410

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IS THE SEVERE STRESS URINARY INCONTINENCE WITH HYPOTONIC URETHRA DUE TO DESTRUCTION OF ELASTIC FIBERS ? AN ELECTRONMICROSCOPICALLY STUDY

Hypothesis / aims of study

Stress urinary incontinence is one of the most common types of urinary incontinence in women. It is defined as an involuntary loss of urine associated with a rise of the intra-abdominal pressure due to coughing, sneezing or physical exertion without contraction of the detrusor muscle.

Factors like increasing age, neurological and psychiatric disorders, physical immobility, pregnancy and delivery, obesity or previous pelvic surgery contribute to the occurrence of stress urinary incontinence in women.

There is a growing body of evidence that components and structures of pelvic connective tissue play an important role in the urinary continence mechanism. The hypothesis of Papa Petros and Ulmsten (1990 [Integral theory]) and DeLancey (1994 [hammock hypothesis]) outline the importance of connective tissue alterations affecting the urethral closure mechanism. Ultrastructural and quantitative studies of collagen fibers in the paraurethral connective tissue of stress urinary incontinent and urinary continent women showed a higher content and a larger diameter of these fibers in stress incontinent women in reproductive age (Ulmsten and Falconer 1999).

Changes in structural support of the urethtra and bladder neck have been proposed to be among the important factors in the pathogenesis of stress urinary incontinence. In this context, we electronmicroscopically investigated the elastic system in the periurethral area in incontinent women with normtonic and hypotonic urethra (urethral pressure ≤ 15 cm H2O) without pelvic organ prolapse. The exact localization and morphological structure of these fibers (elastic, elaunin and oxytalan fibers), their relation to other connective tissue components are to be characterized as well as their possible part in the development of severe stress urinary incontinence with hypotonic Urethra.

Study design, materials and methods

Specimen of periurethral connective tissue from 44 women were studied by electron microscopy. Thirty of these women (median age: 50 years, range: 35-72 years) suffered from urodynamic stress incontinence with normotonic urethra (maximum urethral pressure ≥ 15 cm H2O) , the other forteen women (median age: 61 years, range 52-81 years) suffered from urodynamic stress incontinence with hypotonic urethra (maximum urethral pressure ≤ 15 cm H2O) . Samples of periurethral connective tissue were obtained during different surgical methods: in stress-incontinent women during TVT (tension-free vaginal tape)-procedure, and in the continent women at reconstructive surgery of the pelvic floor.

Ultra thin sections were stained according to Kajikawa (1975) with 5% tannic acid/ 5% uranyl acetate and lead citrate. This procedure results in a selective staining of elastin-containing tissue structures, as previously described by Klein and Boeck (1983) and Boeck (1999) to demonstrate elastic and elaunin fibers in human endocardium and in the fallopian tube.

The sections were examined in a transmission electron microscope EM 900 by Carl Zeiss at 50 kV.

Results

The elastin-containing components of the elastic system (elastic and elaunin fibers) were detected selectively in remarkable amounts in the periurethral connective tissue of all women in our study. Mostly elastic, elaunin and oxytalan fibers lie in close neighbourhood and seem to be connected with each other. In the samples taken from stress incontinent with normotonic urethra they form wide elastic networks and contain areas with rich or low amounts of elastin. The components of the elastic fiber system are in close contact with fibrocytes and smooth muscle cells.

We detected an irregular, fragmented distribution of the protein elastin in all patients with severe urodynamic stress incontinence (hypotonic urethra, maximum urethral pressure ≤ 15

cm H2O). Moreover, the elastin-containing, homogenous and electron-dense core of elastic fibers was lost. Fragmented elastic fibers of different sizes were found between collagen fibers, fibrocytes and smooth muscle cells.

Interpretation of results

Specific differences between the elastic fiber system of stress incontinent women with normotonic and hypotonic urethra were detectable. The ultrastructure of periurethral connective tissue of women with severe stress urinary incontinence is altered, the elastic fiber system is destroyed.

Concluding message

We assume that these structural changes lead to functional consequences, like diminished tissue extensibility and stability around the female urethra. These altered connective tissue properties may affect the mechanism of urethral closure under stress (e.g. coughing) and therefore contribute to the occurence of urodynamic stress incontinence. This more in-dept knowledge of the ultrastructure of elastic fibers may in future lead to new therapeutic options in a cellular or biochemical level.