these findings. Although Aslan and Nazli (2001) showed in the goat and Morkaraman sheep that origins of the dorsal and ventral branches were approximately 2.44 cm and 2.35 cm far from the hilus, respectively, this investigation documented that distance to be 1–1.7 cm. The number of interlobar arteries emanated from the dorsal and ventral branches in the Morkaraman sheep was approximately 4.95 and 4.55, respectively (Aslan and Nazli, 2001). This study, though, found those to be 4.33 and 4, respectively.

To date, the finding in one right kidney, a third branch arising from the junction of the dorsal and ventral branches and supplying the dorsal surface of the kidney, was not mentioned in the literature. In one left kidney of this study, moreover, an interlobar artery arose from the dorsal branch nourishing the ventral surface of the caudal extremity, and the interlobar artery of the ventral branch normally supplying the ventral surface of the caudal extremity was absent. This was in parallel with the literature (Aslan and Nazli, 2001) which mentioned that the dorsal branch gave off two interlobar arteries for the ventral surface and the ventral branch sent one interlobar artery for the dorsal surface in one goat and one Morkaraman sheep. Our study displayed no interlobar artery of the ventral branch going to the dorsal surface, though. Although Aslan and Nazli (2001) mentioned an anastomosis between the dorsal and ventral branches in one sheep and two interlobar arteries originating directly from the renal artery in two sheep, this study indicated no such occurrence similar to those findings.

CONCLUSION

Pattern of the renal arteries of Tuj sheep resembled that reported in the literature even though there present some essential variations. There were, at first, no anastomoses between the renal arteries and their branches. Secondly, a third branch originated from the junction of the dorsal and ventral branches in one right kidney. Finally, a dorsal branch gave rise to an interlobar artery nourishing the ventral surface of one left kidney, and an interlobar artery did not originate from the ventral branch at this part.

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