



Original Contribution

COMPARATIVE MORPHOLOGICAL INVESTIGATION ON THE MAST CELLS IN THE FELINE MALE PELVIC AND FEMALE URETHRAS

R. Dimitrov*, A. Vodenicharov, G. Kostadinov, Hr. Hristov, K. Stamatova

Department of Veterinary Anatomy, Histology and Embryology;
Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria

ABSTRACT

The density, form and dimensions of the mast cells are examined in the urethra of 14 sexually mature, clinically healthy (9 male and 5 female), European shorthair cats, following euthanasia. The material was fixed in Carnoi's fixative, dehydrated, embedded in paraffin and stained with 0.1% toluidine blue.

The light microscopy revealed that most mast cells were located in the propria of urethra, the number and density were higher in the male animals, compared with the same in the female ones. High number of mast cells was observed in the internal longitudinal smooth muscle layer in the feline male pelvic urethra. The mast cells were longest in the circular muscle layer and thickest in the propria. The data were statistically processed (Data Analysis of the StatMost for Windows).

From our studies, it could be suggested that mast cells in the connective tissue of feline pelvic urethra participate in the normal tissue status.

The results of the investigation showed, that the mast cells' morphology in the female urethra shows variations and depends on their localization in the both sexes.

Key words: mast cells, urethra, cat.

INTRODUCTION

It's known, that the structure of the feline pelvic urethra is specific (1), while the data referring to female urethra of the cat are relatively few.

The female urethra is investigated mainly in the human. A lot of authors study its histochemical and immunohistochemical particularities, about the presence and characteristics of the prostate lobules in its propria (2, 3, 4). The female prostate is observed in association with its predisposition to development of adenocarcinomas and cysts in this part of the urethra (5, 6, 7, 8).

In the Mongolian gerbil and rat, the female urethra and prostate are investigated histologically and immunohistochemically, except the mast cells in these organs (9, 10, 11, 12).

From studies of (13, 14) about the number and distribution of mast cells in human testis with normal and abnormal spermatogenesis is observed, that in cases with abnormal spermatogenesis the number of mast cells increases. Mast cells' concentration in testis is considerably higher. Their quantity in testis is high in sterility, compared with their number in inflammations and neoplasms (15, 16).

In the testicular interstitium of healthy boars, the mast cells' concentration is decreased, in these with unilateral cryptorchism, mast cells are few whereas in bilateral cryptorchids there are numerous mast cells (17).

The density of mast cells in rat's testicular interstitium is increased in the intact testis, after unilateral torsion of one of the both testis (18).

Other authors (19) prove the important role of the mast cells in regulation of the vascular tone and microcirculation in the urethra of the domestic pig.

* **Correspondence to:** R. Dimitrov, Department of Veterinary Anatomy, Histology and Embryology; Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria, E-mail: rosiros38@abv.bg

The lack of data about the motility, the form and dimensions of mast cells in the female feline urethra, compared with these in the pelvic one of the male cat motivated the present study in order to elucidate their role in the function of urethra in this animal species.

MATERIAL AND METHODS

Pelvic urethras of 9 clinically healthy, sexually mature European shorthair male cats (at the age of 1 - 2 years), weighing 2.8 - 4 kg and 5 female ones, weighing 2,2 - 3 kg were studied. The cats were euthanised i.v. with 200 mg Thiopental (Biochemie, Austria).

The material was fixed in Carnoi's fixative for 4 hours, then put in 70° ethanol for 12 hours, dehydrated in an ascending alcohol series, cleared in xylene and embedded in paraffin

The cross-sections (5 - 7 μm) were stained with 0.1% solution of toluidine blue in McIlvane's buffer, pH 3 (20).

The density (number, in mm^2) and dimensions (in μm) of mast cells were measured with an eyepiece micrometer (one element of the scale of the eyepiece is 18 μm , with magnification X 100) and their form was determined via light microscopy.

The data were statistically processed (Data analysis, StatMost for Windows).

RESULTS AND DISCUSSION

The total area of studied histological sections, in the feline male pelvic urethra was 572 mm^2 , the area of these in the feline female urethra was 69 mm^2 . The external smooth muscle layer of male cats had the biggest part (165 mm^2 - 28,8 %), followed by the middle circular one and the propria, the internal circular layer of feline cats had also the biggest part (25 mm^2 - 36,2%), followed by the external longitudinal smooth muscle layer - (23 mm^2 - 33,3%), and the propria - (21 mm^2 - 30,4%). Total number of mast cells was 4060, in the male examined animals the highest number of mast cells was observed in the propria - 1100 (27,3 %), followed, by the middle circular, internal, and external layers, the least number was found in the prostate lobules-33 (0,9 %). In the female cats, from 350 observed mast cells, the highest number was observed in the propria - 150 (42,9%), and the least one in the external longitudinal smooth muscle layer - 95 (27,1%). The highest number of

these cells in mm^2 was found in the propria of the male individuals, - $9,41 \pm 0,68$, followed by the internal, circular and external muscle layers, and the least one in the disseminated prostata - $0,92 \pm 0,24$. In the female cats, the highest number of mast cells in mm^2 was examined in the propria - $7,14 \pm 0,32$, and less in the muscle - $4,30 \pm 0,26$. The mast cells, in the male individuals, were longest in the circular muscle layer - $16,36 \pm 0,33 \mu\text{m}$, and shortest in the prostate parts - $7,36 \pm 1,69 \mu\text{m}$, thickest in the propria - $8,22 \pm 0,27 \mu\text{m}$, and thinnest in the disseminated prostata - $4,23 \pm 0,98 \mu\text{m}$ (table 1). In the female individuals, the mast cells were longest in the circular muscle layer ($18,51 \pm 0,82 \mu\text{m}$) and shortest in the propria ($15,11 \pm 1,89 \mu\text{m}$), thinnest in the external muscle layer - $8,31 \pm 0,59 \mu\text{m}$ and thickest in the propria - $8,69 \pm 0,59 \mu\text{m}$ (Table 1, Table 2).

The light microscopy studies showed that the most significant density of mast cells is in the propria of the male pelvic and female feline urethras. Comparable higher number of mast cells was found in the internal longitudinal muscle layer of the male cats, followed by the middle and external ones, compared with the female cats.

The investigations on the form and the dimensions of mast cells showed that they are longitudinal (fusiform) in the circular layer of the both sexes and thickest in the propria (Fig. 1, 2).

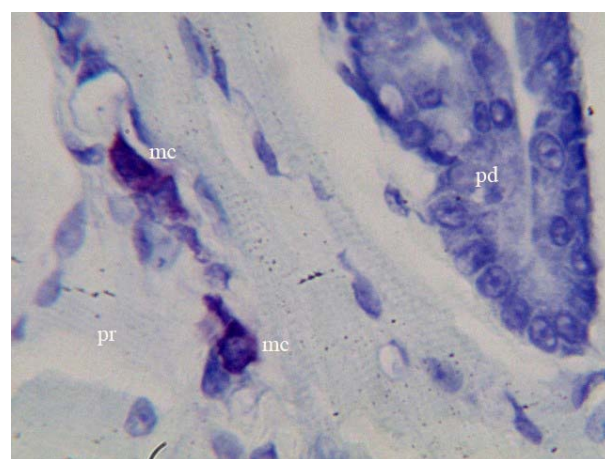


Fig. 1 Mast cells (mc), localized in the propria (pr) of the pelvic urethra and near to the lobules of the disseminated prostata (pd) (magnification X 400)

Table. 1. Area (mm²) of the examined parts of the female urethra, quantity and dimensions (μm) of the mast cells in the examined parts.

Index	EM	IM	PR	Общо
Area %	23 33.3	25 36.2	21 30.4	69 100
Number %	95 27.1	105 30	150 42.9	350 100
Number – mm ²	4.30±0.26	4.36±0.24	7.14±0.32	5.26±0.27
Min – max	2-6	2-6	4-9	2-9
SD	1.26	1.22	1.46	1.31
Lenght	18.51±0.82	19.27±1.43	15.11±1.89	17.63±1.38
Min – max	17-23.8	17-23.8	10.2-27.2	10.2-27.2
SD	2.47	3.51	5.67	3.89
Thickness	8.31±0.60	8.5±0.76	8.69±0.59	8.5±0.65
Min – max	6.8-10.2	6.8-10.2	6.8-10.2	6.8-6.8
SD	1.79	1.86	1.79	1.81

EM – external longitudinal muscle layer; DP – disseminated prostata

IM – internal longitudinal muscle layer

PR – propria and erectile tissue

Table. 2. Area (mm²) in the examined parts of the pelvic urthra, quantity and dimensions (μm) of the mast cells in the examined parts.

Index	EM	MM	IM	PE	DP	Общо
Area %	165 28.8	143 25	110 19.2	118 20.7	36 6.3	572 100
Number %	936 23.1	1033 25.4	948 23.3	1100 27.3	33 0.9	4060 100
Number– mm ²	5.67±0.36	7.22±0.34	8.62±0.61	9.41±0.68	0.92±0.24	6.97±1.5
Min – max	3.6-8.6	5.5-11.2	5.9-13.4	6.1-14.5	0-3.3	0.92-9.41
SD	1.59	1.43	2.57	2.88	1.03	3.36
Lenght	12.25±0.65	16.36±0.33	11.26±0.34	12.84±0.46	7.36±1.69	12.01±1.45
Min – max	7.9-17	13.6-19	9.5-15	10.2-16.3	10.2-18.7	7.36-16.36
SD	2.74	1.41	1.45	1.95	7.19	3.23
Thickness	6.97±0.34	6.3±0.37	6.17±0.31	8.22±0.27	4.23±0.98	6.37±0.65
Min – max	4.5-9.5	3.4-6.8	4.8-8.5	6.8-10.2	6.8-11.9	4.23-8.22
SD	1.44	1.56	1.32	1.15	4.14	1.45

EM – external longitudinal muscle layer; DP – dessiminated prostata

MM –middle circular muscle layer; PE – propria and erectile tissue

IM – internal longitudinal muscle layer

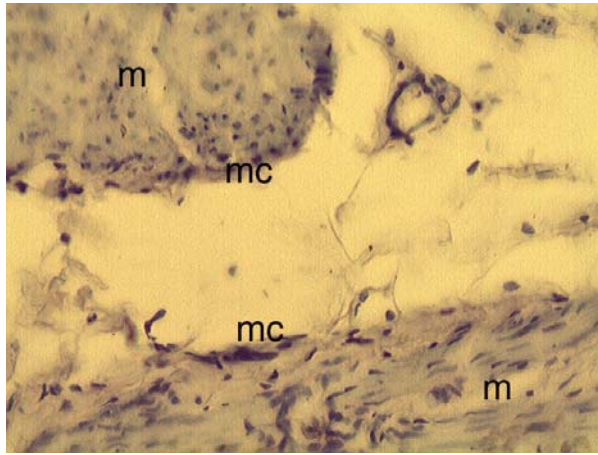


Fig. 2 Mast cells (mc), localized in the muscle layer (m) of the female urethra (magnification X 400)

The female prostata isn't observed in the cat, compared with the studies of other authors (2, 3, 4, 5, 6, 7, 8), about this structure in the human and other mammals.

With the present investigation for the first time the mast cells are described in the feline female and male pelvic urethras, compared with the other mammals (1, 9, 10, 12). It was observed analogical connective tissue localization in the both sexes. These data add further to the knowledge about mast cells' number in the interstitium of male genitals of the rat, mouse, gerbil, boar, and human (11, 13, 17, 18).

Our results motivate us to support the suggestion, that the mast cells have predominant effect to the fibroelastic elements in the pelvic urethra (1), and may be in the female one, that corresponds with mast cells' density in the testicular interstium of the rat, mouse and human (15, 16, 14, 18). The higher number of mast cells, observed by us in the propria of the pelvic urthra (9, 14) and in the muscle layers (5,67, in the external longitudinal one to 8,62 in the internal one), compared with their density in the propria ($7,14 \pm 0,32$) and in the muscularity ($4,30 \pm 0,26$) of the female urethra motivate us to suggest about their important role in the motility of the fibroelastic elements, the regulation of the vascular tonus and the microcirculation in the pelvic urethra of the male cat, like these, described by (19) in the urether of the domestic pig.

According to us it's important, that the mast cells in the middle circular muscle layer had longest shape in the both sexes, compared with the other layers. That motivates us to

suggest, that the significant length of the cells is resulted by the high contractile amplitude of the circular layer.

Higher number of mast cells in the male cat's pelvic urethra, compared with the female one, probably is resulted by the various functional role of the male urethra.

In conclusion, the results of the investigation convincingly showed, that the significant presence of mast cells in the propria, compared with this in the urethral muscularity, suggest about their active role in the connective tissue element of the feline male pelvic and female urethras.

REFERENCES

1. Wrobel, K., In: Dellman H., Eurel J (eds), *Textbook of Veterinar: Histology: Male Reproductive System* Fifth Edition, Williams & Wilkins, Philadelphia, pp 238– 244, 1998.
2. Wernert, N., Albrech, M., Seseherenn, I., Goebels, R., Bonkhoff, H., Seitz, G., Inniger, R. and Remberger, K., The "female prostate": location, morphology, immunohistochemical characteristics and significance. *Eur Urol*, 22, 1: 64-69, 1992.
3. Zaviacic, M., Jakubovska, V., Belosovic, M. and Breza, J., Ultrstructure of the normal adult human female prostate gland (Skene's glands). *Anat Embryol (Berl)*, 201, 1: 51-61, 2000.
4. Zaviacic, M. and Albin, RJ., The female prostate and prostate-specific antigen. Immunohistochemical localization, implications of this prostate marker in women and reasons for using the term "prostate" in the human female. *Histol. Histopathol.*, 15, 1: 131-142, 2000.
5. Lee, Nh. and Kim, SY., Skene's duct cysts in female newborns. *J Pediatr Surg*, 27,1: 15-17, 1992.
6. Pongtippan, A., Malpica, A., Levenback, C., Deavers, M. and Silvia, E., Skene's gland adenocarcinoma resembling prostatic adenocarcinoma. *Int. J Gynecol Pathol*, 23, 1: 71-74, 2004.
7. Sloboda, J., Zaviacic, M., Jakubovsky, J., Hammar, E. and Jonsen, J., Metastazing

- adenocarcinoma of the female prostate (Skene's paraurethral glands). Histological and immunohistochemical prostate markers studies and first ultrastructural observation. *Pathol Res Pract*, 194, 2: 129-136, 1998.
8. Zaviacic, M., Sidlo, J. and Borovsky, M., Prostate specific antigen and prostate specific acid phosphatase in adenocarcinoma of Skene's paraurethral glands and ducts. *Virchows Arch A Pathol Anat Histopathol*, 423, 6: 503-505, 1993.
 9. Flamini, MA., Barbeito, CG., Gimeno, EJ. and Portiansky, EL., Morphological haracterization of the female prostate (Skene's gland) of *Lagostomus maximus*. *Ann Anat*, 184, 4: 341-345, 2002.
 10. Inomata, T., Ninomiya, H., Somiya, H., Saito, H. and Mochizuki, K., Histological observation on the female prostata in Mongolian gebril (*meriones unguiculatus*). *Jikken Dobutsu*, 41, 3: 383-386, 1992.
 11. Satoh, H., Mori, K. and Furuham, K., Morphological and immunohistochemical characteristics of the heterogeneous prostate-like glands (paraurethral gland) seen in female Brown-Norway rats. *Toxicol Pathol*, 29, 2: 237-241, 2001.
 12. Santos, FC., Carvalho, HF., Goes, RM. and Taboga, SR., Structure, histochemistry and ultrastructure of the epithelium and stroma in the gebril (*Meriones unguiculatus*) female prostate. *Tussue Cell*, 35, 6: 447-457, 2003.
 13. Galli, S. J., New Concepts about the mast cell. *The New England Journal of Medicine*, 328, 47: 257-265, 1993.
 14. Meineke, V., Frungieri, M., Jessberger, B., Vogt, H. and Mayerhofer, A., Human testicular mast cells contain tryptase : increased mast cell number and altered distribution in the testes of infertile men. *Fertil Steril*, 74, 2: 239-244, 2000.
 15. Appa, D. D., Cayan, S., Polart, A. and Akbay, E., Mast cells and fibrosis on testicular biopsies in male infertility. *Arch Androl*, 48, 5: 337-344, 2002.
 16. Kollur, S. M., Pattankar, V. L. and Hag IA., Mast cells in testicular lesions. *Ups J Med Sci*, 109, 3: 239-245, 2004.
 17. Pinart, E., Bonet, S., Briz, M., Sancho, S., Garcia, N. and Badia, E., Cytology of the interstitial tissue in scrotal and abdominal testes of post-puberal boars. *Tissue Cell*, 33, 1: 8-24, 2001.
 18. Qo, S., Mast cell induction to the mouse testicular interstitium. *Nippon Hinyokika Gakkai Zasshi*, 85, 5: 747-752, 1994.
 19. Vodenicharov, A., Leiser, R., Gulubova, M. and Vlaykova T., Morphological and immunocytochemical investigations on mast cells in porcine ureter. *Anat Histol Embryol*, 34: 343-349, 2005.
 20. Pearce, A., Histochemistry, 2nd ed., J. & Churchill Ltd, London, pp 692, 1960.