Morphological and Morphometric Studies on the Epididymis of West African Dwarf Buck Goat (*Capra hircus*).

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Abstract

The present studies were carried out on the epididymis collected,in summer season, from twenty-four matured West African Dwarf male goats at the Ipata abattoir, Ilorin, Kwara state, Nigeria. Macroscopically, the results revealed three major regions of the epididymis namely the head, body and tail. The head appeared irregularly oval and flat; the body was long, slender and cylindrical while the tail appeared short and U-shaped. The microscopic examination revealed predominant principal cells, the basal cells, in all regions. The head was characterized by tall columnar epithelium with apical cells;thin long narrow cells and stereocilia, extending into lumen, which was scarcely filled with spermatozoa. The body was characterized by low columnar epithelium with short narrow cells and stereocilia. Its lumen was filled with more spermatozoa than the head region. The tail was formed by cuboidal epithelium with no stereocilia but more densely filled with spermatozoa than the head and body regions. Gross morphometric results revealed no significant differences in the mean weight, length of the head, body, tail and total length of the right and left epididymis ($p < 0.05$). Histomorphometric result showed that there was a significant reduction in epididymal epithelia height of the tail compared with the head of the right and left epididymis ($p < 0.05$).

Keywords: Morphology, Morphometry, Epididymis, West African Dwarf Buck.

Introduction

The mammalian epididymis is a highly convoluted structure situated on the caudolateral margin of each testis. It is an integral segment of the spermatic ducts that serves to transport sperm cells produced in the testis through the vas deferens and urethra to the exterior (Robaire et al., 2006; Joseph et al., 2009). Furthermore, it is the site where sperm cells acquire full maturation, motility, fertilizing capacity and stored before ejaculation (Turner et al., 1990; Joseph et al*.,* 2009). Previous studies have shown that there are variations in the morphology and morphometry of the epididymis in the different species and breeds of animals (Nicander and Glover, 1973; Oke, 1988; Akinloye et al., 2002; Adebayo and Olurode, 2010; Olukole et al., 2014). However, there is only a dart of information on the epididymis of West African Dwarf (WAD) buck goats. It is important to fill this gap because these bucks play significant roles in WAD goat production and largely or ultimately in animal protein supply to human (Devendra, 1999). Reviewing the available-showed that there is very scarce gross biometric data on the epididymis in this breed of animal, which are, necessary to study the function and monitoring the reproductive development. In addition, it is important to know the normal histology and histomorphometry of this valuable reproductive organ. Histological examination provides basic understanding of the normal epididymal structures and functions (Turner, 2011). Histomorphometry on the other hand, provides information on the amount of tissues, cellular activities and normal dimensions of the various epididymal regions (Gofur, 2015). Therefore, this study was embarked upon with a view to provide data on the morphology and morphometry of post pubertal WAD buck epididymisthat would be useful in the better understanding of the reproductive anatomy and ultimately improving the reproductive potentials of these small ruminants.

Materials and Methods

Animals and collection of epididymis

Twenty-four whole epididymides were collected in summer season from the scrota of matured WAD bucks at the Ipata Abattoir in Ilorin,

Kwara state, Nigeria. In harvesting the epididymides, the scrota were washed with soap, cleaned with warm water and disinfected with iodine. Thereafter, a size 4 scalpel blade was used to make an incision from the dorso-medial aspect of the testis. The skin of the scrotum was reflected laterally and the subcutaneous tissue and scrotal fascia were incised to expose the *tunica vaginales*. The *tunica albuginea* was carefully removed from the testis. The epididymis was then carefully separated from the testis using the scalpel blade and thumb forceps.

Gross morphometric parameters

Weights of the right and left epididymis: These were taken by using a digital weighing balance (OHAUS®).

Length of head, body, tail and total length of the right and left epididymis: These were taken by using a measuring ruler (Best B.M. ®).

Histological procedure

Samples of the epididymis were fixed in Bouin's fluid, dehydrated in graded alcohol concentrations, cleared in three changes of xylene, infiltrated in paraffin wax, sectioned, de-waxed and stained with Haematoxylin and Eosin (Adebayo and Olurode, 2010; Raji et al., 2012). Selected images were captured using Moticam 2.0 digital camera attached to a laptop computer (hp Model).

Histo-morphometric procedure

Measurements of captured images were taken and analyzed using the Motic Images Plus (MIPlus). The measurements taken included epididymal ductal diameter (EDD), epididymal luminal diameter (ELD) and epididymal epithelial height (EEH). Ten measurements were taken per section for each parameter.

Statistical analysis

The data obtained in this study were analyzed using Pearson Product Moment Correlation (PPMC) and Student t-test Analyses at 5% level of significance using SPSS version 20.

Results and Discussion

The current study revealed that the epididymis of the WAD buck goat was formed of the head (caput) of the epididymis, which was irregularly flat and oval in shape, the body (corpus) was long, slender and cylindrical, while the tail (cauda) was raised, short and U-shaped. These findings were simi-

lar to those reported in rabbits (Holtz, 1972) and in African giant rat (Oke, 1988). In our work results (Table 1), the mean weight, length of the head, body, tail and total length of the right epididymis were 3.35 ± 0.19 cm, 2.43 ± 0.17 cm, 4.88 ± 0.22 cm, 1.66 ± 0.15 cm and 8.97 ± 0.25 cm respectively; while those for the left epididymis were 3.37 ± 0.16 cm, 2.39 ± 0.20 cm, 4.88 ± 0.21 cm, 1.58 ± 0.16 cm and 8.85 ± 0.25 cm respectively. There were no significant differences between the means of the weight, length of the head, body, tail and total length of the right epididymis and those of the left epididymis ($p = 0.68$, $p = 0.49$, $p = 1.00$, $p = 0.10$ and $p = 0.08$ respectively, at the level of significance of $p < 0.05$). As far as we know, these gross morphometric findings are relatively new in this species. Although, Bitto and Egbunike (2006) and Ugwu (2009) reported on close values for the weight of epididymis but they did not report on the other morphometric parameters observed in this present study.

Histological observations revealed three major segments of the epididymis namely the head, body and tail. All of these segments were characterized by epididymal ducts separated by connective tissue and surrounded by the peritubularsmooth muscle layer. However, compared with the other two regions, the head was covered by columnar epithelium. The various cell types observed on this epithelium included the basal, principal, narrow and apical cells. The predominant cells were the principal and the narrow cells. The principal cells were numerous and dark elongated cells at the mid-section of the epithelium adjacent to the narrow cells. The free ends of the surface of the narrow cells possessed small branching microvilli called stereocilia,which were visible at higher magnification on the light microscope, extending into the lumen of the epididymal ducts. Few goblet shaped apical cells were observed close to the lumen but having no contact with the connective tissue, basement membrane and the peritubular smooth muscle layer in contrast to the principal and narrow cells. Also, the hemispherical shaped basal cells were observed adhering along the basement membrane and without direct access to the lumen. The lumen of the epididymal duct in this region was scarcely populated with spermatozoa (Fig

3). The body region was characterized by low columnar epithelium and small groups of spermatozoa within the lumen. The predominant cells were the principal cells but the adjacent narrow cells were shorter if compared to those of the head region. However, they still possess the stereocilia that was communicating with the lumen. The apical and basal cells were also present in this body region. (Fig 5). The tail region of the epididymis was characterized by cuboidal epithelium but unlike the head and body region, possessed no stereocilia. Large amount of spermatozoa were observed within the lumen of the ducts. The predominant cells were the principal cells; in addition,there were also some basal cells. The peritubular smooth muscle layer surrounding the epididymal ducts were particularly prominent in this region (Fig 7). These histological findings are similar to those reported in *Capra hircus* goat (Sharma et al; 2014); in greater cane rat (Adebayo and Olurode, 2010); in Northern Great Grey Kangaroo (Khamas et al., 2014); and in African sideneck turtle (Olukole et al., 2014).

The histomorphometric results of the EDD, ELD and EEH of the right and left epididymis were as presented in Table (1). There were no significant differences in the mean of EDD, ELD and EEH of the right compared with left head of the epididymis ($p = 0.89$, $p = 0.74$ and $p = 0.88$), body of the epididymis ($p = 0.92$, $p = 0.83$ and $p = 0.93$) and tail of the epididymis ($p = 0.86$, $p = 0.71$ and $p = 0.95$) respectively. Also when these parameters were compared between the head and body of the right epididymis ($p = 0.79$, $p = 0.83$, and $p = 0.97$ respectively); and the left epididymis ($p = 0.72$, $p = 0.88$ and 0.95 respectively). However, the mean EDD and ELD of the tail region were significantly higher than those of the body region for the right epididymis ($p = 0.01$, $p = 0.01$ respectively) and left epididymis ($p = 0.01$, $p = 0.01$) respectively). But the mean EEH of the tail was significantly lower than that of the body for the right epididymis ($p = 0.02$) and left epididymis ($p = 0.02$) respectively.. As far as we know, this is the first report on histomorphometric studies of the epididymis of WAD buck goat. The mean values of EEH, EDD and ELD of the head, body and tail observed for the right and left epididymis of WAD buck goat in this study were higher than those reported in greater cane rat (Adebayo and

Olurode, 2010); in Northern Great Grey Kangaroo (Khamas et al., 2014); and in African sideneck turtle (Olukole et al., 2014).

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Table (1): Mean and standard deviation of histomorphometry of epididymis

Parameters	N	HRE (µm)	BRE (µm)	TRE (µm)	HLE (µm)	BLE (µm)	TLE (µm)
Epididymal ductal diameter	24	963.8*^{ac} ±113.3	980.2*^{bc} ±91.2	1945.1*^{abc} ±249.7	971.9*^{df} ±110.8	992.4*^{ef} ±90.8	1937.8*^{efg} ±238.9
Epididymal luminal diameter	24	692.5*^{ac} ±53.1	701.4*^{bc} ±39.2	1720.7*^{abc} ±236.5	712.3*^{df} ±56.3	699.2*^{ef} ±44.5	1713.6*^{efg} ±238.2
Epididymal epithelial height	24	204.7*^{ac} ±23.4	201.7*^{bc} ±20.7	130.4*^{abc} ±40.0	207.4*^{df} ±24.0	202.6*^{ef} ±19.5	127.8*^{efg} ±38.6

*Significant P < 0.05, a-f columns.

HRE – Head of right epididymis, BRE - Body of right epididymis, TRE - Tail of right epididymis, HLE – Head of left epididymis, BLE - Body of left epididymis, TLE - Tail of left epididymis

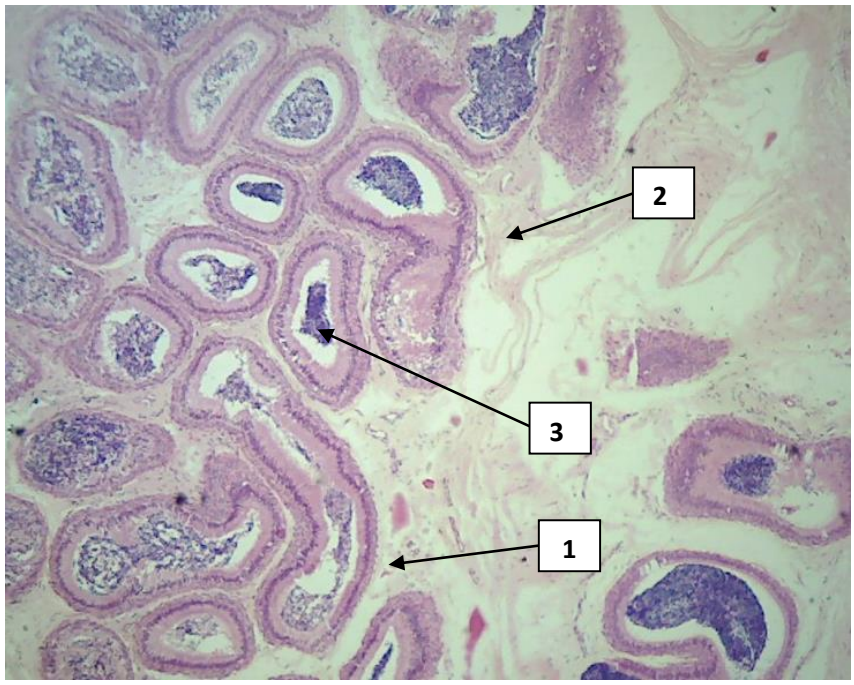

Fig (1): A section of caput epididymis. H & E stain.
1 Epididymal duct, **2** Connective tissue, **3** Lumen filled with spermatozoa.

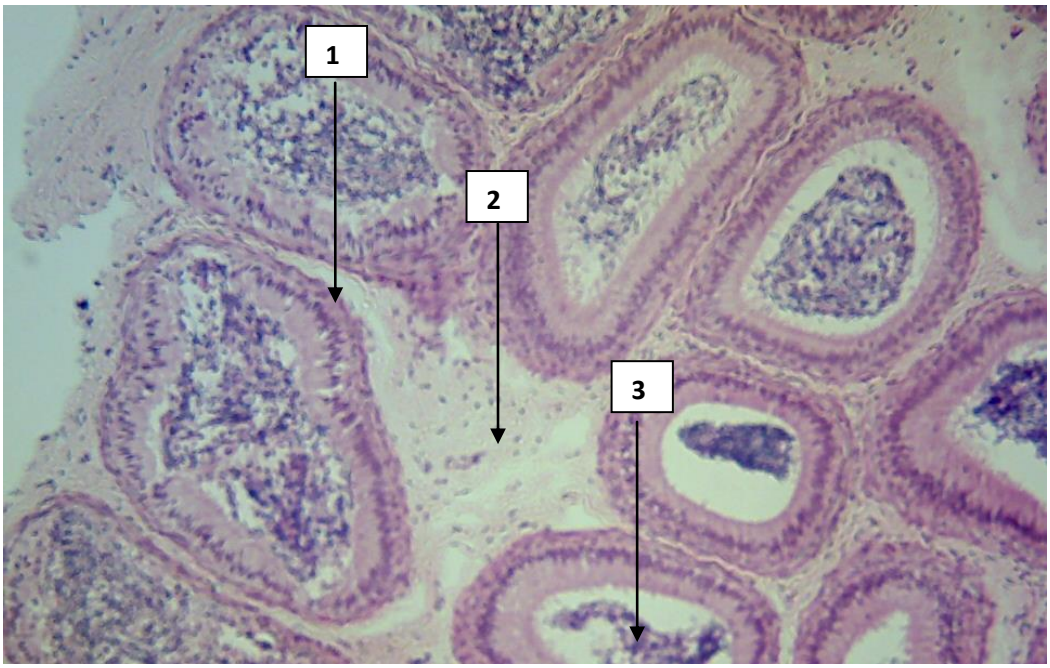

Fig (2): A section of caput epididymis. H & E stain (X 100).
1 Epididymal duct, **2** Peritubularconnective tissue, **3** Lumen filled with spermatozoa.

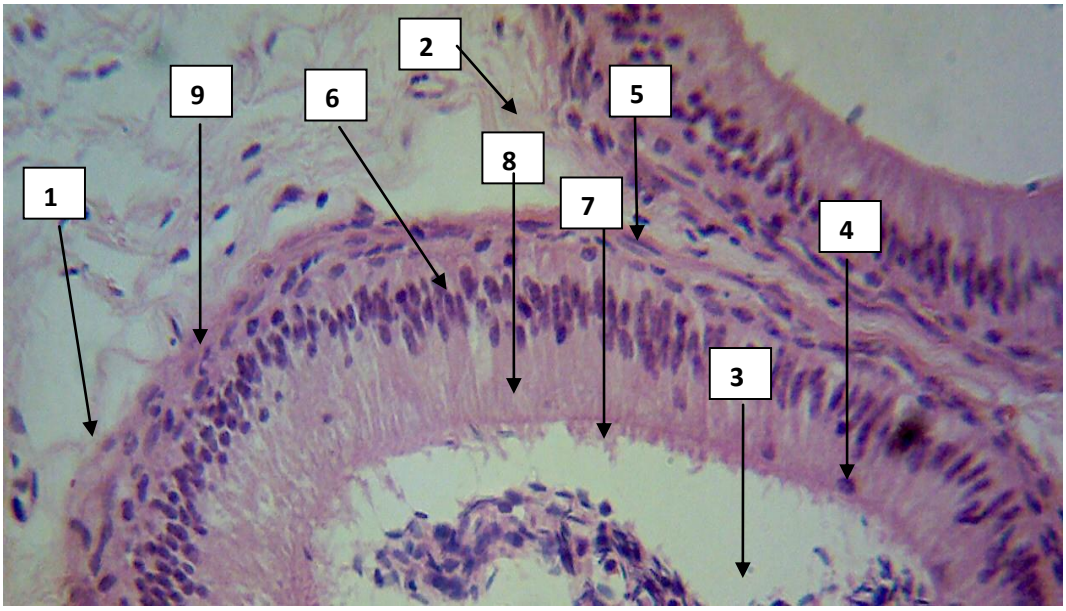

Fig (3): A section of caput epididymis. H & E stain (X 400).
1 Epididymal duct, **2** Connective tissue, **3** Lumen filled with spermatozoa, **4** Apical cell, **5** Basal cell, **6** Principal cell, **7** Stereocilia,**8**Narrow cell, **9** Peritubular smooth muscle layer.

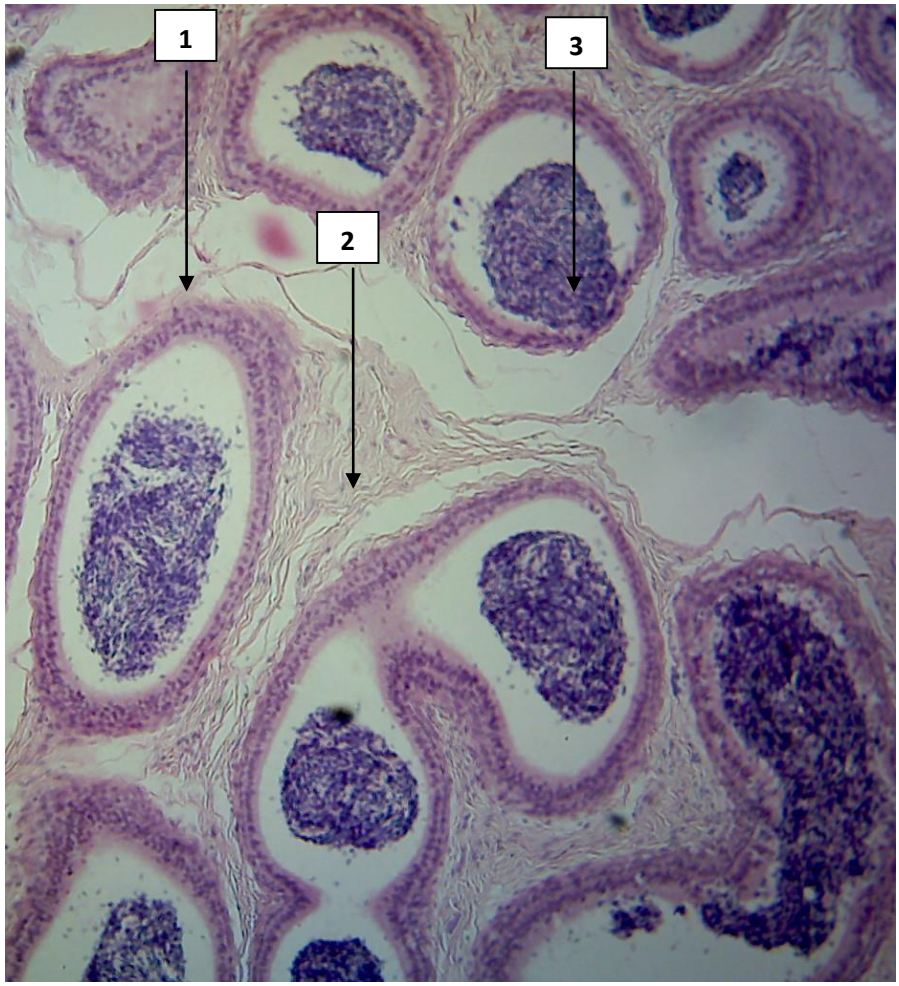

Fig (4): A section of corpus epididymis. H & E stain (X 100).
1 Epididymal duct, **2** Peritubular Connective tissue, **3** Lumen filled with spermatozoa.

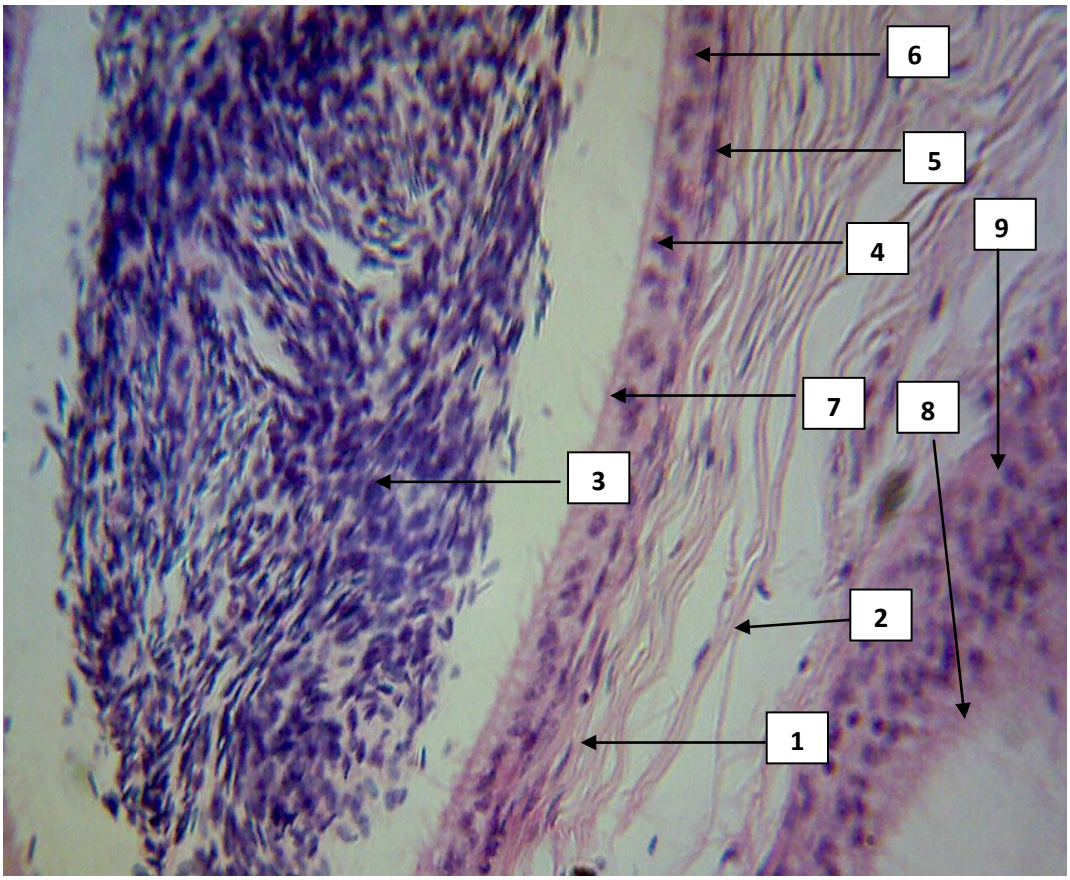

Fig (5): A section of corpus epididymis. H & E stain (X 400).
1 Epididymal duct, **2** Connective tissue, **3** Lumen filled with spermatozoa, **4** Apical cell, **5** Basal cell, **6** Principal cell, **7** Stereocilia,**8**Narrow cell, **9** Peritubular smooth muscle layer.

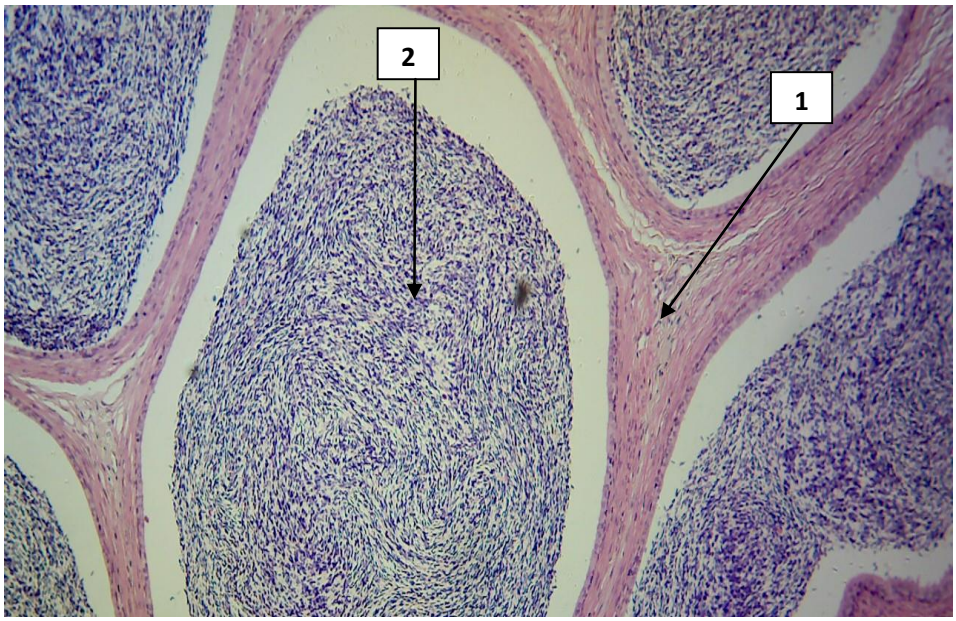

Fig (6): A section of cauda epididymis. H & E stain (X 100).
1. Connective tissue, **2.** Lumen filled with spermatozoa.

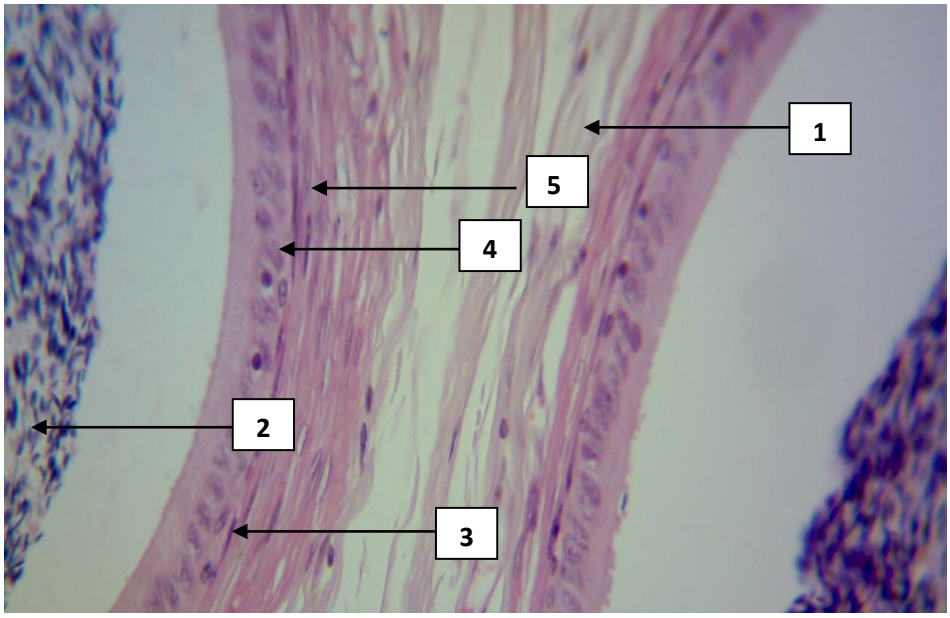

Fig (7): A section of cauda epididymis. H & E stain (X 400).
1 Connective tissue, **2** Lumen filled with spermatozoa, **3** Basal cell, **4** Principal cell, **5**Thick peritubular smooth muscle layer.