



ISSN: 2456-2912

VET 2024; 9(3): 213-216

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www.veterinarypaper.com

Received: 02-03-2024

Accepted: 06-04-2024

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Micrometry of renal tubules in Barbari goat in the eastern plain zone of Uttar Pradesh

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Abstract

A study was conducted on the kidneys of six Barbari goats of either sex between the ages of 1.5 and 2 years. After the histological examination of the kidneys, micrometry was done. Micrometry of renal corpuscles showed that the juxtamedullary renal corpuscles were larger than the cortical corpuscles. The average diameter of the proximal convoluted tubule was 45.17 ± 1.83 microns, and the average diameter of the distal convoluted tubule was 38.42 ± 1.27 microns. Similarly, the average diameters of the thin and thick segments of Henle's loop are 16.50 ± 0.57 and 30.65 ± 1.38 microns, respectively. The average diameter of distal convoluted tubules was 38.42 ± 1.27 microns.

Keywords: Barbari goat, kidney, micrometry

Introduction

Goat are an important species of livestock for the poor farmers of India. Goat has been described as Poor Man's Cow because of its immense contribution in ensuring food and nutritional security. (Singh *et al.*, 2022) [8]. Goat survives better under extreme agro-climatic condition therefore goat keeping is a sort of insurance against effects of drought, famine disasters and other calamities. Therefore, goat have been frequently referred to as Poor Man's Cow. The goat population in the country is about 148.88 million. Barbari is mainly evolved and adapted around Agra, Aligarh, Etah, Etawah, Hathras, Mathura districts of Uttar Pradesh and Bharatpur district of Rajasthan. In mammals, the kidneys are the chief excretory organs of the body. They have a major role in the maintenance of fluid and electrolyte balance and in controlling blood pressure. The kidneys also produce and release a humoral agent (erythropoietin) into the bloodstream, which affects blood formation. The present investigation has been planned to study the micrometry of the renal tubules.

Materials and Methods

For the histological examination, small pieces of tissue (2 mm in size) were collected from 12 kidneys (6 right and 6 left). From each kidney, the tissues were collected from six fixed anatomical regions to explore regional differences, if any. The tissues were preserved in 10% formal saline for 48 hours, Bouin's fluid for 12 hours, and Zenker's fluid for 18 hours (Singh and Sulochana, 1997) [6]. Fixed tissue was later washed in running tap water for 6–10 hours, followed by dehydration in an ascending grade of alcohol, clearing, embedding in paraffin wax with a melting point of 58–60 °C, preparation of blocks, section cutting (5–6 µm thick), mounting of sections on albuminized slides, drying of sections, and finally staining with the routine Haematoxylin and Eosin and special staining methods to demonstrate different components of the kidney (Luna 1968) [3]. Then micrometry of different components of renal tubules was done with the help of ocular and stage micrometres.

Calculations

One division of ocular micrometer = $\frac{\text{No. of divisions of stage micrometer}}{\text{No. of divisions of ocular micrometer}} \times 100$

Results and Discussion

Renal Corpuscles

The renal corpuscles of the Barbari goat were spheroidal bodies (Fig.1.). The mean transverse diameter of cortical renal corpuscles was 124.27 ± 4.47 microns, and the mean vertical diameter was 92.89 ± 3.78 microns. The mean transverse diameter of juxtamedullary renal corpuscles was 149.63 ± 2.74 microns, and the mean vertical diameter was 105.32 ± 3.56 microns. The glomeruli (Fig. 4) in the cortical region had an average transverse diameter of 101.28 ± 2.95 microns and an

average vertical diameter of 83.43 ± 2.17 microns. The average transverse diameter of juxtamedullary glomeruli was 118.55 ± 2.56 microns, and the average vertical diameter was 90.87 ± 1.62 microns (Table 1). It showed that the juxtamedullary renal corpuscles were larger than the cortical corpuscles. This was in agreement with the findings) of Sarmad-Rehan and Qureshi (2006) [5] in one-humped camels. Whereas Ommer and Mariappa (1970) [4], and Tiwari and Swarup (1977) [10] found that cortical corpuscles were larger than the juxtamedullary renal corpuscles in buffalo

Table 1: Statistical details of different variables for diameters of subcapsular renal corpuscles and glomeruli and juxtamedullary renal corpuscles and glomeruli (microns).

	Cortical Renal Corpuscles		JM Renal Corpuscles		Cortical Glomeruli		JM Glomeruli	
	TD	VD	TD	VD	TD	VD	TD	VD
Mean±S.E	124.27±4.47	92.89±3.78	149.63±2.74	105.32±3.56	101.28±2.95	83.43±2.17	118.55±2.56	90.87±1.62
S.D	23.45	19.54	16.85	17.50	21.32	17.81	19.35	13.48
C.V.	18.8702	21.03563	11.26111	16.61603	21.05055	21.34724	16.32223	14.83438

Proximal Convoluted Tubule

The diameter of the proximal convoluted tubule, as in (Fig. 2), varied from 39.4 to 67.9 microns, with an average of 45.17 ± 1.83 microns (Table 2). It was similar to the findings of Trautmann and Fiebiger (1957) [9], who stated that the diameter of proximal convoluted tubules ranged from 45 to 60 microns in domestic animals. Yadava and Calhoun (1958) [12] recorded the average diameter of the proximal convoluted tubule to be 56, 50, 45, and 45 microns for horses, ox, sheep, and goats, respectively. Whereas Ommer and Mariappa (1970) [4] reported in Indian buffalo that an average diameter was 45.17 ± 2.02 microns with a range of 40.7 to 57.7 microns. Krishna Nand Singh *et al.* (2018) [2] recorded The average diameter of PCT was 49.91 microns in Marwari sheep.

Thin Segment of Henle's Loop

Thin tubules had a diameter varying from 12.7 to 24.58 microns, with an average of 16.50 ± 0.57 microns in the present study (Table 2). Yadava and Calhoun (1958) [12] recorded the average diameter of a thin segment of the henle's loop to be 30, 26, 22, and 24 microns for horses, ox, sheep, and goats, respectively. Trautmann and Fiebiger (1957) [9] described that the diameter of a thin segment of Henle's loop ranged between 10 and 17 microns in domestic animals. Krishna Nand Singh *et al.* (2018) [2] recorded The average diameter of the thin segment of Henle's loop was 19.50 microns in Marwari sheep.

Thick Segment of Henle's Loop

It had a diameter varying from 23.64 to 48.28 microns (Fig. 3) with an average of 30.65 ± 1.38 microns (Table 2). Trautmann

and Fiebiger (1957) [9] described that the diameter of a thick segment of Henle's loop ranged between 25 and 40 microns in domestic animals. Krishna Nand Singh *et al.* (2018) [2] recorded that the average diameter of the thick segment of Henle's loop was 32.85 microns in Marwari sheep.

Distal Convoluted Tubule

The diameter of the distal convoluted tubule, as shown in (Fig. 2, varied from 21.0 to 48.28 microns, with an average of 38.42 ± 1.27 microns (Table 2). Yadava and Calhoun (1958) [12] recorded the average diameter of the distal convoluted tubule as 36 microns in sheep, 38, 50, and 45 microns in goats, ox, and horses, respectively. Trautmann and Fiebiger (1957) [9] described that the average diameter of the distal convoluted tubule ranged between 35 and 53 microns. Krishna Nand Singh *et al.* (2018) [2] recorded. The average diameter of the distal convoluted tubule was 39.14 microns in Marwari sheep.

Straight collecting Tubule

The diameter of these tubules (Fig 1) varied from 37.0 to 46.5 microns, with an average of 40.83 ± 0.83 microns (Table 2). Yadava and Calhoun (1958) [12] recorded an average diameter of 39 microns in sheep, 42, 53, and 66 microns in goats, ox, and horses, respectively. Trautmann and Fiebiger (1957) [9] described that the diameter of straight collecting tubules ranged between 35 and 53 microns in domestic animals. Krishna Nand Singh *et al.* (2018) [2] recorded that the average diameter of a straight collecting tubule was 42.80 microns in Marwari sheep.

Table 2: Statistical details of different variables for diameters of PCT, DCT, and collecting duct thick and thin segments of the Henle loop (microns)

	PCT	DCT	Collecting duct	Thick segment	Thin segment
Mean±SE	45.17±1.83	38.42±1.27	40.83 ±0.83	30.65±1.38	16.50±0.57
S.D.	7.52	6.29	4.21	6.35	8.95
C.V.	16.64822	16.37168	10.31105	18.87073	54.24242

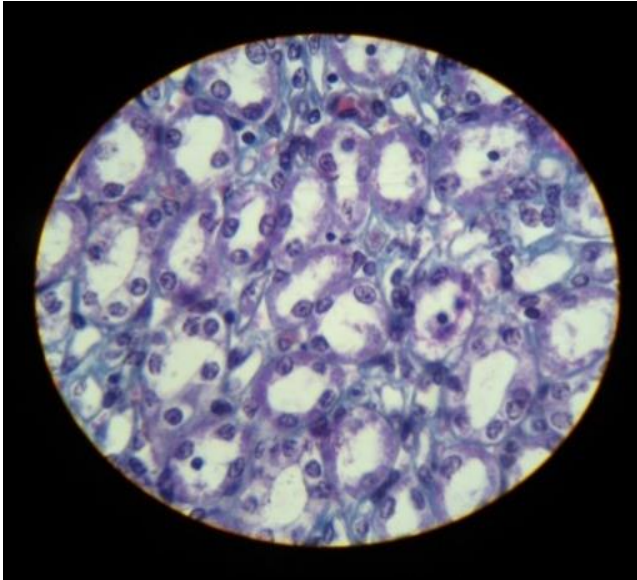


Fig 1: Photomicrograph of kidney showing Collecting duct, ascending vasa recta, Descending vasa recta, Thin tubule of Henle's loop. H and E Staining, 400X

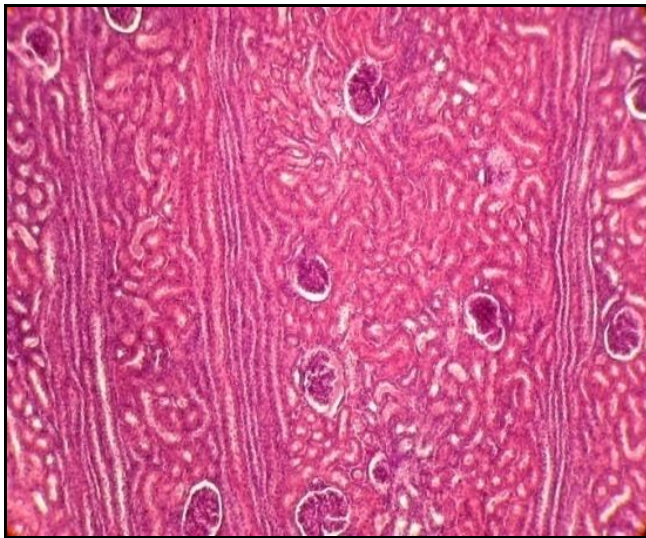


Fig 2: Photomicrograph of kidney cortex showing Medullary ray, Glomeruli, PCT, DCT, Collecting duct

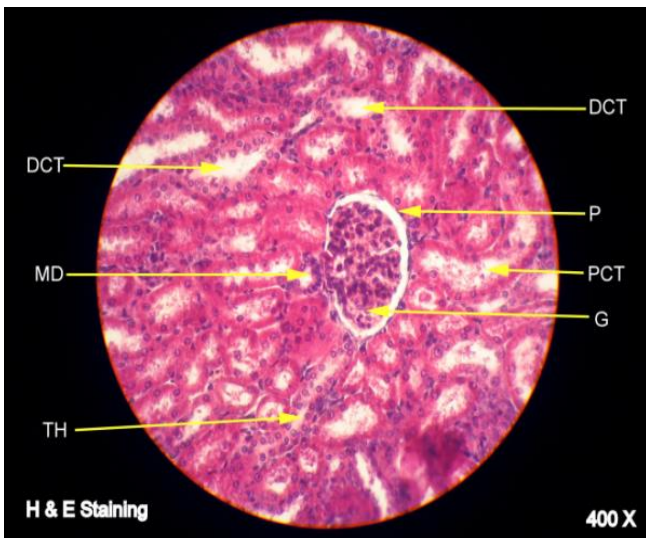


Fig 3: Section of kidney showing (TH) Thick Segment of Henle's loop, (G) Glomerulus, (MD) Macula densa, (P) Parietal layer of Bowman's capsule, PCT and DCT.

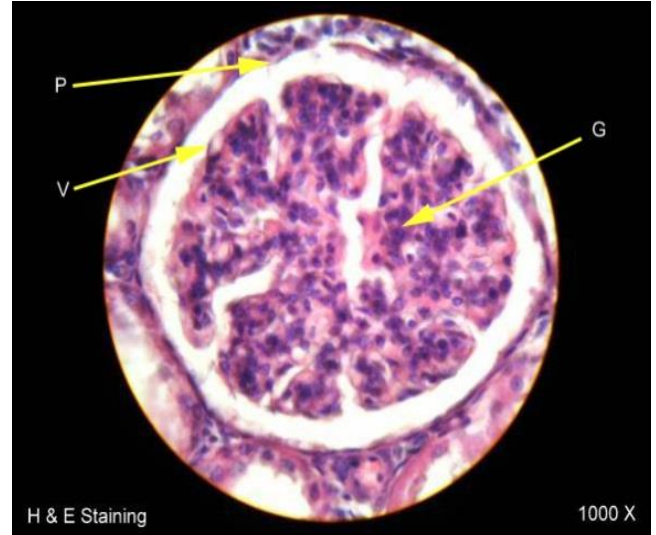


Fig 4: Section of kidney showing (G) Glomerulus, (P) Parietal layer and (V) Visceral layer of Bowmen's capsule.

Conclusion

In conclusion, the study of renal corpuscles in Barbari goats revealed distinctive morphometric parameters, indicating significant variations compared to previous findings in different species. Specifically, juxtamedullary renal corpuscles exhibited larger dimensions compared to cortical ones, aligning with observations in other species such as one-humped camels. Similarly, the diameters of various tubular segments, including the proximal convoluted tubule, thin and thick segments of Henle's loop, distal convoluted tubule, and straight collecting tubule, showed consistency with previous studies across different animal species. These findings contribute to our understanding of renal anatomy in Barbari goats and provide valuable insights for comparative anatomical research across diverse mammalian taxa.

Acknowledgement

This is a part of the Master thesis submitted by the first author to the Acharya Narendra Deva University of Agriculture & Technology, Kumarganj Ayodhya. The authors are grateful to Dean, C.V.Sc. & A.H., ANDUAT, Kumarganj, Ayodhya for providing necessary facilities and support for the successful completion of his research work within time.

Conflict of Interest

There is no conflict of interest among authors.

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