

Histological Studies on the Kidneys of Barbari Goat (*Capra hircus*)

Vinay Kumar Gautam, Krishna Nand Singh*, Mukesh Kumar, Nripendra Singh, Mayur Sudhirrao Nimgaonkar

ABSTRACT

A histological study was conducted on the kidneys of six Barbari goats of either sex between the ages of 1.5 and 2 years. The microscopic examinations showed the thick fibrous capsule consisted of two layers. Interstitial tissue contained network reticular fibers which extended from the capsule to the apex of the papilla. The proximal convoluted tubule was lined by simple truncated pyramidal cells with a brush border. Its lumen was irregular, while the distal convoluted tubule, collecting duct, and thick segment of Henle's loop were lined by simple cuboidal epithelium. In contrast, the thin segment of Henle's loop was lined with simple squamous epithelium. The juxtaglomerular cells were present within tunica media of the preglomerular portion of afferent and efferent arteriole. The cells forming macula densa were single-layered. The papillary duct is lined with simple columnar epithelium, which becomes transitional before opening into the papilla.

Keywords: Barbari Goat, Histology, Kidney.

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INTRODUCTION

The Barbari or Bari is a small compact breed of domestic goats distributed in Haryana, Punjab, and Uttar Pradesh in India and in Punjab and Sindh provinces of Pakistan. The world goat population is estimated at 2.4 million (Kumar, 2018). The Barbari is a dual-purpose breed, reared both for meat and milk, and is well adapted to Indian conditions. In mammals, the kidneys are the chief excretory organs of the body. The primary function of the kidney is to filter blood and form urine. The histological structures of the filtering units of the kidney (renal corpuscles) are crucial for this function. They have a major role in the maintenance of fluid and electrolyte balance and in control of 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 histological structure of the kidneys to justify its importance and essentiality in the body.

MATERIALS AND METHODS

In the present histological study, 12 kidneys (6 right and 6 left) of 6 mature Barbari goats of either sex were collected soon after slaughter. The small pieces of tissues (2 mm size) were collected from all kidneys from the six specified fixed anatomical regions to explore regional differences in the histological structures if any. The tissues were preserved in 10% formal saline for 48 h, Bouin's fluid for 12 h, and Zenker's fluid for 18 h (Singh and Sulochana, 1997). Fixed tissues were later washed in running tap water for 6-10 hours followed by dehydration in ascending grade of alcohol, clearing, embedding in paraffin wax of melting point of 58-60°C,

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preparation of blocks, section cutting (5-6 µm thick), and mounting of sections on albuminized slides, drying of sections and finally stained with the routine Haematoxylin and Eosin and special staining methods to demonstrate different components of the kidney (Luna, 1968).

RESULTS AND DISCUSSION

The Capsule and Connective Tissue Stroma

Histologically the kidneys of Barbari goats were invested by a thick fibrous capsule which consisted of two layers (Fig. 1). It is simulated to the reports of Dellman and Brown (2006) in ruminants, Halder *et al.* (2002) in spotted deer and Sikarwar *et al.* (2016) in Large White Yorkshire pig. In the present study, the outer layer was primarily composed of collagen fibers (Fig. 2). Their oval nuclei were surrounded by a small

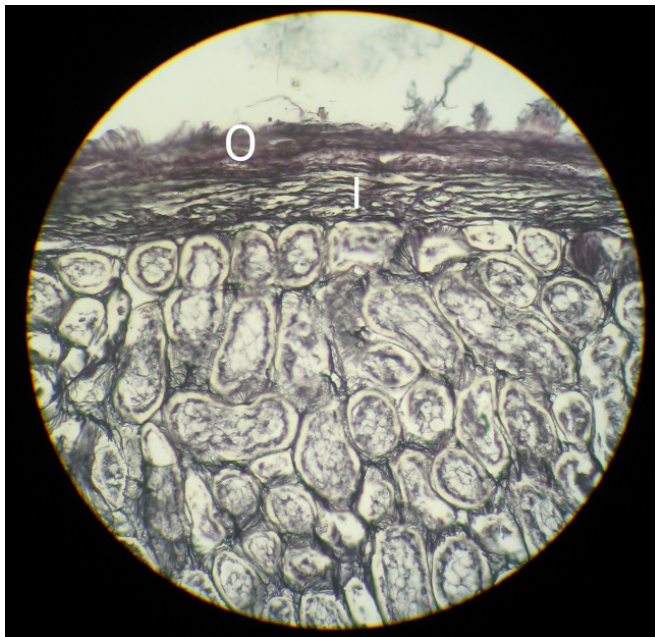


Fig. 1: Photomicrograph of kidney showing outer and inner layer of a capsule and reticular fibers (Gomori's method 400 X)

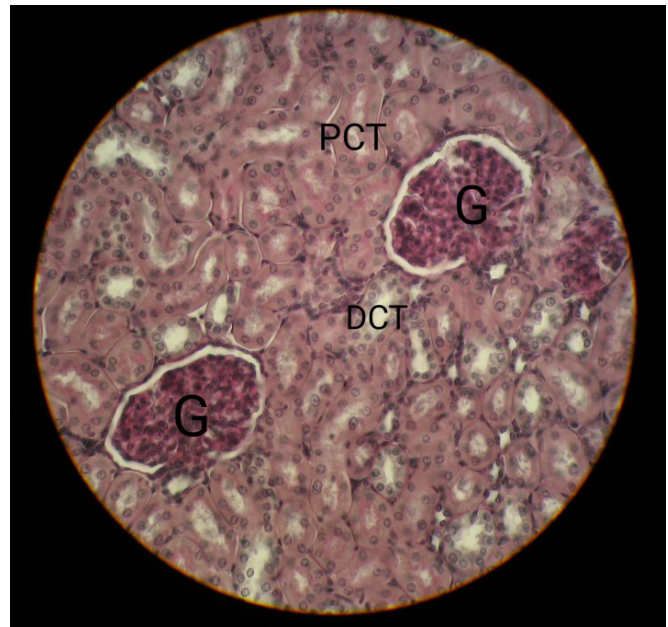


Fig. 3: Photomicrograph of a section of kidney cortex showing glomerular basement membrane, Glomerulus (G), PCT, and DCT. (Periodic Acid-Schiff Stain, 400X)

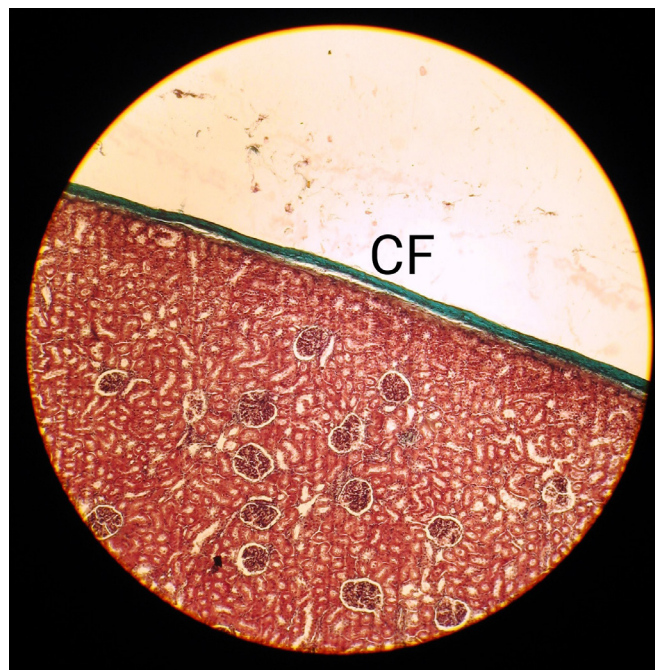


Fig. 2: Photomicrograph of a kidney showing Collagen fibers (CF) in outer layer of the capsule (Masson's trichrome stain 100 X)

amount of lightly acidophilic cytoplasm, and cells had few short processes. Elastic fibers were very few between the collagenous fibers. Similar findings were also reported by Singh *et al.* (2018) in Marwari Sheep.

The thin inner layer consisted predominantly of reticular fibers with collagenous fibers. The reticular fibers were arranged parallel to the collagenous fibers and transversely dipped into the cortex of the kidney. The inner layer had a distinct thick, smooth muscle layer. Numerous smooth muscle cells were entangled between the loose collagenous and

reticular fibers. Similar findings were reported by Gupta and Sharma (1991) in yak and Zade *et al.* (2007) in panther, whereas Malik *et al.* (2001) reported thin renal capsule composed of loose superficial and compact deep layers with inconspicuous smooth muscle fibers in an Asian elephant.

The interstitial space contained reticular fibers, which extended from the capsule to the apex of the papilla. Its branching fibers formed a network in narrow spaces between the kidney's tubules. The collagenous fibers surrounded the large blood vessels and a few fine collagenous fibers invested the tubules and Bowman's capsule. Similar findings have been reported by Dellman and Brown (2006), Konig and Liebich (2006), Dyce *et al.* (2010) in domestic animals, and Singh *et al.* (2018) in Marwari Sheep.

The Uriniferous Tubules

The nephron and collecting tubules were entirely enveloped by a basement membrane which was thickest in the parietal layer of Bowman's capsule and in the thin limb of the loop of Henle's (Fig. 3). Similar observations were recorded by Dellman and Brown (2006), Konig and Liebich (2006), Dyce *et al.* (2010) in domestic animals, and Singh *et al.* (2018) in Marwari Sheep.

The Renal Corpuscles

The renal corpuscles of Barbari goat were spheroidal bodies. Both the parietal and visceral layers of the Bowman's capsule had a flattened squamous epithelium enclosing considerable capsular space (Fig. 3), which is in consonance with the findings of Dellman and Brown (2006) in domestic animals, and Singh *et al.* (2018) in Marwari Sheep, while Malik *et al.* (2001) reported narrow capsular space in the Asian elephant.

The Proximal Convoluted Tubule

The proximal convoluted tubule was lined by simple truncated pyramidal cells with a brush border. Its lumen was irregular (Fig. 3), which was similar to the finding of Dellman and Brown (2006), Konig and Liebich (2006) and Dyce *et al.* (2010) in domestic animals, Shang-Jian *et al.* (2008) in Panther and Gaykee *et al.* (2008) in Sambhar.

The Distal Convoluted Tubule

The distal convoluted tubule was lined by cuboidal epithelium and had a visible clear lumen (Fig. 3) which was similar to the finding of Dellman and Brown (2006), Konig and Liebich (2006), and Dyce *et al.* (2010) in domestic animals, Shang-Jian *et al.* (2008) in Panther and Gaykee *et al.* (2008) in Sambhar.

Henle's Loop

The thin segment of Henle's loop was lined by flattened epithelial cells while the thick segment was lined by cuboidal epithelium (Fig. 4). This was similar to the finding of the above-referred authors.

The Collecting Tubule

The straight collecting tubule was lined by simple cuboidal epithelium (Fig. 4), which became wider and taller towards the papillary duct. This was similar to the findings of Dellman and Brown (2006), Konig and Liebich (2006), and Dyce *et al.* (2010) in domestic animals.

The Papillary Duct and Papilla

The papillary duct was lined by simple columnar epithelium. The transitional epithelium was present at the opening of the ducts (Fig. 5). Similar observations were made by Konig and Liebich (2006) and Dyce *et al.* (2010) in domestic animals. While Gupta and Sharma (1991) were of the opinion that in the kidney of yak, the papillary ducts were lined with stratified cuboidal epithelium. The 2-3 cell layered

transitional epithelium occurred at the papilla only. The renal papilla was lined by transitional epithelium (Fig. 5), which was also observed by Dellman and Brown (2006), Konig and Liebich (2006), Dyce *et al.* (2010), and Singh *et al.* (2018) in domestic animals. On the angle of reflection, low, transitional epithelium lined the side of papilla as observed in the present investigation.

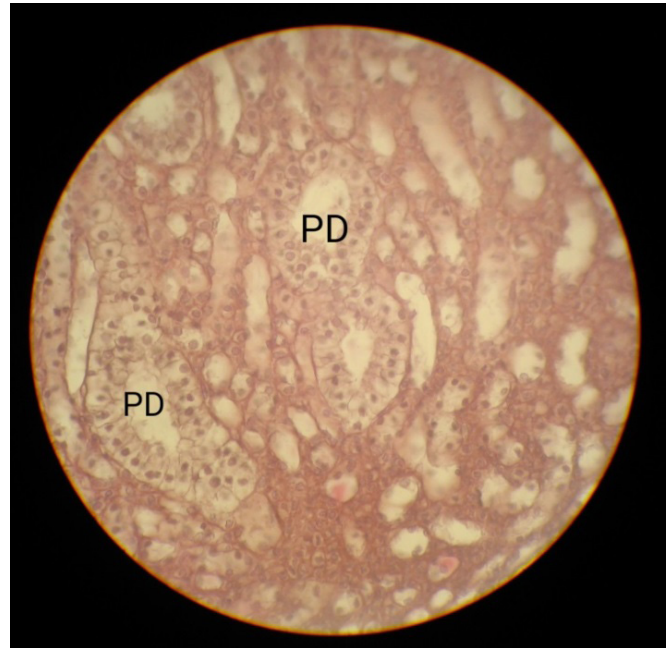


Fig. 5: Photomicrograph of kidney section showing Papillary duct (PD) with transitional epithelium at the tip of papilla. (Haematoxylin and Eosin stain, 400X)

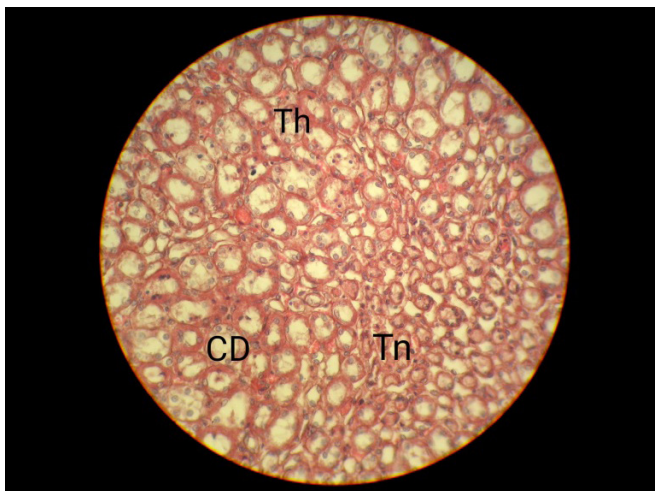


Fig. 4: Photomicrograph of a section of kidney medulla showing collecting duct (CD), thick (Th), and thin (Tn) segment of Henle's Loop. (Haematoxylin and Eosin Stain, 400X)

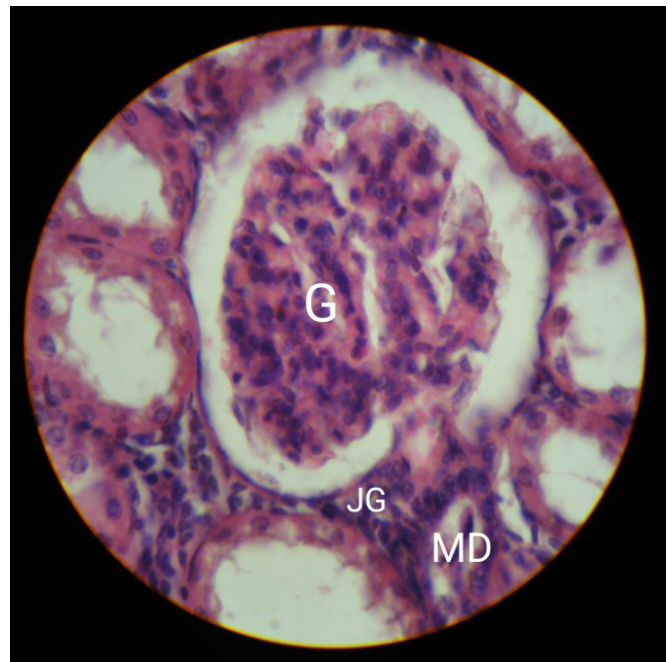


Fig. 6: Photomicrograph of a section of Bowman's capsule showing Macula densa (MD), Glomerulus (G), and JG cells (Haematoxylin and Eosin stain, 1000X)

The Juxtaglomerular Apparatus

The nuclei of the juxtaglomerular cells were spherical and stained deeply with hematoxylin and eosin (Fig. 6). Dellman and Brown (2006) stated that when the afferent arteriole entered the renal corpuscle, the muscle cells in the tunica media were modified in domestic animals. The nuclei were spherical, and the cytoplasm contained many secretory granules and few myofilaments. These modified smooth muscle cells were the juxtaglomerular cells. These observations have already been made by Gupta and Sharma (1991) in yalk, Dellman and Brown (2006), Konig and Liebich (2006), and Dyce *et al.* (2010) in domestic animals and in Marwari Sheep by Singh *et al.* (2018).

The Macula Densa

The cells forming the macula densa were single-layered, having faintly stained cytoplasm. These cells were closely associated with the juxtaglomerular cells and were taller than the rest of the distal tubule cells. The nuclei were spherical and contained densely stained nucleolus and coarse chromatin granules (Fig. 6). Similar observations were made by Dellman and Brown (2006) in domestic animals and Singh *et al.* (2018) in Marwari Sheep.

CONCLUSION

It was concluded from the study that the distribution of epithelium in the different parts of the kidney tubules was directly correlated with the function of the kidney. Squamous epithelium was present in tubules that perform filtration and selective diffusion, whereas cuboidal epithelium was present in tubules that perform secretion and absorption.

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