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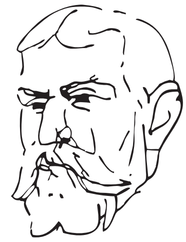

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STEREOMORPHOLOGY OF THE GLANDULAR PARENCHYMA OF THE INFEROPOSTEROLATERAL AREA OF HUMAN PROSTATE GLAND

STEREOMORFOLOGIA MIĄŻSZU POWIERZCHNI DOLNO-TYLNO-BOCZNEJ LUDZKIEGO GRUCZOŁU KROKOWEGO

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ABSTRACT
Introduction: The human prostate gland contains numerous tubular masses of different calibers in its parenchyma. They form the tubuloalveolar prostate glandules, constituting from numerous prostatic excretory ductules as well as major excretory ducts.
The aim: The study was aimed at 3D visualization of individual microelements of the tubuloalveolar aggregations, localized within the peripheral area.
Materials and methods: To meet the objectives of the study a series of paraffin plane-parallel 4 μm sections has been obtained in the peripheral prostate area. The serial sections were stained with hematoxylin and eosin. After the analysis of the series of sections, the graphical two-dimensional and plastic 3D reconstructions of the investigated microobjects have been made sequentially in depth.
Results: Presence of the epithelial creases and invaginations of the wall in the luminal contour of tubuloalveolar aggregations of the prostate has been found. Creases can be solitary, multiple, or wavy; they can be localized both symmetrically and asymmetrically, with different heights and thicknesses. Intraluminal invaginations, along with the epithelial crease, contain a stromal muscle component with localized blood loop-shaped microvessel. The creases of the glandular epithelium and intraluminal invaginations can "overlap" the lumens of the tubuloalveolar aggregations up to 2/3 of the width, making the inner lumen sinuous that influences the laminar flow of the liquid.
Conclusions: Alternation of the considerable enlargement and narrowing of the inner diameter is common for the tubuloalveolar aggregations which can affect the secreta deposition and movement.

KEY WORDS: human prostate gland, peripheral area, tubuloalveolar aggregations, crease, invagination.

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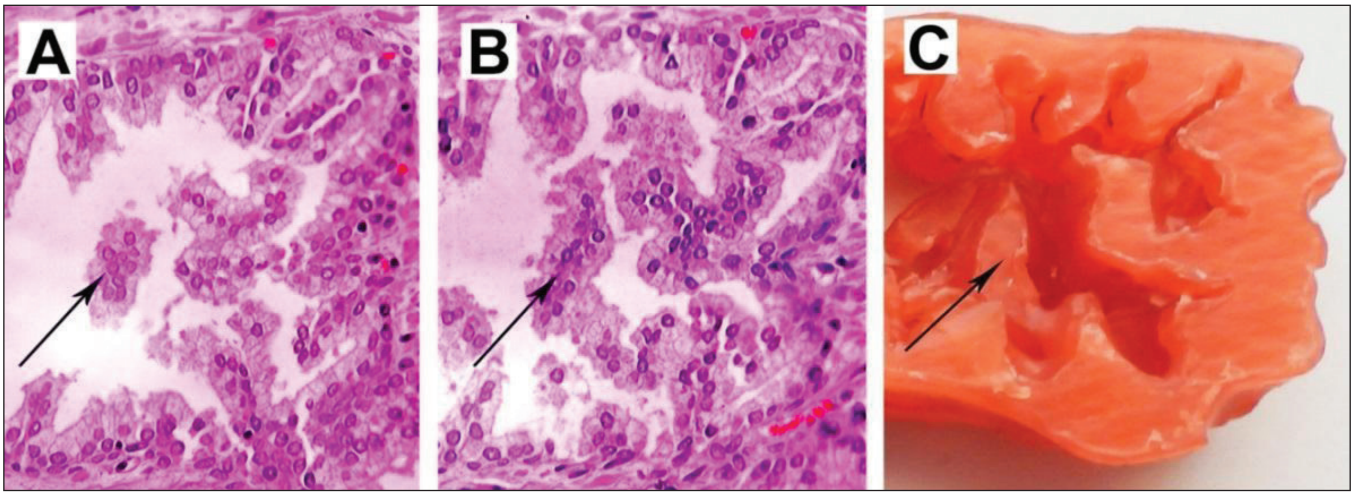
INTRODUCTION
The human prostate gland contains numerous tubular masses of different calibers in its parenchyma. They form the tubuloalveolar prostate glandules, constituting from numerous prostatic excretory ductules as well as major excretory ducts. The term "prostatic ductules" should be interpreted as any ducts of glandular area [1, 2, 3], since no clear landmarks have been found in prostate which would allow distinguishing lobules, sublobular units, acini, adenomeres in its glandular area. Consequently, there are difficulties in attempts to rank the excretory ducts of the prostate. The difficulty of their identification is also in the fact that the glandules of the peripheral area glands are represented by the compound of numerous complex tubuloalveolar microstructures. The acini adhere very close to each other and differ in the variety of shapes of their luminar contours. The excretory microtubes itself are often curved, with heliciform path, complex configuration of the luminal contour, which also makes it difficult for the researcher to be aware of their spatial localization and organization.

THE AIM
The study was aimed at 3D visualization of individual microelements of the tubuloalveolar aggregations, localized within the peripheral area.

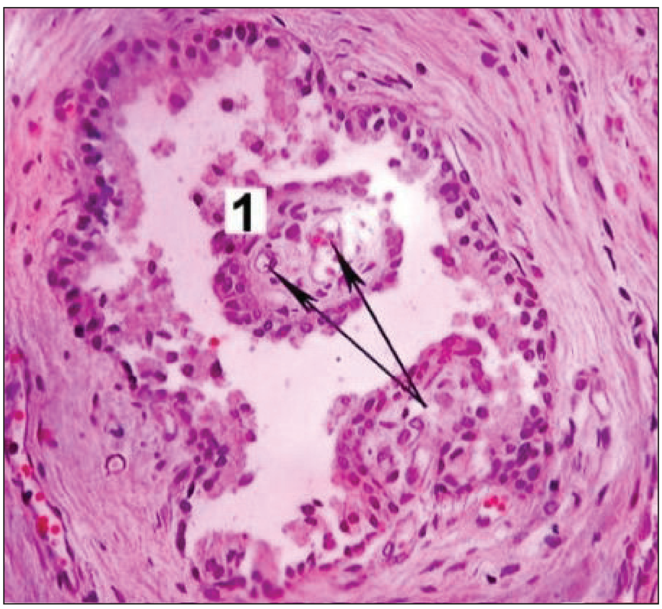
MATERIALS AND METHODS
9 isolated specimens of the prostate taken from men who died of diseases that did not cause changes in the investigated organ. To meet the objectives of the study, we have received a series of paraffin plane-parallel 4 μm sections has been obtained in the peripheral area of the human prostate area. The serial sections were stained with hematoxylin and eosin [4]. After the analysis of the series of sections, the graphical two-dimensional and plastic 3D reconstructions of the investigated microobjects have been made sequentially in depth. The three-dimensional reconstruction of the tubuloalveolar aggregations was performed on their luminal contour [5].

RESULTS
Isolated and "rejected" fragments of tissue can be constantly seen on the histological specimens of the glandular



A – contain the "isolated" fragment; B – the fragment is included into the epithelial crease; C – a fragment of the plastic 3D ("isolated" area of the epithelial lining is marked by the arrow).

Fig. 1. The segment of peripheral area of the human prostate. Hematoxylin and eosin stain. Magnification × 400:

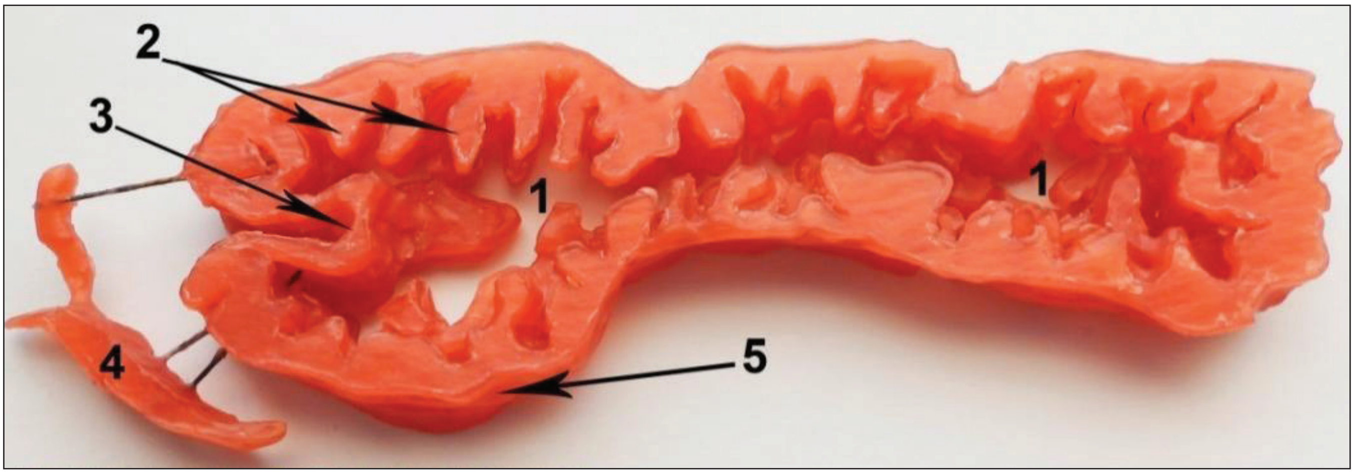


1 – "loose-lying" fragment, containing capillary vessels (marked by arrows).

Fig. 2. The acinus of the peripheral area of the prostate. Hematoxylin and eosin stain. Magnification × 400:

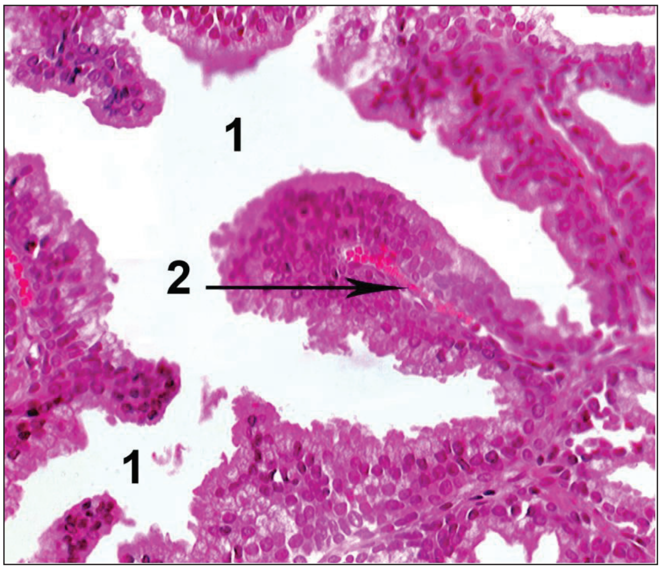
peripheral area of the human prostate in the luminal contour of the tubuloalveolar aggregations. The sequential (line-by-line) analysis of the series of histological specimens and the specimen-based three-dimensional plastic reconstructions allow us to assert that in some cases these are fragments of the glandular epithelium creases of larger or smaller size (Figure 1 A). In other cases such fragments contain, apart from the epithelial lining, the stromal-muscle component and microvessels (Figure 2, 4). Such individual histological section can deceive and lead the researcher to wrong conclusions. Therefore, before any conclusions are to be drawn, it is necessary to try to imagine what is actually above or below the plane of the section. Commonly, our serial specimens and plastic 3D reconstructions clearly show that such loose-lying fragments of tissues are the integral parts of the intraluminal creases of the glandular epithelium or invaginations of all layers of the wall of the tubular structures. Epithelial creases can be solitary or, more commonly, wavy (Figure 1 B). In such cases, the internal surface of the acini and excretory ducts from the side of the luminal contour are pectiniform (Figure 1 C, Figure 3). Intraluminal creases and invaginations of the glandular epithelium can have different parameters and overlap the lumen of the ducts and alveoli up to two thirds of their width. Generally, they almost symmetrically move toward each other from opposite directions, turning the lumen into a fissured spiral space. Three-dimensional plastic reconstructions show that intraluminal invaginations and high epithelial creases are localized in the lumen in different planes, and that's why they can be seen as isolated from their base on the individual sections. Notably, in normal condition no rugosity of the epithelial lining can occur in the lumen of the tubuloalveolar aggregations on a certain length. In the acini and coherent excretory ductules, abrupt narrowings and ampoule-shaped enlargements of the luminal contour are constantly found. The presence of epithelial creases, invaginations of all elements of the wall, the ampoule-shaped enlargements and its abrupt narrowings contribute to the fact that the luminal contour of the tubuloalveolar aggregations takes the form of the most intricate labyrinth, along which the secreta must move and excrete.

Within the peripheral area, the entire glandular ductal-acinar system, with the exception of the distal seg-



1 – luminal contour; 2 – epithelial creases; 3 – invagination of the wall; 4 – venous microvessels; 5 – outer contour.

Fig. 3. Plastic reconstruction of the excretory ductules of the peripheral area of the prostate. Linear magnification × 400:



1 – lumen of the acinus; 2 – capillary with red blood cells.

Fig. 4. Intraluminal invagination (crest) of the human prostate, containing capillary loop. Hematoxylin and eosin stain. Magnification × 400:

ment of the main excretory ducts near urethra, is layered with the columnar secretory cells which are identical both in the ducts and acini. Notably, this fact is confirmed by the results of the immunohistochemical study of the prostatic specific antigen and the prostatic acid phosphatase. Evidently, there should be no morphological or biological differences between the ductal carcinomas and acinar carcinomas. Apparently, the anomalies of the structural organization of the glands from this area, as well as the other ones, are subjectively defined by the pathologists due to its deviations from the so-called "normal" dimensions and forms of their constituent epithelial secretory components [6].

DISCUSSION

Stereomorphologically, previous study of the microstructure, particularly, the human salivary glands, we have not encountered with any particular difficulty in analyzing, description and spatial reconstruction of their tubular glandular structures, since they are mostly represented by the regular-shaped tubes, gradually changing their outer diameter and the lumen as they approach the common excretory duct. Such system of excretory ducts clearly distinguishes their specific gradations corresponding to the lobe, lobule, sublobule unit and acinus. The outer contour and cavity of their acini were usually regular-shaped and orbicular. At the same time, the acini were quite clearly visualized from the system of the excretory ducts due to the presence of the intercalated segments. These elements could be successfully visualized even when, within the glandular lobule, they had very dense spatial "packing" of their acinar and intercalated segments [7, 8, 9].

On the contrary, the tubuloalveolar components of the human prostate, due to the absence of the intercalated ducts, more resemble "jigsaw puzzles" with the highest degree of adherence to each other, where the connective tissue interlayers are very thin, and, usually, without nonstriated elements. The human prostate is assigned to "compound" glands by some authors, considering the great density of the glandular and non-glandular elements' composition in different areas [10]. In the luminal contour of the tubuloalveolar aggregations of the prostate gland occurrence of the epithelial creases and invaginations of the wall have been noted, which can "overlap" its lumen up to 2/3 of its width. Creases can be both solitary and multiple, symmetrical, and asymmetric. Invaginations contain stromal muscle component with capillary vessels. The detected alternation of enlargements and narrowings of the luminal contour throughout the tubuloalveolar aggregations is likely to affect the laminar flow of the prostatic secreta.

CONCLUSION

1. In the luminal contour of the ductal-alveolar aggregations the epithelial creases can be solitary, multiple or wavy. They can be localized both symmetrically and asymmetrically and vary in height and thickness.
2. Intraluminal invaginations are also found in the in the luminal contour of the ductal-alveolar aggregations which along with the epithelial crease, contain a stromal muscle component with localized blood loop-shaped microvessel.
3. The creases of the glandular epithelium and intraluminal invaginations can "overlap" the lumens of the tubuloalveolar aggregations up to 2/3 of its width, making the inner lumen sinuous, affecting the laminar flow of the liquid.
4. A regular phenomenon for ductal-alveolar aggregations is the occurrence of the alternating considerable enlargements and narrowings of the inner diameter, which may have some impact on the deposit of the secreta and its movement.

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