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THE BIOCHEMICAL STUDY OF THE PARAURETHRAL GLANDS' SECRETION IN WOMEN OF REPRODUCTIVE AGE

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Abstract

The development of anatomy as a science has awakened interest in the female paraurethral glands and sparked a centuries-long debate whether this organ is rudimentary or functionally active in the female body. The aim of the present study was to show, through biochemical analysis, that the organ's secretion is neither urine, nor blood or its derivatives. Fourteen samples, with a volume of 0.5 to 2.5 ml, were collected from healthy women. Most of the samples were colorless, few had a yellowish tint, one had a slight opalescence, and another one had signs of hemolysis. The secretion was studied for: protein concentration, creatinine concentration, and activity of several enzymes, such as alkaline phosphatase, γ-glutamyltranspeptidase and neutral α-glucosidase. The found protein concentration in the samples was very low and did not correspond to that of the blood serum. The creatinine concentration was analyzed in the biomaterial diluted 50-fold, according to the instructions for the reagent kit. Creatinine in the samples was either not found or found in negligible amounts, i.e. its level did not correspond to that in the urine. The activity of γ-glutamyltranspeptidase and neutral α-glucosidase in all samples was quite high: within the range from 42.2 to 975.6 nm/(s×l) for γ-glutamyltranspeptidase, and within the range from 42.7 to 1602.6 nm/(s×l) for neutral α-glucosidase. The activity of alkaline phosphatase was not found, except for the samples that differed visually: 17 nm/(s×l) was registered in the sample with signs of hemolysis, and 703.1 nm/(s×l) in the sample with opalescence. High activity of the above enzymes is characteristic of organs and tissues with high metabolic activity as well as those involved in the transport of nutrients or related to secretion. It was concluded that the secretion of the female paraurethral glands is neither blood serum or its derivative, nor urine, but rather an independent biological fluid with high enzymatic activity. Thus, the obtained data support the non-vestigial concept that sees the paraurethral glands in the female as a functionally active organ.

All human studies were conducted in compliance with the rules of the Helsinki Declaration of the World Medical Association "Ethical principles of medical research with human participation as an object of study". Informed consent was obtained from all participants.

Keywords: *female paraurethral glands, female prostate, secretion, protein, creatinine, enzymes*

Introduction

For many centuries, scientific medical community has been debating over the existence and functioning of the female paraurethral glands. Although the debate is almost as old as the science of anatomy itself, till recently there were no adeqate research methods to allow an in-depth study of this organ.

Some researchers would consider the female paraurethral glands to be an organ homologous to the male prostate, while others would opt for the vestigial theory, seeing this organ as rudimentary. Over the last centuries the scientific and technological development has reached the point where the issue can be addressed in a thorough and comprehensive way.

The term "female prostate" was first used in 1672 by a young Dutch physiologist Rainier de Graaf, who described in detail the anatomical structure of the female paraurethral glands, based on its homology to the male organ and tried to identify their functions in the female body [1].

At the end of the 19th century, the anatomy of the female prostate was researched by American gynecologist Alexander Skene. He drew attention to two paraurethral ducts and emphasized their role in genital infections. Since then, the paraurethral glands in the female have received the names of "Skene's glands" and "Skene's ducts". Due to the female prostate's small size in comparison with the male gland, insufficient amount of scientific data about it, and lack of evidence of pathological changes in it, Skene classified this organ as rudimentary [2].

Subsequently, German scientist Rudolf Virchow, as a pathologist and, in particular, as a histologist, described the accumulation of amyloid cells – which were thought to be typical only for the male prostate – in the tissue of the female paraurethral glands. Taking into account the fact that in the embryo female paraurethral glands, just like the male prostate, develop from the urogenital sinus, and based on his own histological studies, Virchow came to the conclusion that this genitourinary organ is independent and has its own functional activity [3, 4].

In the middle of the twentieth century, gynecologist John W. Huffman of Northwestern University (Evanston, Illinois), upon studying serial sections of wax preparations of the urethra of adult women, presented his own explanation of anatomy and histology of the paraurethral ducts. The scientist noticed that the numerous (while Skene described only two) ducts along the distal urethra often end in tubular glands and are lined with columnar epithelium, which has some, although limited, secretory activity. In his subsequent works Huffman showed that inflammatory processes in the ducts of the paraurethral glands play an important role in the etiology of lesions of the urethra and anterior wall of the vagina [5].

The development of medical science and the introduction of new technologies in diagnostics in the second half of the twentieth century sparked renewed interest in the study of female paraurethral glands and allowed to bring the research to a whole new level.

Towards the end of the 20th century, a significant contribution to the study of the organ's nature and its formation was made by Milan Zaviacic (M. Zaviačič), of Institute of Pathological Anatomy, Faculty of Medicine, Comenius University, Bratislava. Based on autopsy data, the Slovak scientist conducted organometric studies of the female paraurethral glands and compared the results with similar parameters of the male prostate [6]. Then he studied the secretion of the female paraurethral glands, calling it ejaculate, and compared it with male prostatic secretion [7]. He also showed a correlation between maturation and functional activity of this organ, and the level of estrogen in the female body [8]. He described six anatomical types of glandular accumulation of tissue along the urethra and conducted an immunohistochemical study; Finally, he investigated the content of prostate-specific antigen of acid phosphatase and some microelements in female secretion [9, 10].

In 2008, based on the work of M. Zaviacic, the Federal International Committee for Anatomical Terminology (FICAT) officially recognized the term "female prostate."

Scientists are still facing certain difficulties both in collecting the organ's secretion and in conducting research on its histological aspects – the latter mainly due to insufficient amount of the biomaterial.

The purpose. The purpose of this study was to show, via biochemical analysis of the secretion of female paraurethral glands, that this biomaterial is neither urine, nor blood or its derivatives, but rather an independent bioliquid produced by a functionally active organ.

Methods

Fourteen samples of paraurethral gland secretion from women, with no chronic conditions and no current health complaints, were analyzed. In most cases, the samples were colorless, few were yellowish; there was one with a slight opalescence and one with signs of hemolysis. The presented samples had a volume of 0.5 to 2.5 ml.

The content of creatinine in the secretion of the paraurethral glands was studied by the conventional Jaffa's method, using a set of reagents.

As the concentration of creatinine in the urine is much higher than in blood serum, the instruction to the reagent kit recommends 50-fold dilution of urine, whereas serum in such procedures is not diluted. 0.5 ml of biomaterial is required for analysis. In view of the limited amount of the tested substance, it was decided to determine the concentration of creatinine by analogy with urine, i.e. by 50-fold dilution.

The protein concentration was accessed by the biuret method.

The activity of γ-glutamyltranspeptidase and alkaline phosphatase was studied using appropriate sets of reagents to identify these enzymes in the blood according to the instructions.

The activity of neutral α-glucosidase in the secretion of women's paraurethral glands was measured against the rate of glucose formation in a neutral environment, with decomposition of maltose in 0.2 M phosphate buffer (pH 6.5.)

The content of formed glucose was analyzed by glucoseoxidase method, using the suggested set of reagents.

Results

As most samples' volume was very small, to study the concentration of creatinine in the secretion of female paraurethral glands, a 50-fold diluted secretion was used, as recommended for accessing creatinine in urine, since our goal was to compare the biochemical composition of the secretion with urine.

In 10 out of 14 samples, creatinine in concentrations typical for human urine was not found; in the remaining samples, the concentration was at the limit of sensitivity of the method.

It convincingly proves that the studied biofluid was not urine.

The protein concentration in samples of secretion of paraurethral glands was determined by biuret method as well.

The highest value (6.5 g/l) was in the sample with signs of hemolysis. In the rest of the samples, the protein concentration was less than 1 g/l.

The activity of γ-glutamyltranspeptidase, determined in the studied biomaterial, was quite high in all samples without exception and was measured in the range from 42.2 to 975.6 nmol / (s × l).

In the serum of healthy women, this figure is determined within the range of 160-1100 nmol / (s × l), that is, the level of γ-glutamyltranspeptidase activity in the secretion of women's paraurethral glands was comparable to that in blood serum.

The study of the activity of neutral α-glucosidase in the secretion of paraurethral glands of women showed high enzymatic activity in all samples.

The tested enzyme was measured within a rather wide range of 42.7-1602.6 nmol / (s × l). These values are comparable to the corresponding data for urine (before its conversion to creatinine), but significantly lower than the activity of the enzyme in male semen. It's necessary to emphasize that in the ejaculate of healthy men, this enzyme is determined with a much higher activity (above 20 μmol / (s × l), i.e. three orders of magnitude more). However, in male semen, the main source of neutral α-glucosidase is the epididymis, not the prostate gland.

Examination of alkaline phosphatase in the secretion of women's paraurethral glands showed no activity of this enzyme in all but two samples. Only in the samples that differed from others visually, it was possible to register the activity of alkaline phosphatase: 17 nmol / (s × l) was found in the sample with signs of hemolysis, and 703.1 nmol / (s × l) in the sample with opalescence. In the blood serum of healthy women, this figure is 740-2100 nmol / (s × l). It should be emphasized that the high

activity of the above enzymes is typical in tissues with significant metabolic activity, namely in tissues involved in the transport of nutrients, as well as in developing tissues and organs associated with secretion. These enzymes enter the urine due to desquamation of the epithelium of the proximal tubules of the nephrons.

Conclusions

The study showed that biomaterial samples presented as the secretion of female paraurethral glands are neither blood serum or its derivative (low protein concentration), nor urine (non-urine concentration of creatinine), but constitute an independent biofluid with high enzymatic activity. The obtained data support the non-vestigial theory that identifies the paraurethral glands as a functionally active organ in the female, rather than as a rudiment.

Acknowledgments

The authors declare that there are no conflicts of interest.

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