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On the structure of the urinary bladder in the African giant pouch rat (C*ricetomys gambianus*-Waterhouse, 1840) From Eastern Nigeria

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ABSTRACT

The micromorphology of the body of the urinary bladder of the African Palm squirrel was investigated to fill the knowledge gap in available literature. The specimen was processed through routine histology, stained and viewed under the light microscope. Low magnification revealed that the body of the urinary bladder contained longitudinal mucosal folds coated with epithelium. At the core of the mucosal folds was laminar propria. Also prominent at this magnification was the tunica muscularis. At higher magnification, the mucosal folds were seen coated with dome shaped transitional epithelium of 3-4 cell-layer thick. At the base of the mucosal folds, the underlying laminar propria/submucosa contained loose connective tissue, small smooth muscle cells and abundant blood vessels. The tunica muscularis contained smooth muscle cells arranged in mostly inner longitudinal and outer circular orientation. However, some muscle fibres were seen running in diverse directions including obliquely thus presenting a meshwork arrangement. The meshwork tunica muscularis may help the animal withstand pressure due to accumulated urine.

Keywords: urinary bladder, histology, histochemistry, tunica muscularis, epithelium, Nigeria

INTRODUCTION

Urinary bladders are found in the amphibian, chelonian reptiles and mammals [1,2,3]. In these orders liquid urine is stored in the bladder and eliminated at intervals from the body by micturition [1, 2, 4]. In mammals the urinary bladder lies within the pelvic cavity, behind the symphysis pubis somewhat below the parietal peritoneum. Urine produced in the kidneys flows into the bladder via the ureters. The urine is ultimately excreted from the bladder through the urethra.

From available literature, some studies have been conducted on the collagen content in rat urinary bladder [5], fine structure of the normal and hypertrophic musculature of rat urinary bladder [6], histology and fine structure of human urinary bladder muscularis mucosae [7], pig bladder [8], normal ultrastructure of the kidney and lower urinary tract of Sprague-Dawley rats [9], blood supply to the bladder during filling [10], role of mesenchymal-epithelial interactions in normal bladder development in rat fetuses [11], blood-urine barrier formation in mouse urinary bladder development [12] and human urinary bladder ultrastructure [13]. Also, pathological changes in the urinary bladder have been used in disease diagnosis [14-17].

African giant rat (AGR) has become a ready source of animal protein in several rural communities, hence the possibility of its domestication for intensive production [18]. The proposal to use the AGR as a research model to replace Wister rat because of its larger size [19. 20], has been faced by the fundamental challenge of dearth of

information on its biology from published literature [21], hence the need to provide the baseline data on its organs including the urinary bladder. The aim of this work therefore, is to document the basic histology of the AGR urinary bladder from the rainforest vegetative region of Nigeria. It will fill the knowledge gap, help clinicians in disease diagnosis and aid further studies.

MATERIALS AND METHODS

Seven adult African giant rat of both sexes captured in the wild from Olokoro Umuahia in Abia state, Nigeria from June 2012 to September 2013, using metal cage traps, were used for the study. Olokoro Umuahia is in the rainforest vegetation of southern Nigeria characterized by heavy rains and thick mangrove forest trees. They were immediately transferred to the veterinary anatomy laboratory of Michael Okpara University of Agriculture, Umudike, for acclimatization. During this period, the animals were fed with grasses, oil palm fruit and water *ad libitum*.

On the day of sacrifice, the animals were sedated with inhalation chloroform. Animal weight was obtained with Mettler balance (Model Ohaus scout PRO-200; sensitivity: 0.1gm) and each rat was sacrificed according to Adeyemo and Oke [22], and placed on dorsal recumbency. The animal was cut open through mid ventral incision from the inguinal region to the mandibular symphysis. The urinary bladder was dissected out and slices fixed in 10% neutral buffered formalin. The tissues were passed through graded ethanol, cleared in xylene, impregnated and embedded in paraffin wax. Sections 5µm thick were obtained with Leitz microtome model 1512. They were stained with haematoxylin and eosin; and periodic acid Schiff (PAS), reaction [23, 24] for light microscopy examination. The slides were examined and photomicrographs taken with – Motican 2001 camera (Motican UK) attached to Olympus microscope.

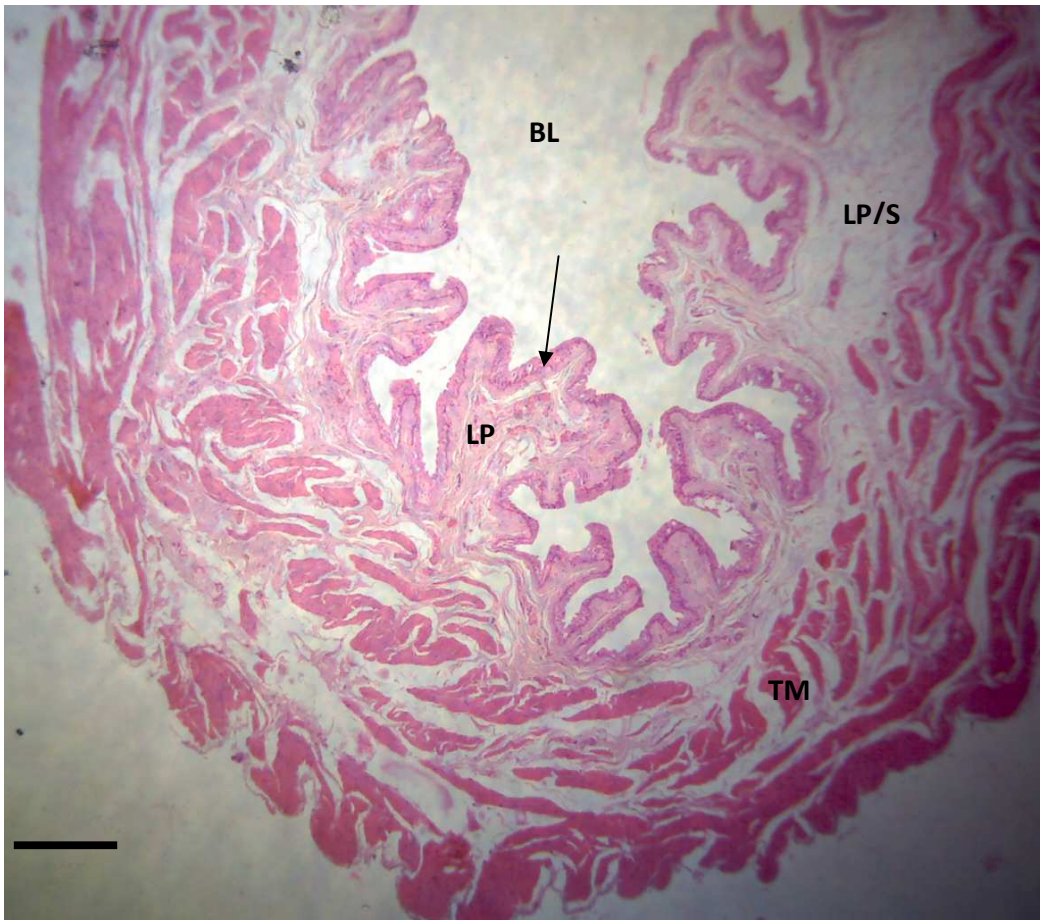

Figure 1. Section of the urinary bladder showing the lumen BL, epithelium (black arrow), lamina propria LP, core of the mucosal fold and tunica muscularis TM. Note the absence of muscularis mucosae hence lamina propria/submucosa LP/S. H&E. (Scale bar = 4µm)

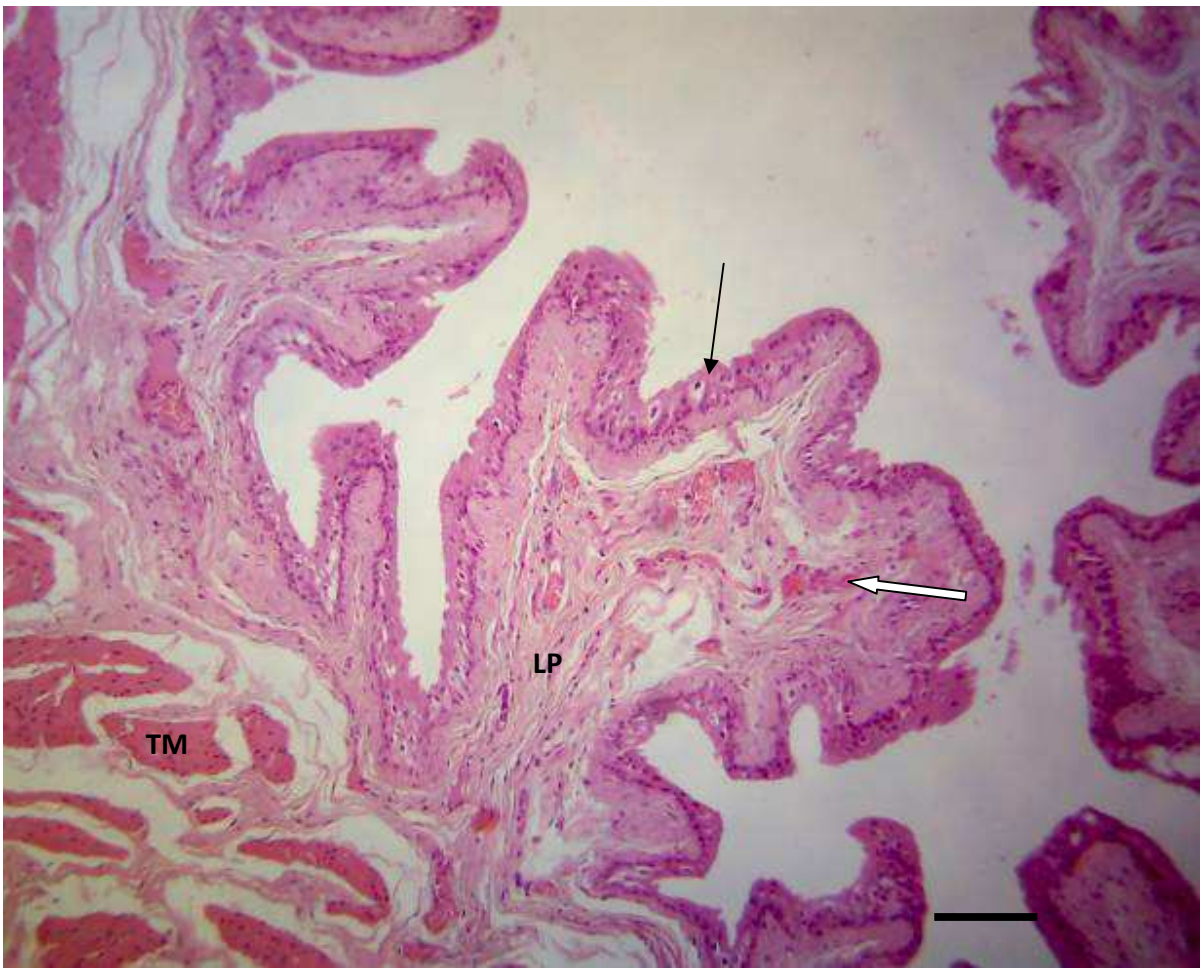

Figure 2. Section of the urinary bladder showing the epithelium (black arrow), lamina propria LP, core of the mucosal fold containing collagen fibres and blood vessel (white arrow) and tunica muscularis TM. H&E. (Scale bar = 10µm)

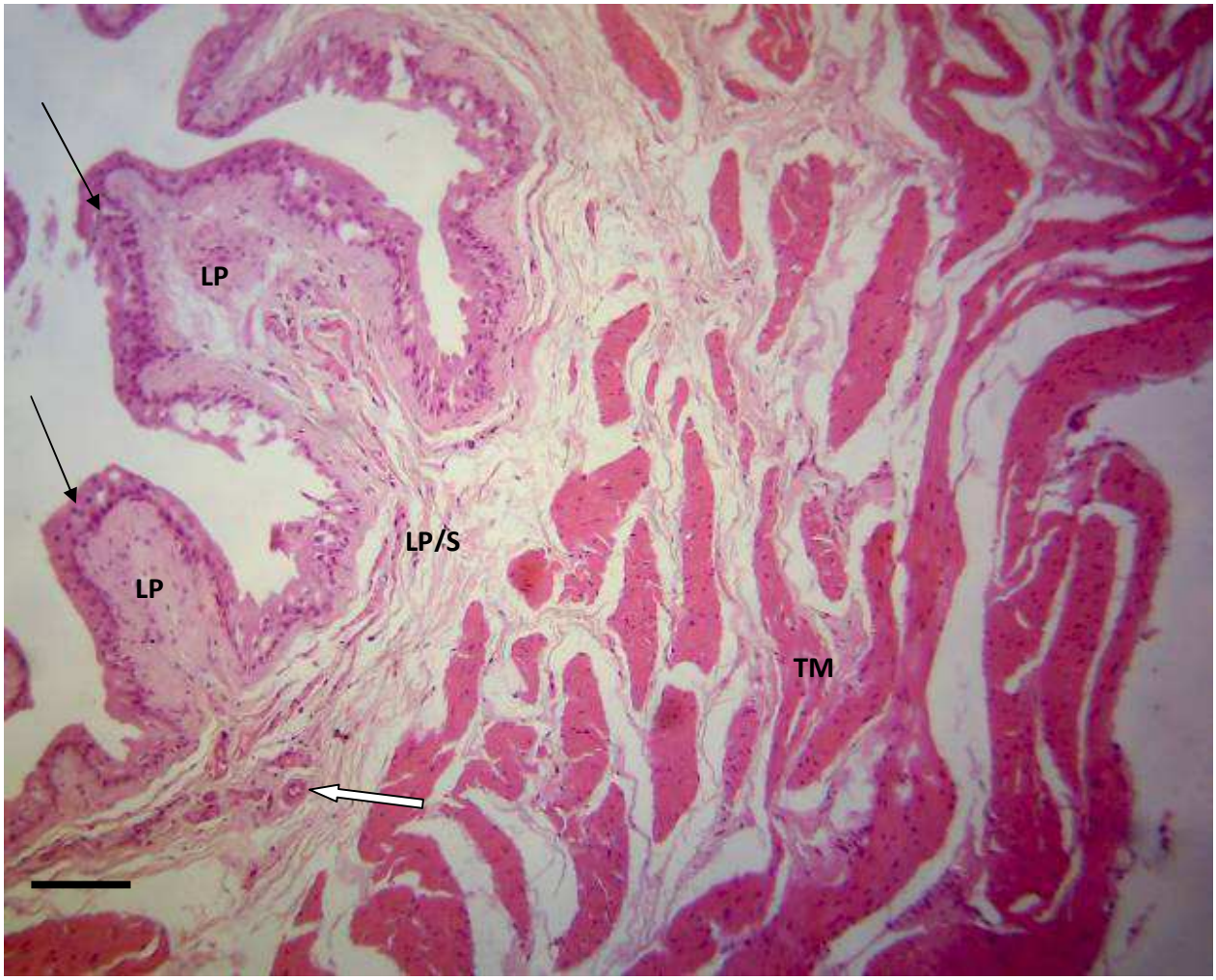

Figure 3. Section of the urinary bladder showing the epithelium (black arrow), lamina propria LP, core of the mucosal fold and tunica muscularis TM. Note the absence of muscularis mucosae hence lamina propria/submucosa LP/S, containing blood vessels (white arrow). H&E (Scale bar = 10µm)

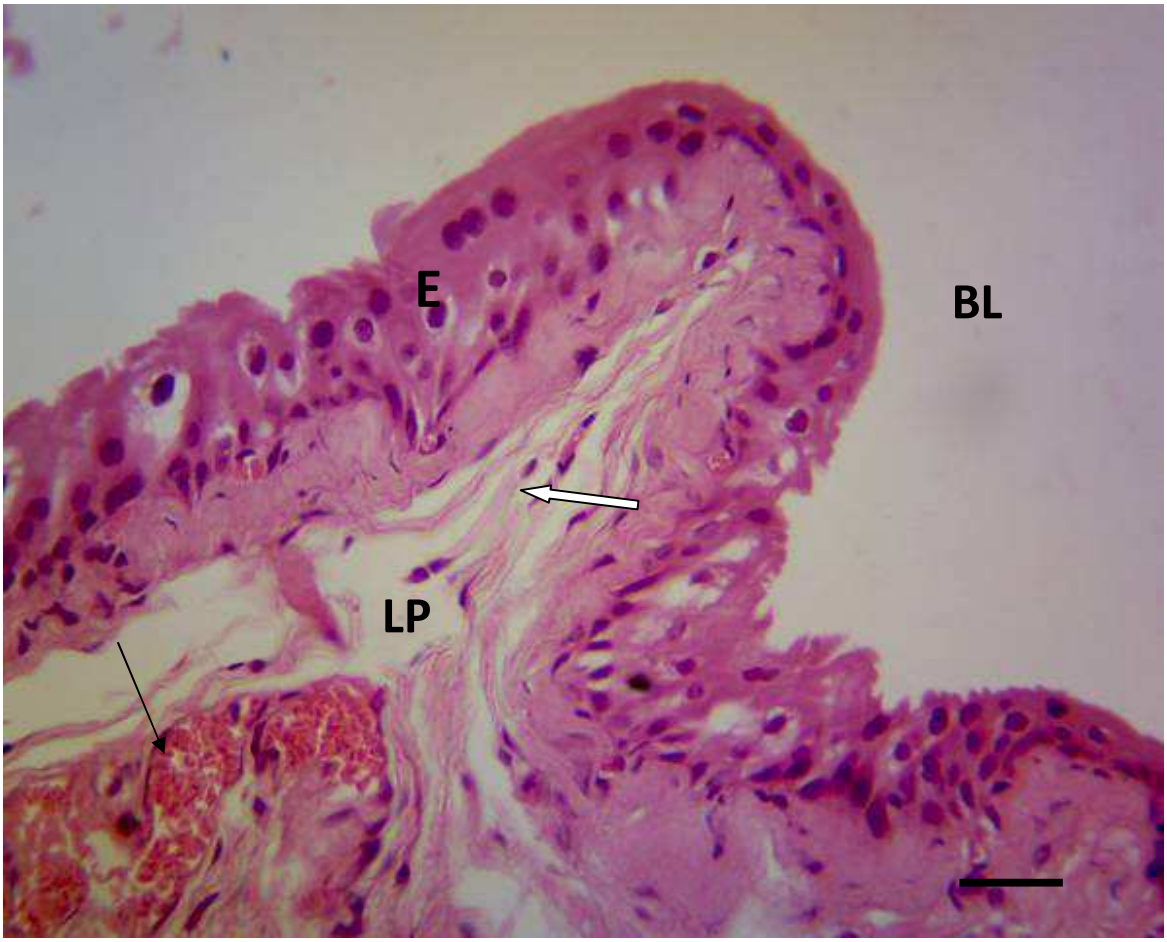

Figure 4. Section of the urinary bladder showing the lumen BL, epithelium E, lamina propria LP, core of the mucosal fold containing collagen fibres (white arrow) and blood vessel (black arrow). H&E. (Scale bar = 40µm)

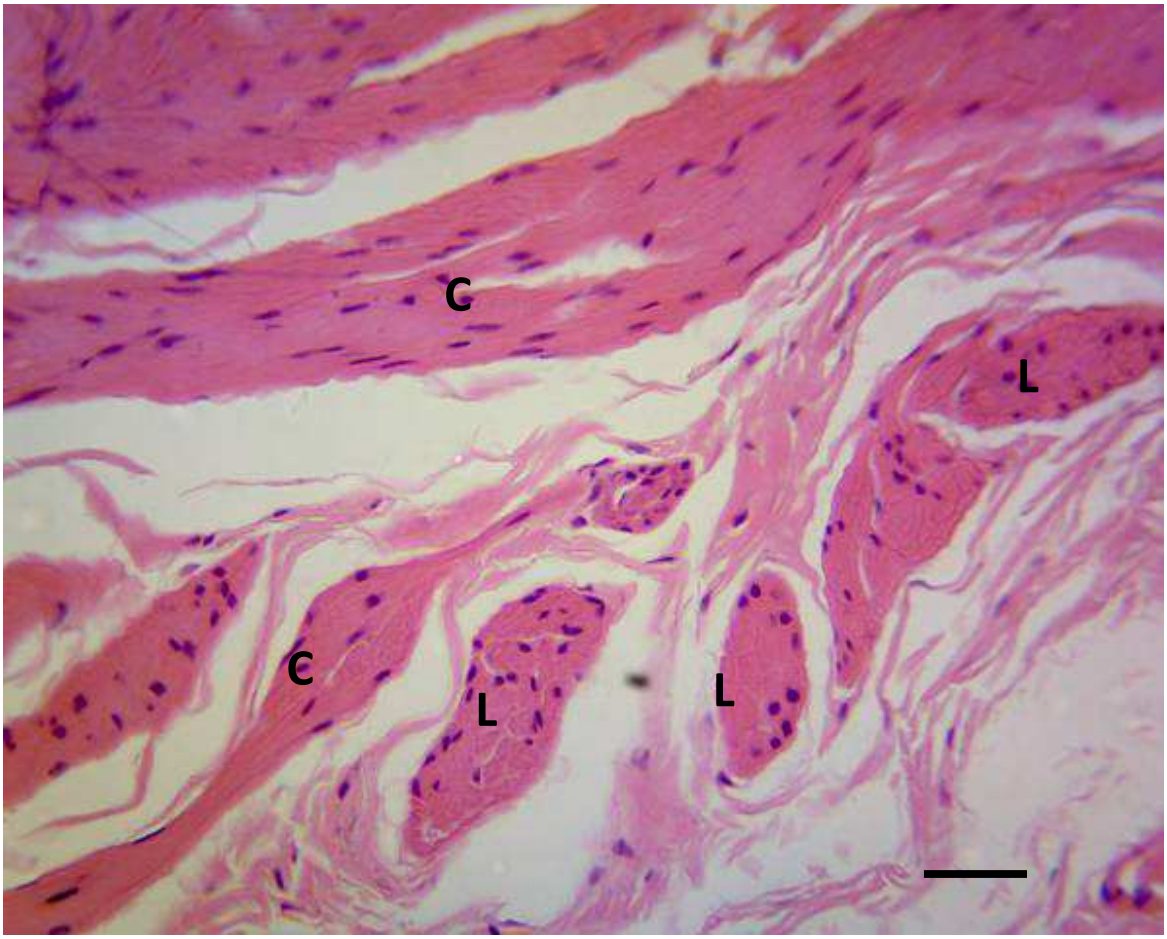

Figure 5. Section of the urinary bladder tunica muscularis showing smooth muscle cells in a circular C, and longitudinal L orientation. Note that the meshwork arrangement of these muscle fibres. H&E. (Scale bar = 40µm)

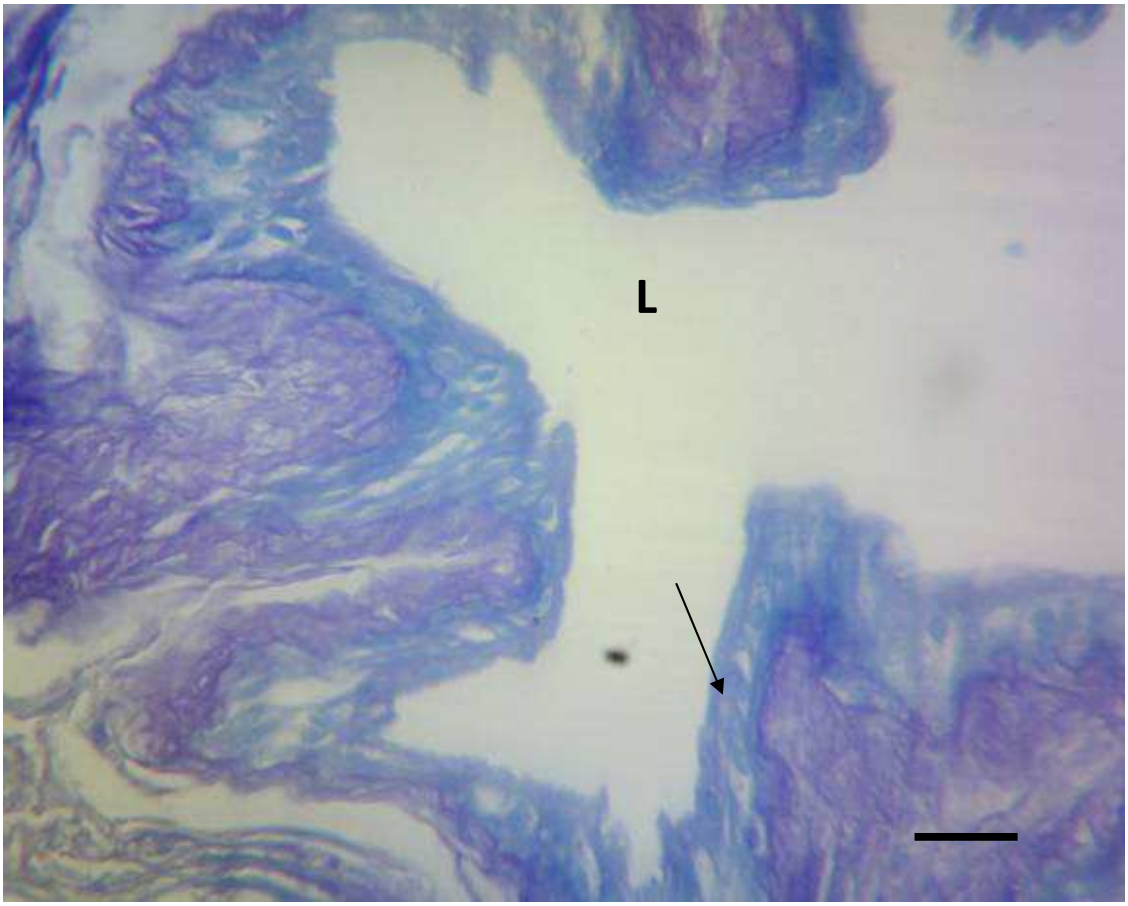

Figure 6. Section of the urinary bladder showing the lumen L, PAS negative epithelium (black arrow). PAS (Scale bar = 40µm)

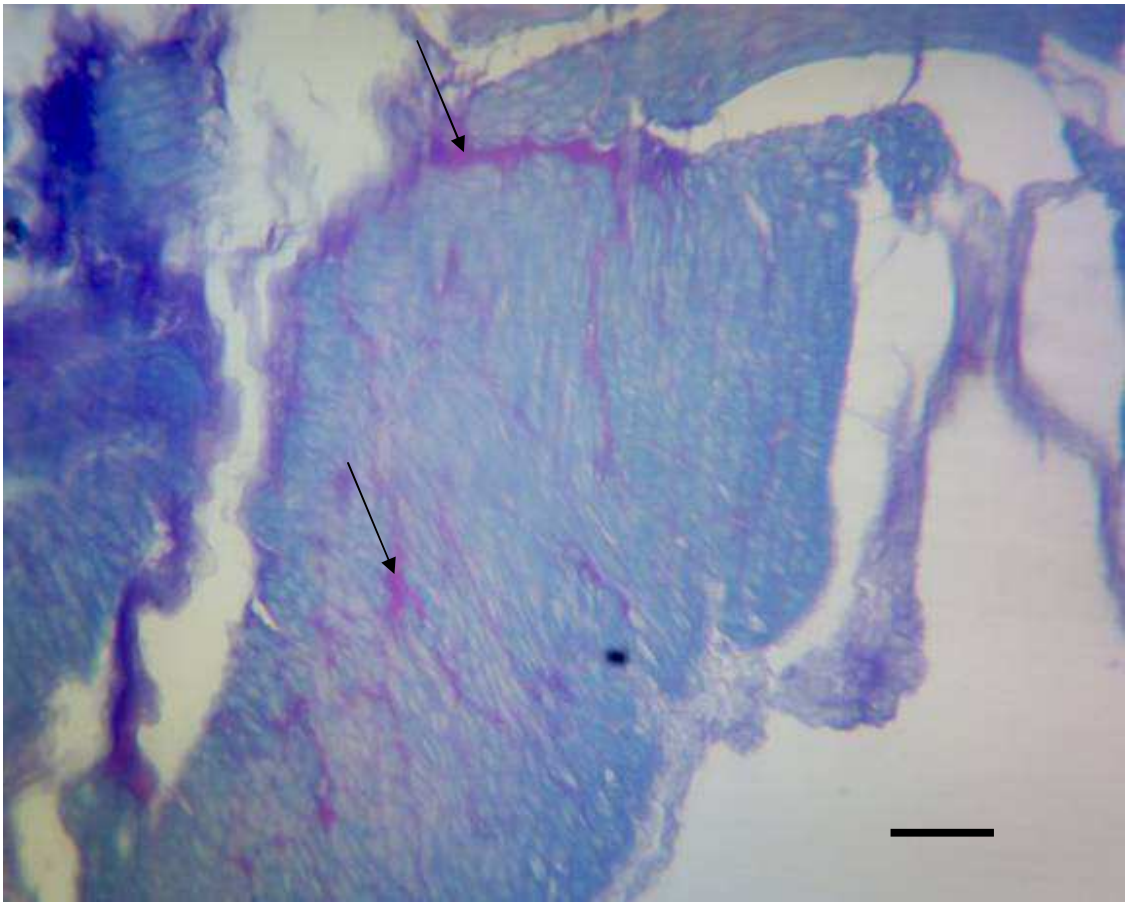

Figure 7. Section of the urinary bladder tunica muscularis showing PAS positive connective tissue (black arrow) surrounding muscle cells. PAS (Scale bar = 40µm)

RESULTS AND DISCUSSION

On low magnification, the body of the urinary bladder contained longitudinal mucosal folds coated with epithelium (Fig.1, 2). At the core of the mucosal folds were laminar propria (Fig. 1, 2). Also prominent at this magnification was the tunica muscularis (Fig. 1, 3). At higher magnification, the mucosal folds were coated with dome shaped transitional epithelium of 3-4 cells layer thick (Fig. 4). The laminar propria core contained collagen fibres, fibrocytes, fibroblasts, few smooth muscle cells and blood vessels (Fig.4). Muscularis mucosae were absent. At the base of the mucosal folds, the underlying laminar propria/submucosa contained loose connective tissue, small smooth muscle cells and abundant blood vessels (Fig. 1, 3). The tunica muscularis contained smooth muscle cells arranged in mostly inner longitudinal and outer circular orientation (Fig.5), but some muscle fibres were seen running in various directions including obliquely. In some sections, there were no definite muscle orientations. The tunica serosa was of simple squamous cells. PAS reaction revealed the absence of carbohydrate moieties secretory epithelial cells (Fig.6), hence the epithelium was PAS negative but some secretion of the tunica muscularis were PAS positive (Fig. 7).

Transitional epithelium observed in this study has been reported in several mammals and it is related to the ability of the organ to accommodate large volume of urine since the epithelial cells slide pass each other to increase luminal cavity [2, 4, 9, 11]. In this study the 3-4 cell layer thickness was observed, but 3-6 layers of cells in the urothelium has been reported in humans [25, 26].

The lamina propria core may support and provide somewhat rigidity to the mucosal fold. The blood vessels in the lamina propria nourishes the cells in the mucosal folds especially the epithelial cells through diffusion. The absence

of muscularis mucosae as seen in this study has been reported in the cats [4], while its presence has been documented in the human urinary organ [7].

Mesh work arrangement of the tunica muscularis as observed in the study has been repeated in the rat [6] and humans [26, 27]. This tunica muscularis orientation can be related to the need to provide support to the organ to withstand pressure by urine in all directions

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