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Original Contribution

LOCALIZATION AND DISTRIBUTION OF ELASTIC FIBRES IN THE STROMA OF ACCESSORY SEX GLANDS AND THE WALL OF PELVIC URETHRA IN MALE CATS

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ABSTRACT
AIM: Investigation of the different parts of normal feline prostate gland, bulbourethral gland and pelvic urethra in order to establish the predilection for elastic fibres' distribution.
MATERIAL AND METHODS: The accessory sex glands and pelvic urethras were investigated in 10 clinically healthy, sexually mature male European shorthair tomcat weighing 2.8 – 4 kg. Elastic fibres were visualized by orcein staining by the method of Una-Tencer.
RESULTS: A predominant localization of elastic fibres was observed in prostatic stroma, with almost equal density in the different parts of the glandular interstice. A marked presence of elastic elements was observed in the region of the subendothelial connective tissue layer of prostatic epithelial cells. In the wall of stromal small arteries, the elastic tissue was barely present, with poorly visible inner elastic membrane, disrupted at some places.
The elastic elements of bulbourethral gland were relatively scantily presented in the interstice and the capsule. They were predominantly located in the vascularized connective tissue layer, situated among the parenchyma and the muscular capsule, as well as in the layer embracing the glandular lobules.
Elastic fibres were also seen in the thickened connective tissue of urethral adventitia, but their amount was fewer as compared to propria. Their presence was clearly marked in the interstice of disseminated prostate gland.
CONCLUSION: Our results could be used in the interpretation of some morphological features of fibrous elements of connective tissue components in studied organs with regard to diagnosing the hyperplastic lesions in this region.

Key words: elastic fibres, prostate gland, bulbourethral gland, urethra, tomcat.

INTRODUCTION

Homeostasis is the property to maintain the complex interaction between cell proliferation and cell death. The growth-regulating factors stimulate or inhibit these events. They are identified in the prostate gland. The integration of these factors includes the relationship between the epithelium and the stroma, and fibrous elastic elements of the gland in particular. The impaired equilibrium between these tissue components could lead to abnormal growth, and consequently to benign prostatic hyperplasia in men and animals (1, 2).

The prostatic epithelium plays an important role in the development of malignant lesions, whereas the stroma is involved in the development of benign prostatic hyperplasia (3).

The relationship between epithelium and stroma is essential for the normal growth of rat prostate. The glandular stroma is the predilection site for androgen action of the gland (4).

The dorsal sulcus and the inner septum divide the prostate in carnivores into two lateral lobes that are further subdivided into lobules of fine,

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predominantly connective tissue septae originating from the capsule (5).

In human prostate, a relationship between the basal membrane, stromal cells and fibrillar components have been observed. Collagen type VI and elastin-associated fibrils form a mixed network in the gland and participate in the control of cellular behaviour and the maintenance of the integrity of the organ secondary to deformation under smooth muscle contractions (6).

Some authors (7, 8) have investigated the elastic fibres in the stroma of ventral prostate in rats. The relationship stroma-epithelium was very important form the morphogenesis and physiology of the gland. They believe that the presence of elastic fibres in the ventral rat prostate was an integral part for the accommodation of gland's secretion under the action of smooth muscle cells.

The increase in the fibrous tissue element is considered predominant in human prostate enlargement. Although the total volume of histological components increased together with prostate's size, the major role in prostatic enlargement was that of fibrous tissue (9).

The morphometric analysis of changes occurring in connective tissue and smooth muscles in human benign prostatic hyperplasia (10) evidenced that the changes in these two tissues were inversely related but the contribution of the stromal component to the total gland remained constant.

The feline bulbourethral gland has an incomplete connective tissue capsule, with some of their peripheral tubules being located directly among the fibres of the surrounding m. bulboglandularis (11).

The propria and the submucosa of the pelvic urethra in domestic carnivores are composed of connective tissue with small amount of elastic fibres and smooth muscle cells (12).

The urethra of male cats has relatively more elastic fibres that that of dogs. The differences in the amount of fibrous components of the urethral wall should be taken into consideration when interpreting the urethral lesions in these carnivore species (13).

In the Anatolian souslik, prostate gland has a fibromuscular capsule and stroma with abundance of collagen fibres. In the capsule of bulbourethral gland, connective tissue was a mix from the adventitial and skeletal muscle tissues. The propria of the urethra contained a lot of elastic fibres (14).

The incomplete bibliographic data about the location and distribution of elastic fibres in these anatomical sites in male cats motivated the present investigation. It aimed to establish the different parts of normal feline prostate gland, bulbourethral gland and pelvic urethra, in order to establish the predilection for elastic fibres' distribution.

MATERIAL AND METHODS

The accessory sex glands and pelvic urethras were investigated in 10 clinically healthy, sexually mature male European shorthair tomcats (1-2 years of age) weighing 2.8 – 4 kg, obtained from a licensed breeder. The animals were euthanized with 200 mg Thiopental (Biochemie, Austria) i.v.applied in the cephalic vein.

The studies were performed under strict adherence to the European convention for the protection of vertebrates used for experimental and scientific purposes (Strasburg, 16.05. 1986), the European convention for protection of companion animals (Strasburg, 13.11. 1987) and the Law of animal protection in Bulgaria (Section IV- Experiments with animals, as per art. 26, art., 27, and art. 28; passed on 24.01.2008 and published in Official Gazette issue 13 in 2008).

The staining for detection of elastic fibres was done according to the method of Una-Tencer (15) as followed:
After the euthanasia, the accessory sex glands were removed and specimens from the organs were fixed in Bouin's fixative. Serial histological cross sections of 5–7 μm were cut on a rotary microtome Reichert (Austria) then stained with 1% orcein solution in ethanol for 1 hour. Afterwards, preparations were washed with water, then with 96% ethanol, were differentiated in absolute ethanol, cleared in xylene and embedded in entellan. Elastic fibres were coloured in brown-red.

Light microscopy studies were performed with a light microscope Primo Star (Zeiss, Germany), and results were recorded with a digital microscope camera (ProgRes CT3, Germany).

RESULTS

The elastic fibres were predominantly located in those parts of connective tissue components of studied organs, which were in vicinity to secretory glandular structures.

In the connective tissue component of the prostate gland, both in the intra- and extralobular stroma, a considerable predominance of elastic fibres was detected, with almost equal density in the different glandular stromal zones. These fibres accompanied the collagen fibrous structures of connective tissue in the stromal prostatic component and this way, participated in the formation of its fibrinous configuration. A marked presence of elastic elements was observed in the region of the subendothelial connective tissue layer of prostatic epithelial cells. In the wall of stromal small arteries, the elastic tissue was barely present, with poorly visible inner elastic membrane, disrupted at some places. At the boundary between the media and the adventitia, there were elements of external elastic membrane **(Fig. 1)**. In the muscle venules of the capsule, elastic elements were also encountered, but they were relatively less abundant. Only isolated areas of the vascular wall with presence of elastic fibres were seen. There was no fully developed elastic membrane. Extralobular prostatic outlet ducts possessed elastic elements mainly in their peripheral parts.

Fig. 1. Feline prostate gland (pars externa): prostatic epithelium (e), intertubular glandular stroma (s), lumen of glandular tubule (L), elastic fibres (ef), small arteries (a), elastic membrane in the arteria (m). Orcein staining. Bar = 30 μm.

The connective tissue skeleton of bulbourethral gland was located among the glandular lobules, among the glandular muscle layers and among the skeletal muscular fibrous capsule and the underlying parenchyma. Elastic elements were relatively poorly presented in the interstice and the capsule of the gland. They were predominantly located in the vascularized connective tissue layer, situated among the parenchyma and peripheral muscles and the layer embracing the glandular lobules. Intralobular interstice is built mainly of connective tissue, including elastic fibres, and is extremely vascularized. Elastic fibres are well visible in the wall of glandular small arteries, especially those in the interstitial layer, peripherally to the glandular parenchyma **(Fig. 2)**. When using higher magnifications, there were neither clusters of elastic fibres, nor formation of outer elastic membrane.

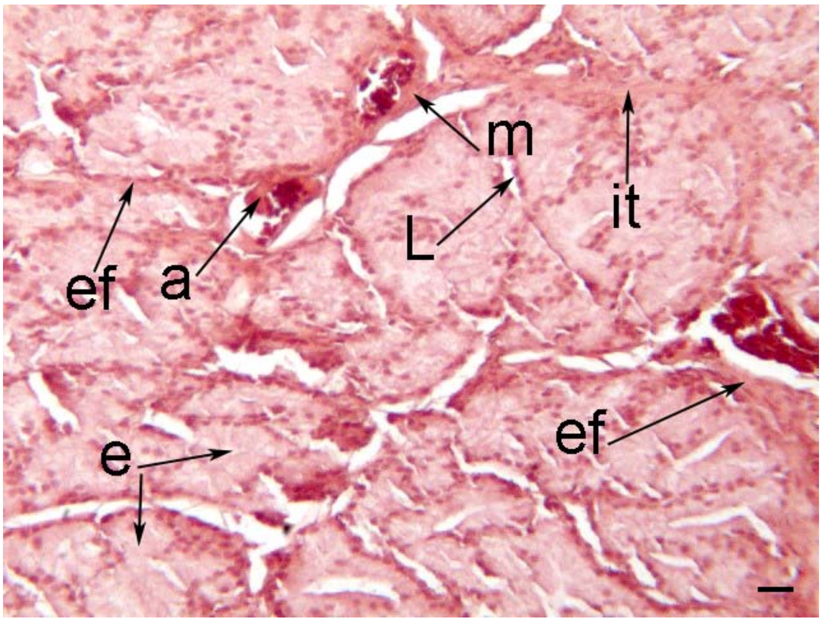

Fig. 2. Feline bulbourethral gland: glandular epithelium (e), lumen of glandular tubule (L), interlobular interstitim (it), small arteries (a), elastic membrane in the arteries (m), elastic fibres (ef). Orcein staining. Bar = 20 µm.

A considerable presence of elastic fibres in the propria of pelvic urethra and in the subepithelial connective tissue was observed. In the thickened connective tissue of the adventitia, elastic fibres were encountered, but in a fewer amount as compared to the propria. In the wall of caverns of both erectile layers, elastic fibres were abundant. Elastic elements predominated mainly in the propria, whereas in the musculature, there were observed only in the connective tissue among the muscular layers. The presence of elastic fibres was clearly marked in the interlobular interstitium of disseminated prostate in contrast to their absence among the prostatic parenchyma **(Fig. 3)**. Arterial blood vessels in the adventitia showed a considerable occurrence of elastic fibres in the tunica media unlike venous blood vessels.

Fig. 3. Pelvic urethra in a male cat: urethral epithelium (eu), urethral lumen (Lu), propria (pr), disseminated part of the prostate (pd), prostatic epithelium (e), lumen of glandular tubule (L), elastic fibres (ef). Orcein staining. Bar = 20µm.

DISCUSSION

The occurrence of elastic fibres in feline prostate gland is an essential component of the elastic accommodation of the tubuloalveolar glandular part during secretion, under the action of contractile smooth muscle element. Most probably, elastic fibres in the intralobular interstice compensated for the scarce amount of smooth muscle cells that is important for the motility and for the compensatory potential of this interstitial part. Also, the different elements of the parenchyma are surrounded with elastic fibres that further support our hypothesis about the anti-compression potential of prostatic lobules. It could be assumed that these peculiarities of localization and distribution of elastic fibres in feline prostate correlated and add to the findings of a number of authors (2, 3, 4, 7) about the relationship between the prostatic epithelium and stroma, the role of fibrous stromal elements in the development of benign prostate hypertrophy and the factors, maintaining the homeostasis of this gland.

The extralobular prostatic outlet ducts possess elastic elements mainly inn their periphery, that suggests about their peristaltic and compensatory roles and their resistance to pressure, as shown in studies in rats (6, 8).

The elastic membrane in the wall of prostatic stromal vessels and the predominance of smooth muscle tissue suggests that the structure of stromal vessels was expected to resist against the tissue pressure during the contraction of smooth muscle cells in the glandular stroma. The blood vessels of the capsule were richer in elastic elements that could be attributed to the high blood pressure in them from one part and to the pressure during the contraction of the superficial layer of the gland from the other. This is partly in accordance with the finding in canine prostate gland (1).

The predominant localization of elastic elements in the stromal prostatic part and in the wall of stromal blood vessels corresponded to the reported results (9, 10) about the morphometry of the fibrous tissue element of human prostate gland with regard to gland's hyperplasia.

The relatively modest presence of elastic elements in the interstice and in the capsule of feline bulbourethral gland was probably due to the predominance of skeletal and smooth muscle tissue in these areas. Therefore, the elastic fibres at those sites are not important for the anti-compression properties of the gland during ejaculation, in contrast of the essential function of the muscle tissue in bulbourethral gland's accommodation.

Our results for scarce presence of elastic fibres in the bulbourethral gland of cats were in concordance with studies on the structure of this organ in cats and Anatolian sousliks (11, 14).

The considerable presence of elastic fibres in the propria of the feline pelvic urethra and in the walls of caverns from both cavernous layers could be probably attributed to the role of local elastic elements in contractile and peristaltic events during micturition, erection and ejaculation. These data correspond to an opinion about the differences in the structure of the urethral wall in these two carnivore species (13).

Therefore, our results could be used in the interpretation of some morphological features of fibrous elements of connective tissue components in studied organs with regard to diagnosing the hyperplastic lesions in this region.

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