LOCALIZATION AND SHAPE OF BASAL CELLS IN FELINE PROSTATE GLAND

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ABSTRACT

PURPOSE: To study the localization and the shape of basal cell in the prostate gland of the cat with regard to assist the understanding of their role in the pathogenesis of benign and malignant lesions in this animal species.

MATERIALS AND METHODS: The prostate glands of 12 sexually mature, clinically healthy male European Shorthair cats at the age of 1–2 years, weighing 2.8 to 4 kg were investigated. The localization and the shape of basal cells were determined in semi-thin and ultrathin cross sections by light and transmission electron microscopy.

RESULTS: Epithelial basal cells in feline prostate alveoli did not attain the alveolar lumen and formed an incomplete, discrete boundary layer, located in close vicinity to the basal membrane. These cells are observed as an occasional and rare epithelial population in the alveolar part of feline prostate parenchyma. The shape of alveolar basal cells varied from oval and triangular to irregular. Basal cells were also observed in the epithelium of prostate excretory ducts that also formed a discontinuous incomplete boundary layer. The basal cells are a sporadic finding in feline prostate ductal epithelium. The shape of ductal basal cells is also variable. The invaginations of the karyolemma in irregularly-shaped cells were observed. Secretory-like granules were observed in the cytoplasm of basal cells.

CONCLUSION: For the first time, two types of basal cells have been described in feline prostate gland depending on their localization: alveolar and ductal.

Key words: prostate, basal cells, cat.

INTRODUCTION

Prostate epithelium plays an important role in neoplastic alterations of the gland. The role of human and animal basal epithelial cells with this regard is still partly understood. Basal cells are described as undifferentiated precursors of luminal cells. In men, basal cells form a boundary continuous layer between the basal membrane and the luminal (secretory) epithelial layer. Therefore, prostatic epithelial in this part has two layers unlike the other mammals in which is ranges from apparently multilayer to transient because of the lower density and discontinuity of basal cellular layer. The basal to luminal cells ratio in men is 1:1, whereas in the other animal species it is 1:7. It is assumed that basal cells are an element of the blood-tissue barrier in prostate gland and function to prevent the passage of substances from blood to prostate luminal cells (1).

As seen from the review of (2) on canine prostate epithelium, basal cells are located between the basal parts of secretory cells in vicinity of blood vessels. The shape of basal cells varies from squamous and low cuboidal to triangular and have no processes. The nuclei are often invaginated. In the cytoplasm, numerous secretory granules are observed.

Basal cells play an important role in the pathogenesis of abnormal proliferations of prostate gland. They are key participants in the growth and organization of glandular ducts and...
alveoli, as we as in the development of the entire gland. Depending on their localization, two populations of basal cells are observed in canine prostate gland: alveolar and tubular. Prostatic intraepithelial neoplasm and prostate carcinoma in dogs originate from basal cells in glandular ducts whereas spontaneous prostate hyperplasia 0 from alveolar basal cells. The latter are the primary proliferative component of prostate glands in humans and dogs. In intercellular spaces of the basal cellular layer, secretory epithelial cells are situated. These spaces are due to the interposition of secretory cells, that have a direct contact with the basal lamina (3, 4, 5).

The proliferative compartment of normal or hyperplastic human prostatic epithelium is located in the basal cellular layer (6, 7, 8, 9). During the malignant transformation of prostatic epithelium, the proliferative basal zone is inverted with shift to luminal cell type. The abnormal growth of luminal epithelium, proper for benign prostatic hyperplasia is related to increased basal cells number. Prostate carcinoma stems from transformed cells, located in basal epithelial layer after androgen stimulation.

According to (10, 11, 12, 13, 14) normal human prostate shows a low proliferative activity contrary to its behaviour in premalignant and malignant states.

In the secretory alveoli of prostate gland of hamsters and camels, high secretory epithelial cells and low basal cells are observed. Both cell types are with rounded nuclei (15).

The sexual maturation of prostate in boars is characterized with reduction of internal glandular zone and enlargement of the external one. The differentiation of internal zone is manifested with reduced number of basal cells, high density of glandular tubules and increase number of secretory epithelial cells (17).

The contradictory literature data about the morphology and the role of prostatic basal cells in mammals and the lack of data for these cells in feline prostate motivated the present investigation. It aimed to study the localization and the shape of basal cell in the prostate gland of the cat with regard to assist the understanding of their role in the pathogenesis of benign and malignant lesions in this animal species.

MATERIALS AND METHODS
The experiment was performed with 12 sexually mature, clinically healthy male European Shorthair cats at the age of 1–2 years, weighing 2.8 to 4 kg, obtained from a licensed animal breeder. The animals were euthanized with intravenous injection of 200 mg Thiopental (Biochemie, Austria) into the cephalic vein.

The investigation was carried out under strict observance of the European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasburg/16.05.1986), the European Convention for the Protection of Pet Animals (Strasburg/13.11.1987), and Law on Animal Protection in the Republic of Bulgaria (part IV: Experiments with animals, art 26, 27, 28, promulgated on January 24 2008, Official Gazette 13/2008).

The fixation of organ samples was done via in vivo perfusion with 3% glutaraldehyde in cacodylate buffer. Samples were collected immediately after opening of abdominal and pelvic cavities of euthanized animals. After removal of prostate glands, tissue pieces of 1 mm³ were cut, fixed for 2 h in the same fixative, washed in cacodylate buffer and postfixed in osmium tetroxide (OsO₄). The pieces were then washed, dehydrated in ascending ethanol series, put in propylene oxide and Durcupan, and finally embedded in Durcupan (Fluka, AG, Buchs Sg, Switzerland).

Semi-thin cross sections of 1 µm were prepared by means of ultramicrotome and stained with 0.1% aqueous solution of toluidine blue. Then, ultrathin cross sections were obtained from preselected areas and contrasted with uranyl acetate (18, 19, 20).

For light microscopy studies of semi-thin cross sections, a Primo Star light microscope was utilized (Zeiss, Germany), and data were recorded with a digital camera Prog Res CT3 (Germany).

For electron microscopy, a transmission electron microscope OPTON EM 109 (Germany) was used.

RESULTS
Light microscopy on semi-thin cross sections revealed that epithelial basal cells in feline prostate alveoli did not attain the alveolar
lumen and formed an incomplete, discrete boundary layer, located in close vicinity to the basal membrane. Above, the complete, continuous layer of epithelial secretory cells that reaches the alveolar lumen is situated (Fig. 1 and Fig. 3). In some of studied glandular alveoli, basal cells were invaginated among contacting luminal cells via their apical poles (Fig. 1 and Fig. 2). Basal cells were situated most commonly in pairs, sometimes by groups of 3–4 and rarely as single findings (Fig. 3). Thus, basal cells are observed as a occasional and rare epithelial population in the alveolar part of feline prostate parenchyma. The glandular epithelial layer was single-layer or transient to bi- or three-layer (Fig. 1, Fig. 2 and Fig. 3).

Fig. 1. Feline prostate gland: lumen of glandular alveolus (L), basal cells (BC), epithelial cells (E) and stroma (S) (semi-thin cross section). Toluidine blue, Bar =15µm.

Fig. 2. Feline prostate gland: lumen of a glandular tubule (L), basal cells (BC), epithelial cells (E) and stroma (S) (semi-thin cross section). Toluidine blue, Bar =20 µm.
Fig. 3. Feline prostate gland: lumen of a glandular tubule (L), basal cells (BC), epithelial cells (E) and stroma (S) (semi-thin cross section). Toluidine blue, Bar =10 µm.

The shape of alveolar basal cells varied from oval and triangular to irregular. Their longitudinal axis was perpendicular to the respective axis in secretory luminal cells and more often, was parallel to the alveolar luminal relief. Most of investigated cells were apically-basally flattened (Fig. 3). The base of triangular basal cells was more frequently positioned on the basal membrane whereas the apex was oriented towards intercellular spaces of the luminal epithelial layer (Fig. 1 and Fig. 2). The invaginations of the karyolemma in irregularly-shaped cells were observed on the surface oriented towards secretory cells, whereas the opposite basal surface of basal cells exhibited a regular relief pattern (Fig. 1).

Basal cells were also observed in the epithelium of prostate excretory ducts that also formed a discontinuous incomplete boundary layer, with ductal luminal epithelial cells remaining apically, and basally – contacting the basal membrane of glandular ducts. The investigated basal cells are a sporadic finding in feline prostate ductal epithelium. Here again, basal cells are encountered most commonly in pairs are rarely as single cell formations. Apical poles of some of them are also inserted between the overlying luminal cells, but this trait is more rarely observed as compared to the identical findings in glandular alveoli (Fig. 4 and Fig. 5).

Fig. 4. Feline prostate gland: lumen of an interlobular glandular duct - Portio terminalis (L), basal cells (BC), epithelial cells (E) and stroma (S) (semi-thin cross section). Toluidine blue, Bar =20 µm.
Fig. 5. Feline prostate gland: lumen of a glandular excretory duct (L), basal cells (BC), epithelial cells (E) and stroma (S) (semi-thin cross section). Toluidine blue, Bar =10 µm.

The shape of studied cells is also variable ranging from rounded, elongated oval or triangular to irregular. Elongated oval basal cells were parallel to ductal lumen and perpendicular to the longitudinal axis of luminal epithelial cells. The irregularly-shaped basal cells exhibited invaginations of the karyolemma that could be observed on the contact surface with luminal cells (Fig. 4 and Fig. 5).

The electron microscopy showed that basal cells in feline prostate parenchyma were situated in the basal parts of the glandular parenchymal epithelium. The shape of basal cells’ nuclei was elongated oval, with longitudinal axis parallel to the glandular lumen and perpendicular to the axis of luminal cells’ nuclei (Fig. 6). Secretory-like granules were observed in the cytoplasm of basal cells.

Fig. 6. Feline prostate gland: lumen of a glandular tubule (L), epithelial cells (E) basal cells (BC) (TEM). Bar =2.2 µm.
DISCUSSION
In this study, the localization and the shape of basal epithelial basal cells in feline prostate is described for the first time. Two cell types have been differentiated depending on their location – alveolar and ductal.

Our data about the localization of basal cells in prostate epithelium confirmed the results (1) about basal cells morphology in human and mammalian prostate glands. The location of investigated cells and their variable shape as compared to luminal cells allowed assuming that basal cells were less differentiated and had probably the characteristics of stem cells. The data suggest the important role of prostate basal cells in epithelial regeneration of the gland and therefore, in the development of benign and malignant prostate lesions. The facts showing the basal cell layer as a discrete boundary structure support the findings of (1) about the layered structure of mammalian prostate epithelium. Similarly to what is known for other animal species, the glandular epithelial layer in cats was also from single-layer or transient to bi- or three-layer, due to the incomplete marginal presence of the basal cell layer. Similarly to the assumptions of (1) it could be hypothesized that basal cells are an element of the blood-tissue barrier in feline prostate gland.

Contrary to what was reported by (2) for basal cells in canine prostate, these cells in male cats were less frequently localized near blood vessels. Second, their cell nuclei did not exhibit invaginations (with the exception of those with irregular shape) as shown in dogs (2). The shape of feline prostate basal cells was similar to those observed in dogs by (2), except for irregularly-shaped basal cells, determined as crown-shaped. Basal cells in feline prostate had no projections, neither secretory-like granules in the cytoplasm, just as reported in dogs (2).

In concordance with the data of (3, 4, 5) for basal cells in canine prostate, in cats, depending on the localization, two basal cells populations were also observed – in alveoli and in glandular ducts. We could assume that alveolar basal cells in cats are the primary proliferative compartment of prostate gland. Basal cells whose apical parts are inserted among the luminal parts, corresponds to findings in dogs (2, 3, 4, 5).

Our data about basal cells in prostate epithelium in male cats did not however correspond to those reported by (10, 11, 12, 13, 14) in humans. On one hand, in cats there were two basal cell populations: alveolar and ductal and on the other – basal cells in cats did not form a continuous layer.

The localization of the basal cell layer in feline prostate observed in this study corresponds to data about human prostate epithelium, communicated by (6, 7, 8, 9). It could be assumed by analogy that the basal cell layer could undergo a malignant transformation into a luminal cell type. In male cats, as in men, basal cell layer is probably proliferatively active and its alterations could be in the background of prostate cancer development.

The present results could be useful for elucidation of some morphological traits of epithelial basal cells in feline prostate gland as well as in the interpretation of the role of these cells in proliferative prostate lesions in this animal species.

REFERENCES