

Histological and morphometric studies on the dromedary camel epididymis in relation to reproductive activity



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ABSTRACT

The reproductive efficiency of male dromedary camels under natural conditions is regarded to be low due to a relatively short breeding season and a long prepubertal period. This study was carried out to investigate the histological and morphometric changes in the Sudanese dromedary camel epididymis in relation to the breeding (rutting) and non-breeding (non-rutting) seasons at monthly intervals up to one year. Specimens were collected from different regions of the epididymis of 48 mature and healthy Sudanese male camels slaughtered at Tambul slaughter house in central Sudan. Paraffin sections of the caput, corpus and cauda regions of the epididymis were stained conventionally for general histology and morphometry. The epididymal stereociliated epithelium showed five types of cells: principal, basal, apical, halo and dark cells and the epithelium was surrounded by a thin layer of lamina propria and a circumtubular smooth muscle coat. No significant seasonal histological or morphometric changes were observed in the caput and corpus epididymides. However, a remarkable decrease in epididymal epithelial thickness and length of stereocilia with consequent increase in luminal diameter was observed in the cauda epididymidis during the rutting season; there was also an increase in the smooth muscle coat thickness.

Thus, the results suggest that the epididymis of Sudanese dromedary camel is active throughout the year, but the activity remains low during winter and increases to its maximum during summer, especially during the rainy months.

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1. Introduction

The one-humped camels (*Camelus dromedarius*) are economically important in northern and eastern Africa, particularly in Sudan and Somalia where poor families and nomads keep them for milk, meat, wool, leather, and fuel from dried manure.

Sexually mature camels show a short annual breeding season which is an important factor for low reproductive performance (Skidmore, 2005; Bhakat et al., 2005) and is considered a major obstacle in their population growth (Marai et al., 2009). Male and female camels are both seasonal breeders. They breed only during certain times of the year. Contradictory results are available regarding the beginning and duration of the sexual activity in dromedary camels. For example, it is reported to occur from December to April in Egypt (Hegazy et al., 2004), March to August in Sudan (Musa and Abusineina, 1978), April to May in Somalia (Ghazi, 2007) and October to December in Saudi Arabia (Tingari et al., 1984).

It is well known that mammalian spermatozoa possess limited biosynthetic activities (Dacheux et al., 1989) and

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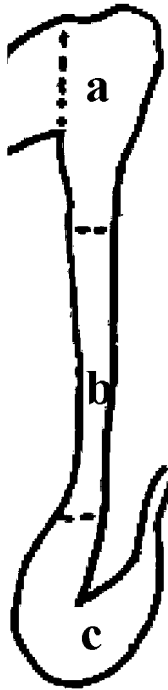


Fig. 1. Diagram of camel epididymis showing three regions: caput (a), corpus (b) and cauda (c).

display a crucial dependence on the activity of the epididymal epithelium for their maturation and survival (Moore and Bedford, 1979; Hinton and Palladino, 1995). The epididymal epithelium and the surrounding structures vary dramatically in their morphological and morphometric properties according to the reproductive activity and the region of the duct (Tingari, 1989; Hinton and Palladino, 1995).

A review of the literature reveals a number of reports that describe a seasonal effect on reproduction and breeding in camels and other mammalian species (Osman et al., 1979; Yagi and Etzion, 1980; Zayed et al., 1995; Aguilera-Merlo et al., 2005). Tingari et al. (1984) studied the seasonal histological and morphometric changes in the testis of Saudi Arabian camels; however, the best of our knowledge, there is no such study for the epididymis in camels. The present study, therefore, aims to describe the histological and morphometric features of the different regions of epididymis during the breeding and non-breeding seasons in the Sudanese camels.

2. Materials and methods

Forty-eight mature (age 5–10 years) and healthy Sudanese male camels were used in this study. Specimens from the caput, corpus and cauda regions of the epididymis (Fig. 1) were collected at regular monthly intervals (four animals, each month) for a period of one year from the Tambul slaughter house, central Sudan. The samples were fixed in Bouin's fluid and dehydrated in a graded series of

ethanol, cleared in xylene and embedded in paraffin. Tissues were sectioned at 5 μm thickness using a rotatory microtome.

For histological observations, sections were stained with haematoxylin and eosin (H&E) as described by Culling (1974). The morphometric analysis was performed on seven selected sections from each epididymal region of rutting and non-rutting animals. An imaging system consisting of Leica light microscope and Leica digital camera EC3 was used. Measurements of epithelial thickness, stereocilia length, luminal diameter and thickness of smooth muscle layer were carried out on five round sections of the duct using processing software, Leica Application Suite/LAS EZ, Leica Microsystems, Switzerland.

Data of the different morphometric parameters were statistically analyzed by Student's *t*-test, and the difference was considered statistically significant at $p < 0.05$.

3. Results

3.1. General histological observations

The general histological organization of the camel epididymis is shown in Fig. 2. Epididymal duct in the caput, corpus and cauda regions was lined by a stereociliated pseudostratified columnar epithelium. The height of the epithelium and stereocilia steadily decreased from the caput to the cauda of the duct. Intraluminal and intraepithelial vacuoles were present at different levels in many tubules. Five types of cells were observed in the epithelium: principal, basal, apical, halo and dark cells. These cells were randomly distributed throughout the epididymal epithelium; the principal and basal cells were found to be the most frequently observed cell types (Fig. 2A and B). The principal cells were tall columnar with apical stereocilia and their nuclei were oval in shape, located at various levels in the basal cytoplasm. The basal cells rested on the basement membrane; these cells were small and more or less round or oval in shape and located between the bases of the principal cells, with round or irregular nuclei. The halo cells which were mainly found in the basal epithelium showed light stained cytoplasm. The dark cells were narrow and tall irregular cells with dark stained cytoplasm and irregular dark nuclei.

The tubular epithelium was surrounded by a thin layer of lamina propria consisting of loose connective tissue followed by a smooth muscle coat which exhibited gradual increase in thickness from the caput to the cauda. The duct was covered by a circumtubular connective tissue (Fig. 2C and D). The tubular lumina were generally irregular in the caput, oval to round in the corpus and folded in the cauda. The luminal diameter and its spermatozoal content gradually increased from caput to cauda region.

3.2. Seasonal observations

In general, epididymal caput and corpus regions showed no significant seasonal differences in histological and morphometric appearance, though such differences were evident in the cauda region (Fig. 3, Table 1). They included increased apical cytoplasmic folds, intraepithelial vacuoles

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