

Submicroscopic changes in bladder walls during acute urinary retention under postresectional pulmonary hypertension

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Acute urinary retention is often found in medical practice and requires urgent interventions, and doctors are not always happy with the results of correction of this pathological condition.

In an experiment on male Vietnamese pigs, a study was made of the features of changes in the structures of the wall of the bladder in acute urinary retention in conditions of pulmonary hypertension.

A comprehensive analysis of the data obtained indicates that acute urinary retention causes significant disturbances in structural bladder homeostasis, which increase with the duration of the simulated pathology under conditions of pulmonary hypertension.

Key words: bladder, urinary retention, pulmonary hypertension.

Acute urinary retention (AUR) is often encountered in medical practice, characterized by a large variety of prevalence and causes, needs urgent interventions and physicians are not always satisfied with the correction results of the pathological condition [1, 2, 5, 7].

MATERIALS AND METHODS

The age submicroscopic changes of the bladder walls during 1–3 diurnal acute urinary retention in terms of pulmonary hypertension was studied in the experiment on the vietnamese male pigs.

19 mature male vietnamese pigs, aged 5–6 months were divided into four groups. The bladder was studied by using electron microscopy. The first group included 4 intact animals, the second – 5 experimental animals on the 1st day of AUR, the 3rd – 5 experimental animals on the 2nd day of AUR, the 4th – 5 experimental animals on the 3rd day of AUR.

RESULTS

Electronic microscopic studies of bladder mucosa of animals of a young age group with acute urinary retention, carried out during 1–3 days of the experiment, have shown a significant change of its structural components. The refinement of the epithelial plate due to damage of the epithelial cells has been marked. Some cells were desquamated, intercellular contacts were violated, and intercellular spaces were augmented. Epitheliocytes' nuclei were transformed, karyoplasm became homogeneous and osmophilic. Karyotheca intussusceptions were present as a result of detachment of outer nuclear membrane. Perinuclear space was locally enlarged. Enhanced tubules of endoplasmic reticulum, large vacuole-like structures, vesicles have been observed in electronically clear cytosol. There were some few mitochondria, which had light matrix and damaged inner structures. Apical surface of epithelial cells was uneven, forming protrusions and intussusceptions [3, 4].

Submicroscopic research of bladder mucosa of the animals of older group with acute urinary retention has been carried out on the 1st–3d days of experiment and displayed the same changes in its structural components like in animals of younger age group, but more pronounced, especially on the third day of the experiment.

A lot of damaged cells in the small epithelial plate have been observed. The epithelial cells which were on the surface, had electronically clear cytosol with a small amount of organelles. Different size vacuoles, vesicles, single altered mitochondria, dilated ducts of endoplasmic reticulum were present. Apical part of plasmolemma was sometimes thick, fuzzy. Moderately osmophilic, homogeneous karyolasm, nuclear envelope with bad contour, perinuclear space sometimes were not determined in modified oblongated form of nuclei.

Enlarged intercellular spaces, damaged intercellular contacts have been observed. This helps to detach damaged epithelial cells.

Altered structural components of microcirculatory bed have been observed in the swollen connective tissue of the lamina propria of the mucosa and submucosa of the bladder in younger and older age groups of animals on the 1st day of the experiment. Capillaries had wide lumina, which were filled with blood cells, preferably erythrocytes. Cytoplasmic areas of endothelial cells were uneven, sometimes thickened, swollen. Luminal-like parts of plasmolemma were thickened, sometimes losing clarity. Basal membrane has enlarged perivascular spaces without clear contours.

Venules had wide lumina, which were filled with blood cells, preferably erythrocytes. The wall was uneven because the cytoplasm of the endothelial cells had different thickness. Basal membrane had bad contours.

Ultrastructural changes of blood capillaries of bladder walls grew, especially in older animals, during the second and especially the third day of the experiment. The majority of hemocapillaries, especially venules, had wide lumina filled with red blood cells and plasma. Endothelial cells' cytoplasm was poorly structured and had very few pinocytosis vesicles, the luminal-like surface had isolated microvilli, basal membrane was significantly altered, without clear contours and counters and in some areas was not determined.

Some of the blood capillaries, especially of the bladder walls, of 11–12 months aged animals on the third day of the experiment have significantly altered walls' ultrastructure. Cytoplasmic areas of endothelial cells were subtle, sometimes lacking. The cytoplasm of thickened areas had a great number of vacuoles, damaged organelles were not structured. Basal membrane had huge destructive phenomena, was subtle or without counter.

Reactive changes of smooth myocytes have been observed on the second day of the experiment after electronic microscopic studying of the muscle layer of the bladder of experimental animals with an acute urinary retention in terms of postresectional arterial pulmonary hypertension. Most of the cells, in the longitudinal section, had an oblongated form, a narrow area of sarcoplasm around nuclei and narrow - in peripheral areas. This reflects stretching of myocytes due to functional stress on the muscle membrane of the bladder.

The nuclei of such smooth myocytes were significantly elongated, karyotheca had very few and shallow intussusception, its membrane had no clear counters. Karyoplasm was electronically diaphanous, included small nucleoli and clumps of heterochromatin. Sarcoplasm was also of low electronic density due to its

swelling, thinning and lysis of miofilaments. Most of mitochondria were greatly changed, were rounded, lost their inner structures, matrix was light, so organelles looked like vacuoles. Small tubules of sarcoplasmic mesh and tanks of Golgi complex were thickened and also looked like vacuoles. Identified submicroscopic changes of smooth myocytes indicated the violations of contractile and energy functions of cells.

Electronic microscopic studying of the muscle layer of the bladder of experimental animals detected the development of destructive changes of that layer. As in a younger group of pigs have been identified oblongated smooth myocytes. In oblique and transverse sections of the cells it has been observed that sarcolemma had uneven contours, osmophilic areas, some parts of sarcoplasm being increased. It included small oblongated nucleoli with tiny intussusception of karyotheca and small nucleoli in light karyoplasm. Accumulation of mitochondria has been observed, perinuclear organelles were hypertrophied. Most of them had electronically transparent matrix with significantly

damaged inner structures. Some of these thickened altered mitochondria and tubules of endoplasmic reticulum were located at the sarcolemma. Myofilaments were partially lysed and kept mostly on the periphery of sarcoplasm. Intercellular substance of connective tissue layers was significantly swollen. Connective tissue layers consisted of electronically light amorphous component, separated bundles of collagen fibers and elastic fiber fragments. Also there were form greatly thickened, of irregular, elastic fibers. Such changes of ultrastructure dominated in experimental animals of older age group.

CONCLUSION

AUR causes severe disorders of cell structural homeostasis of bladder, which are increased significantly with age of animals and duration of simulated disease.

Postresectional arterial pulmonary hypertension complicates significantly the acute urinary retention, resulting in severe pathological changes of the bladder.

Субмікроскопічні зміни стінки сечового міхура при гострій затримці сечі в умовах пострезекційної легеневої гіпертензії А.Д. Беденюк, В.В. Твердохліб, А.І. Мисак, С.О. Нестерук

Гостра затримка сечі часто зустрічається в медичній практиці та потребує термінових втручань, але лікарі не завжди задоволені результатами корекції даного патологічного стану.

В експерименті на свинях-самцях в'єтнамської породи проведено вивчення особливостей змін структур стінки сечового міхура при гострій затримці сечі за умови легеневої гіпертензії.

Всебічний аналіз отриманих даних свідчить, що гостра затримка сечі викликає значні порушення структурного гомеостазу сечового міхура, які збільшуються з тривалістю змодельованої патології та в умовах легеневої гіпертензії.

Ключові слова: сечовий міхур, затримка сечі, легенева гіпертензія.

Субмікроскопические изменения стенки мочевого пузыря при острой задержке мочи в условиях пострезекционных легочной гипертензии А.Д. Беденюк, В.В. Твердохлиб, А.И. Мисак, С.А. Нестерук

Острая задержка мочи нередко встречается в медицинской практике и требует срочных вмешательств, а врачи не всегда довольны результатами коррекции данного патологического состояния.

В эксперименте на свиньях-самцах вьетнамской породы проведено изучение особенностей изменений структур стенки мочевого пузыря при острой задержке мочи в условиях легочной гипертензии.

Всесторонний анализ полученных данных свидетельствует, что острая задержка мочи вызывает значительные нарушения структурного гомеостаза мочевого пузыря, которые увеличиваются с продолжительностью смоделированной патологии в условиях легочной гипертензии.

Ключевые слова: мочевого пузыря, задержка мочи, легочная гипертензия.

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LITERATURE

1. Alory Y. Case 5. Perspectives in-2007 for bladder pathology. Radiation cystitis / Y. Alory // *Ann. Pathol.* 2008. – Vol. 28, № 4. – P. 290–293.
2. Butrick C.W. Diagnosis and treatment of interstitial cystitis/painful bladder syndrome: a review / C.W. Butrick, F.M. Howard, P.K. Sand // *J Womens Health (Larchmt).* – 2010. – Vol. 19, № 6. – P. 1185–1193.

3. Drake M.J. Structural characterization of myofibroblasts in the bladder / M.J. Drake, C.H. Fry, B. Eyden // *BJU International.* – 2006. – Vol. 97. – P. 29–32.
4. Immunohistochemical estimation of hypoxia in human obstructed bladder and correlation with clinical variables / A. Koristiadis, K. Stravodimos, G. Koutalellis [et al.] // *BJU*

International. – 2008. – Vol. 102. – P. 328–332.
5. Twenty years experience with an ileal orthotopic low pressure bladder substitute – lessons to be learned / U.E. Studer, F.C. Burkhard, M. Shumacher [et al.] // *J. Urol.* – 2006. – Vol. 176, № 1. – P. 161–166.
6. The effects of a type 4 phosphodiesterase inhibitor and the muscarinic cholinergic

antagonist tolterodine tartrate on detrusor over activity in female rats with bladder outlet obstruction / Ya. Kaiho, J. Nishiguchi, D. Kwon [et al.] // *BJU International.* – 2007. – Vol. 101. – P. 615–620.
7. Efficacy and tolerability of fesoterodine in men with overactive bladder: a pooled analysis of 2 phase 3 studies./ Herschorn S., Jones J.S., Oelke M. [et al.] // *Urology.* 2010;75(5):1149–1155.

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