

Innovative Methods of Diagnostics of Focal Diseases of the Prostate Gland

*MAMADALIEVA Yashnar Mamasalievna*¹

DSc, professor

*KHUSHNAZAROV Khasan Khalikovich*²

PhD

*SHAMANSUROVA Nargiza Khayotovna*¹

PhD

*Center for the Development of Professional Qualifications of Medical Workers*¹

*Clinic "MedFayTem"*²

Annotation: Early and timely detection of prostate cancer (PC) remains one of the pressing problems of modern medicine. Today, minimally invasive and affordable diagnostic methods aimed at targeted visualization of the tumor process continue to be developed. One of these methods is compression elastography - a method of ultrasound diagnostics (US) aimed at obtaining a qualitative assessment of the color map of changes in the elastic properties of tissues. Research continues around the world aimed at using compression elastography in the early diagnosis of PC.

The aim of this study was to improve early and differential diagnostics of focal lesions of the prostate gland by using modern compression elastography technology.

Materials and methods of the study. The article presents the results of transrectal ultrasound (TRUS) of 146 patients with various focal lesions of the prostate gland. The age of the patients in this study ranged from 52 to 86 years.

TRUS was performed on expert-class ultrasound machines "Mindray DS-70", "Mindray DS-80", "Logiq S 8 XD CLEAR". The study included a comprehensive ultrasound examination with simultaneous use of gray scale mode, Doppler ultrasonography and compression elastography in real time.

All patients were divided into 3 groups. The first group consisted of 47 patients with benign diseases of the prostate gland (PG), the second group consisted of 70 patients with suspected prostate cancer, the third group consisted of 29 patients with histologically verified prostate cancer.

Based on the conducted TRUS of patients, specific ultrasound diagnostic criteria were identified, obtained in gray-scale mode, color Doppler mapping mode and compression elastography, the use of which will allow detecting prostate cancer in the early stages of the disease.

Keywords: prostate cancer, compression stent elastography, dopplerography, early diagnostics, transrectal ultrasound.

Introduction. One of the most important modern medical and social problems is prostate diseases. Prostate cancer (PC) is one of the most common malignant neoplasms in men and occupies a leading place among oncological diseases in developed countries and the second place after lung cancer among causes of death. Mortality in the first year of life after diagnosis is about 25-30%, which indicates an extremely low detection of the disease in its early stages [1]. Currently, according to various authors, from 10 to 19% of PC are "non-visualized" forms, i.e. are not visible during transrectal scanning [2]. The problem of PC has acquired particular relevance today due to the steady increase in morbidity and mortality, as well as in connection with the difficulties of timely diagnosis. New opportunities in ultrasound diagnostics of PC are opened by ultrasound elastography is a non-invasive technique that

makes it possible to assess the stiffness (elasticity) of soft tissues. Ultrasound studies take leading positions in the comprehensive examination of patients with prostate pathology. The high information content of ultrasound allows using ultrasound imaging to diagnose diseases at preclinical stages of their development. Ultrasound is chosen as the method of choice at different stages of therapeutic interventions, after surgery, radiation therapy, and during dispensary observation for early detection of relapse of the disease.

The aim of the study is to improve early and differential diagnostics of focal lesions of the prostate gland by using modern compression elastography technology.

Materials and methods. The work is based on the data of 146 (100%) patients referred for in-depth ultrasound to clarify the nature of nodular formations in the prostate gland. All patients underwent transrectal ultrasound (TRUS) using the compression elastography technique. The patients were divided into 3 groups. Group 1 consisted of 47 patients with benign diseases of the prostate gland, group 2 included 70 patients with suspected prostate cancer, and group 3 consisted of 29 patients with histologically verified prostate cancer.

Table 1. General characteristics of the study groups

Characteristic	1st group (n=47)	2nd group (n=70)	3rd group (n=29)
Average age, years	47.3	62.1	65.2
PSA level, ng/ml	2.26±3.1	18.6±12.8	24.4±19.1
Prostate volume cm ³	49.4±21.8	86.5±35.7	78.9±34.2

The age of the patients in this study ranged from 52 to 86 years. The ultrasound was performed on modern expert-class ultrasound devices "MINDRAY DS-70" (China), "MINDRAY DS-80" (China), Logiq S 8 XD clear GE Healthcare (USA) with transrectal probe frequency range 4-10 MHz, providing real-time gray-scale imaging, Doppler intratumoral blood flow data, and compression elastography data.

A comprehensive ultrasound examination was performed by 2 highly qualified physicians. TRUS was performed using the standard technique with gray-scale imaging, research, color and power Doppler mapping (CDM, EDM, spectral Dopplerography), and the compression elastography mode was also used with the help of which the rigidity of focal formations of the prostate gland was assessed.

To interpret the elastographic study, we used the following scale for typing the obtained cartograms: Type 1 – homogeneous mapping in green, Type 2 – a combination of green and red color fragments, Type 3 – heterogeneous coloring in green and blue, Type 4 – homogeneous mapping in shades of blue.

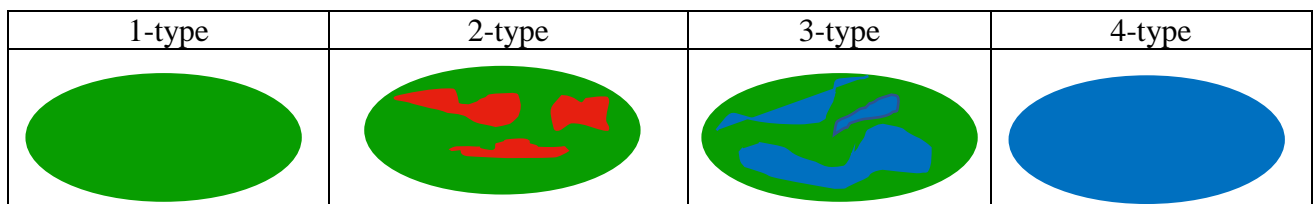


Fig.1. Elastographic cartogram typing scale

As a reference research method, MRI was performed on 89 patients using high-resolution equipment with a power of 1.5 T.

Results of the study and their discussion. Of the results obtained in the grayscale mode, 137 (94.1%) of 146 patients had changes in the size of the prostate gland. Unevenness and blurring of the contours were observed in 112 (76.7%) patients, uneven distribution of echogenicity - in 132 (90.4%) patients. An increase in the volume of the prostate gland was detected in 143 (98.2%). Additional inclusions, such as fibrosis and calcifications were visualized in 65 (44.5%).

Characteristic	1st group (n=47)	2nd group (n=70)	3rd group (n=29)
Increase in prostate volume, cm ³	54 + 21.6	47 + 15.1	49 + 18.2
Unevenness and lack of clarity of the contours of the pancreas	32 (68%)	56 (80%)	24 (82.7%)
Uneven distribution of echogenicity	43 (91.4%)	62 (88.5%)	27(93.1%)
Additional inclusions	21 (44.6%)	29 (41.4%)	15 (51.7%)

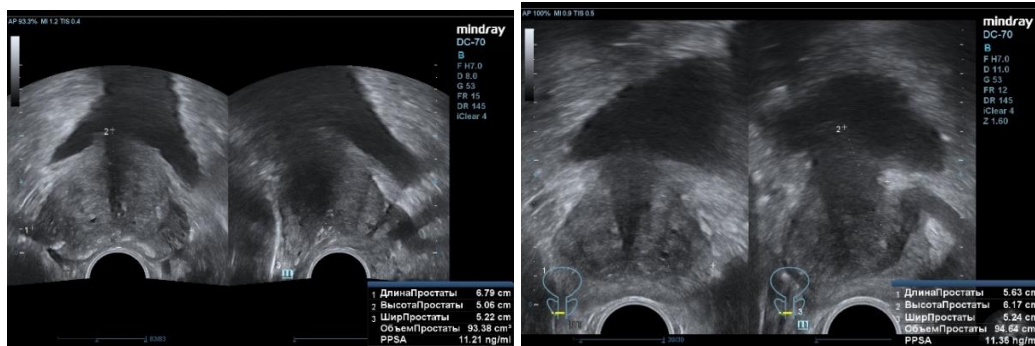


Fig. 2. BPH. With TRUS in grayscale mode

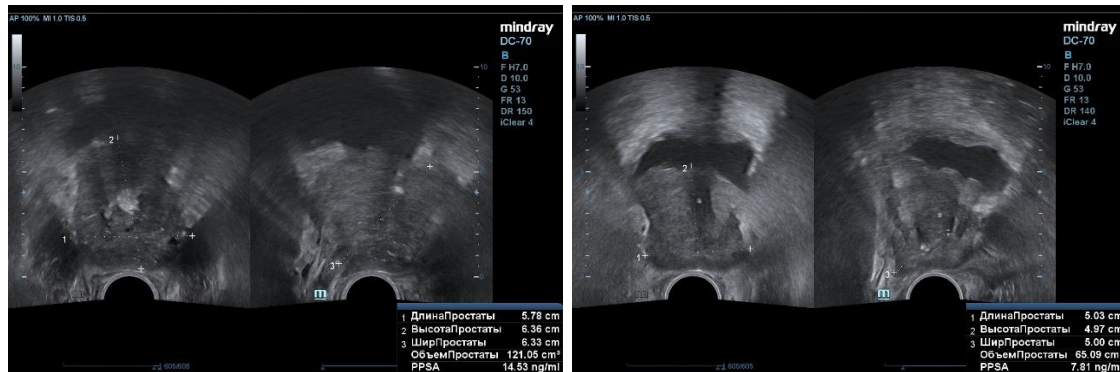


Fig. 3. PCa. With TRUS in grayscale modes

According to color Doppler mapping, hypervascularization of the focal formation was observed in 82 (56.1%) patients, of which it was recorded in 17 patients (36.1%) in the first group, in 44 (62.8%) patients in the second group, and in 21 (72.4%) patients in the third group.

According to compression elastography in BPH (n = 47), types 1 and 2 elastograms were obtained significantly more often – 41 (87.2%). In patients of the second group, as a result of compression elastography, types 1 and 2 were detected in 27 (45.7%) patients, type 3 in 25 (35.7%), and type 4 staining in 18 (25.7%). In patients with histologically In patients with verified prostate cancer (n = 29), types 3 – 11 (37.9%) and 4 – 18 (62.0%) elastograms corresponding to increased prostate tissue density were obtained significantly more often (p < 0.05).



Fig. 4. PCa. With TRUS in energy Doppler modes

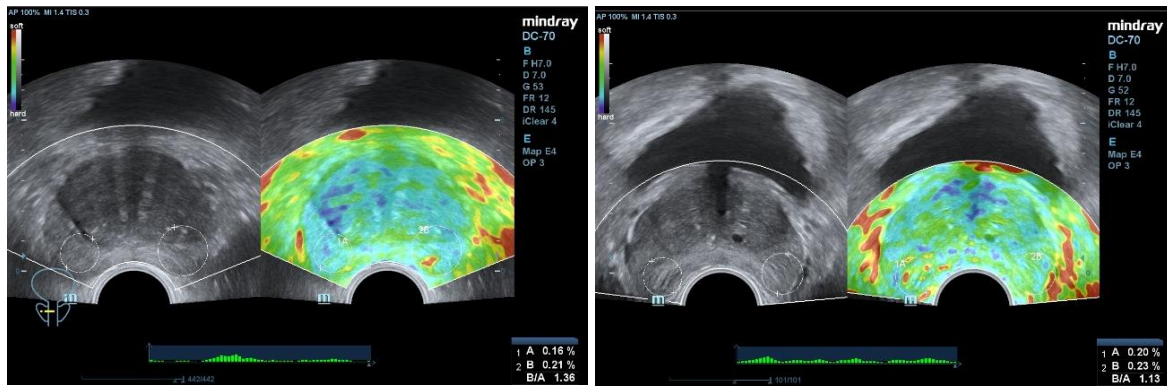


Fig. 5. BPH. With TRUS in compression elastography modes

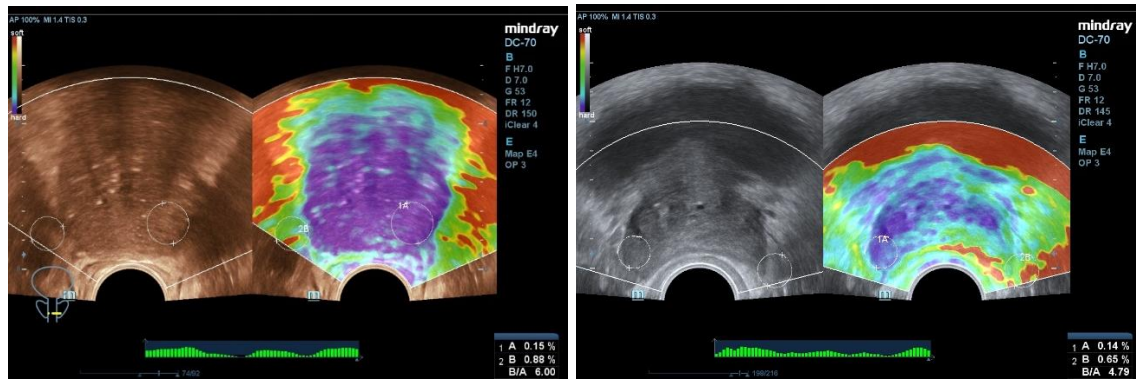


Fig.6. RP. With TRUS in compression elastography modes

Based on the results of the comprehensive ultrasound examination, a number of specific signs were identified that reliably and accurately characterize the malignant nature of the process under study: asymmetry of the thickness of the peripheral zone, asymmetric hyperplasia of the transition zones, areas of accumulation of microcalcifications, deformation of the “surgical capsule” of the prostate, local deformation of the vascular pattern in the gland area, local deformation of the capsule and the “border layer” of the prostate.

When analyzing the obtained data, the signs identified during TRUS and the reference study were compared, as a result of which the sensitivity of the method was 93.1%, specificity - 87.2%, and the accuracy of the method - 90.6%.

Conclusions. Thus, the TRUS technique using innovative modern compression elastography technology allows to detect areas with a high stiffness coefficient, conduct differential diagnostics of prostate cancer, select patients for targeted multifocal puncture biopsy. Compression elastography enables qualitative and quantitative assessment of stiffness in PCa foci ($B / A > 4$ y . e .). Indirect signs of prostate cancer have been identified and systematized, of which the most frequent companions of early prostate cancer are: asymmetry of the thickness of the peripheral zone, asymmetric hyperplasia of the transition zones, areas of accumulation of microcalcifications, deformation of the "surgical capsule" of the prostate, local deformation of the vascular pattern in the power Doppler mapping mode in the projection of hypo and even isoechoic foci in the gland, local deformation of the capsule and the "border layer". Modern complex TRUS including B-mode, EDC, CDC, Doppler and compression elastography is a highly informative diagnostic method in the early detection of prostate cancer. Elastography is a modern method that can significantly improve the results of ultrasound diagnostics of malignant degeneration of nodular formations of the prostate gland.

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