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**PROSTAT XƏRÇƏNGİNİN ULTRASƏS DİAQNOSTİKASININ
ƏSAS LOKALİZASIYADAN ASILI OLAN XÜSUSİYYƏTLƏRİ****R.Y.Abdullayev¹, İ.V.Krijanovskaya¹, M.C.Sultan², O.A.Nakoneçnaya¹,
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Xülasə. Məqalədə prostat vəzi xərçənginin diferensial diaqnostikasında ultrasəs müayinəsi metodunun tətbiq edilməsinin effektivliyini araşdırmaq məqsədilə aparılan tədqiqat işi haqqında məlumat verilmişdir. Prostat vəzi xərçəngi (PX) olan 49 kişidə və xoşxassəli prostat vəzi hiperplaziyası (XPH) olan 67 kişidə transrektal ultrasəs müayinəsinin nəticələrinin retrospektiv təhlili aparılmışdır. Vəzinin periferik zonasında xərçəng şiši hallarının 83,7%-də və XPH hallarının 67,2%-də hipoxogen sahələr aşkar edilmişdir ($p < 0,05$). Bundan əlavə, PX-nin diaqnozunda bu simptomun həssaslığı 81,3%, spesifikliyi 55,6% və dəqiqliyi 75,6% olmuşdur. PX-nin hallarının 59,2%-də mikrokalsifikasiya, 69,4%-də isə hipervaskulyarizasiya aşkar edilmişdir. Vəzidə olan mikrokalsifikasiya sayəsində müşahidə edilən lokal hipoxogen sahə simptomunun həssaslığı müvafiq olaraq 84,0%, spesifikliyi 70,8% və dəqiqliyi 77,6% təşkil etmişdir. Hipervaskulyarizasiyalı lokal hipoxogen sahə simptomu üçün eyni göstəricilər müvafiq olaraq 85,3%, 73,3% və 81,6% təşkil etmişdir.

Prostat xərçəngi olan xəstələrdə vaskulyarizasiyası olan hipoxogen sahədə sıxlığın elastografik təyininin həssaslığı, spesifikliyi və dəqiqliyi müvafiq olaraq 93,1%, 100,0% və 93,5% təşkil etmişdir.

Açar sözlər: transrektal ultrasəs müayinəsi, prostat xərçəngi, prostat vəzində hipoxogen sahə, elastografiya

Ключевые слова: трансректальная ультрасонография, рак предстательной железы, гипохогенный участок в предстательной железе, эластография

Keywords: transrectal ultrasonography, prostate cancer, hypoechoic area in the prostate gland, elastography

**FEATURES OF SONOGRAPHIC DIAGNOSIS OF PROSTATE CANCER DEPENDING
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The article provides information on the research conducted to investigate the effectiveness of ultrasound examination methods in the differential diagnosis of prostate cancer. A retrospective analysis of transrectal ultrasound results was conducted in 49 men with prostate cancer (PCa) and 67 men with benign prostatic hyperplasia (BPH). Hypoechoic areas were detected in the peripheral zone of the prostate in 83.7% of PCa cases and in 67.2% of BPH cases ($p < 0.05$). Additionally, the sensitivity of this finding in the diagnosis of PCa was 81.3%, specificity was 55.6%, and accuracy was 75.6%. Microcalcifications were observed in 59.2% of PCa cases, while hypervascularization was found in 69.4%. In the diagnosis of PCa, the presence

of microcalcification with a localized hypoechoic area had a sensitivity of 84.0%, specificity of 70.8%, and accuracy of 77.6%. For the same localized hypoechoic area with vascularity, the respective values were 85.3%, 73.3%, and 81.6%. The sensitivity, specificity, and accuracy of elastographic assessment of stiffness in the vascularized hypoechoic area of PC were 93.1%, 100.0%, and 93.5%, respectively.

Prostate cancer (PC) is the most common diagnosis in men, and its incidence is expected to rise as the population ages [1]. Transrectal ultrasound is commonly used for imaging prostatic pathology. It is especially effective in diagnosing benign prostatic hyperplasia (BPH), prostate cancer, possible prostatic abscesses, and prostatitis, as well as providing visual guidance for prostate biopsies. BPH is extremely prevalent, with 80% of men being affected by age 70. Imaging is not required for diagnosis, which is typically based on clinical signs, symptom score, post-void residual urine volume, digital rectal examination (DRE) results, pressure/flow studies, and/or cystoscopy. However, changes in the prostate are easily recognized on TRUS, and it may be recommended for anatomical evaluation and volume measurements to help with surgical decision-making and determination of PSA density for cancer screening if any surgical intervention is planned. Transrectal prostate ultrasound is a leading diagnostic method for prostatic disorders, such as prostate cancer, prostatitis, prostatic abscess, and benign prostatic hyperplasia. Besides traditional grayscale imaging, multiple additional technologies, such as shear wave elastography, color Doppler imaging, and contrast enhancement, may aid the diagnosis [2-4].

The widespread worldwide routine monitoring of prostate-specific antigen (PSA) has greatly increased the overall diagnosis rate of prostate cancer. However, these are mostly low-grade neoplasms frequently treated with active surveillance. Transrectal ultrasound is the primary guide for prostate biopsies. About 1 million prostate biopsies are performed in the United States and 3 million worldwide every year, making it one of the most commonly performed urological procedures for men [5].

The prostatic base is adjacent to the bladder neck, and its apex is located at the urogenital diaphragm. The seminal vesicles with the ampulla of the vas deferens at the posterior aspect of the prostate to form the paired ejaculatory ducts, which traverse the gland posteriorly and empty into the prostatic urethra at the verumontanum. These ejaculatory ducts

are typically <2.4 mm in diameter unless pathologically dilated. The prostate is classified into anatomic zones — the peripheral, central, transitional, and periurethral zones, in addition to the anterior fibromuscular stroma, which contains non-glandular tissue [6]. The peripheral zone accounts for 70% of the prostate's mass and is where most prostate cancers arise. Prostate cancer is typically multifocal, whereas most other malignancies tend to be unifocal unless they have metastasized [7].

Transrectal ultrasound-guided prostate biopsies are frequently used in patients suspected of having prostate cancer, especially those with hard nodules detected during digital rectal examination (DRE) or persistently elevated prostate-specific antigen (PSA) levels. All patient with unexplained, persistently elevated PSA levels; a hard, suspicious nodule on DRE; or hypoechoic areas on transrectal prostatic ultrasound, especially in the peripheral zone, should undergo a prostatic biopsy [8, 9].

Objective: to evaluate the diagnostic significance of the most significant sonographic signs of prostate cancer.

Materials and methods. A retrospective analysis of transrectal ultrasonography results was conducted in 116 men with suspected prostate cancer. Based on a comprehensive digital rectal examination, prostate-specific antigen (PSA) results, and ultrasound-guided prostate biopsy, 49 men were diagnosed with prostate cancer, and 67 men were diagnosed with benign prostatic hyperplasia (BPH). Patients ranged in age from 51 to 78 years.

Transrectal ultrasound was performed using grayscale, color Doppler, and elastography modes. The diagnostic value of the most widely used ultrasound features of malignancy in identified localized prostate lesions was assessed.

To assess differences between quantitative indicators in the compared groups, the Student's t-test and the χ^2 test were used. Differences were considered statistically significant at $p < 0.05$.

Results. We studied the frequency of recording the most significant ultrasound signs in prostate cancer and benign prostatic hyperplasia (**Table 1**). A localized hypoechoic area in the peripheral zone of the prostate was recorded in 41 patients ($83.7 \pm 5.3\%$) with cancer and in

Table 1. Frequency of registration of ultrasound symptoms in a prostate cancer and benign hyperplasia

Ultrasound symptoms	Prostatic cancer	Benign prostatic hyperplasia
	n = 49	n = 67
Local hypoechoic area in the peripheral zone	41 (83.7±5.3%) p<0.05	45 (67.2±5.7%)
Local hypoechoic area in the peripheral zone with the presence of a vessel	34 (69.4±6.6%) p<0.001	12 (17.9±4.7%)
Local hypoechoic area in the central or transition zone	13 (26.5±6.3%) p<0.001	38 (56.7±6.1%)
Local hypoechoic area in the peripheral zone with the presence of microcalcifications	29 (59.2±7.0%) p<0.001	9 (13.4±4.2%)
Elastography of a local hypoechoic area in the peripheral zone with the presence of a vessel	31 (63.3±6.9%) p<0.001	9 (13.4±4.2%)

45 patients (67.2±5.7%) with benign hyperplasia (p<0.05), respectively. A local hypoechoic area in the peripheral zone with the presence of a vessel was recorded in 34 (69.4±6.6%) and 12 (17.9±4.7%) patients (p<0.001), a local hypoechoic area in the central or transitional zone – in 13 (26.5±6.3%) and 38 (56.7±6.1%) patients (p<0.001), a local hypoechoic area with the presence of microcalcifications - in 29 (59.2±7.0%) and 9 (13.4±4.2%) patients (p<0.001), an increase in the density of a local hypoechoic area with the presence of a vessel according to elastography data – in 31 (63.3±6.9%) and 9 (13.4±4.2%) patients (p<0.001), respectively.

Table 2 presents the diagnostic parameters – sensitivity, specificity and accuracy of ultrasound symptoms in the diagnosis of prostate cancer. As can be seen from the table, the sensitivity of the ultrasound symptom of a local hypoechoic area was 81.3%, specificity – 55.6%, accuracy – 75.6%, respectively. These parameters for the ultrasound symptom of a local hypoechoic area with the presence of microcalcifications were 84.0%, specificity – 70.8%, accuracy – 77.6%, and for the symptom of a local hypoechoic area with the presence of a vessel – 85.3%, 73.3% and 81.6%, respectively.

Table 2. Diagnostic parameters of a local hypoechoic area

Statistical parameters	Prostatic cancer (n=49)		
	Local hypoechoic area in the peripheral zone (n = 41)	Local hypoechoic area in the peripheral zone with the presence of microcalcifications (n = 29)	Local hypoechoic area in the peripheral zone with the presence of a vessel (n = 34)
TP	26	21	29
FN	6	4	5
TN	5	17	11
FP	4	7	4
Sensitivity	81.3%	84.0%	85.3%
Specificity	55.6%	70.8%	73.3%
Accuracy	75.6%	77.6%	81.6%

Note: TP – true positive, FN – false negative, TN – true negative, FP – false positive

We determined the statistical indicators of elastographic determination of tissue density in a hypoechoic area with a vessel in the diagnosis of prostate cancer. The sensitivity, specificity, and accuracy of this ultrasound symptom were 93.1%, 100.0%, and 93.5%, respectively (**Table 3**).

In prostate cancer diagnostics, special attention was paid to visualizing hypoechoic areas. Of particular importance was their localization in the peripheral zone of the prostate, the detection of colored vascular signals using color Doppler, and the presence of a dense component within hypoechoic areas using elastography. Areas colored blue were considered dense (**Fig. 1-4**).

Table 3. Diagnostic parameters of a elastography of local hypoechoic area

Statistical parameters	Prostatic cancer was diagnosed by the elastography of a local hypoechoic area in the peripheral zone with the presence of a vessel
TP	27
FN	2
TN	2
FP	0
Sensitivity	93.1%
Specificity	100.0%
Accuracy	93.5%

Note: TP – true positive, FN – false negative, TN – true negative, FP – false positive



Fig. 1. Prostate cancer. The arrow indicates a hypoechoic area in the peripheral zone

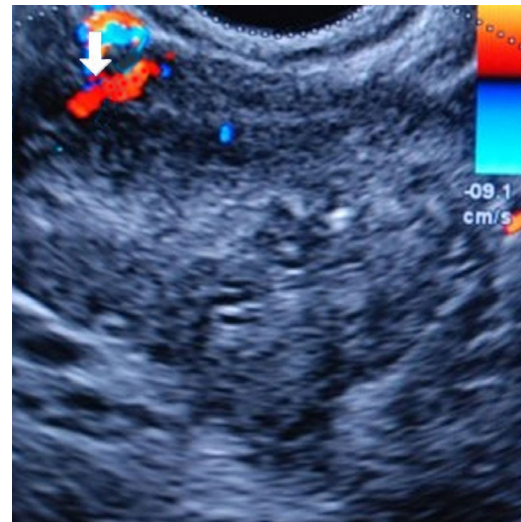


Fig. 2. Prostate cancer. The arrow indicates a hypoechoic area in the peripheral zone with a vessel in color Doppler mode



Fig. 3. Prostate cancer. The arrow indicates a hypoechoic area in the peripheral zone with microcalcifications.

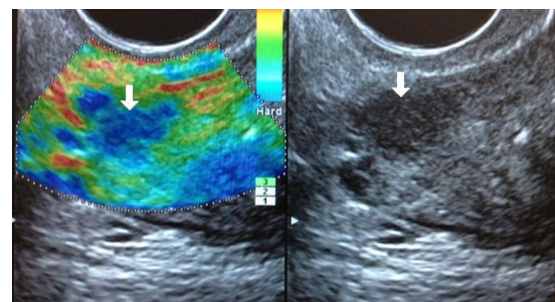


Fig. 4. Prostate cancer. The right arrow shows a hypoechoic area in the peripheral zone. The left arrow shows dense areas in elastography mode.

Discussion

The incidence of prostate cancer is steadily increasing, possibly due to stressful lifestyles, increased public awareness, and the inappropriate use of serum prostate-specific antigen testing during routine physical examinations in middle-aged and older men [10].

Prostate ultrasound should be performed in patients complaining of dysuric symptoms and includes measurement of bladder capacity and assessment of residual urine after voiding. Indications for endosonographic examination of the prostate include pathological changes detected during rectal examination, elevated serum prostate-specific antigen levels, prostate cancer and inflammation with suspected abscess, the need for surgical intervention for benign prostatic hyperplasia, and the diagnosis of ejaculatory disorders. A standard procedure performed for prostate cancer to obtain samples for histopathological examination is a biopsy performed using transrectal ultrasound [6].

We must highlight that not all hypoechoic lesions on TRUS imaging suggest the presence of malignancy, contrariwise, not all cancerous lesions appear hypoechoic. It is known that approximately 60 to 70% of PCa lesions appear hypoechoic on TRUS; the rest may be isoechoic (30-40%) 16 or rarely hyperechoic (<2%). In transrectal ultrasound, hypoechoic areas in the peripheral zone are most suspicious for prostate cancer. Ultrasound-guided biopsy of a hypoechoic area

detects prostate cancer twice as often as biopsy of other areas [11, 12].

The study analyzed not only the value of sonographic detection of a hypoechoic area in the peripheral prostate gland for cancer diagnosis, but also the presence of vascular pedicles using color Doppler, as well as microcalcifications and dense areas using elastography. According to our data, a localized hypoechoic area with a vessel in the peripheral prostate gland was detected in 69.4% of cases, with microcalcifications in 59.2% of cases, and dense areas using elastography in 87.8% of cases, respectively. We also examined the sensitivity, specificity, and accuracy of these ultrasound symptoms, among which the highest diagnostic value was demonstrated by detection of dense components within hypoechoic areas with the presence of vessels – 95.3%, 83.3%, and 93.9%, respectively.

Conclusions:

Detection of a hypoechoic area in the peripheral zone with the presence of vessels and dense components in the elastographic mode during transrectal ultrasound can improve the diagnostic efficiency of prostate cancer.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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ОСОБЕННОСТИ СОНОГРАФИЧЕСКОЙ ДИАГНОСТИКИ РАКА ПРЕДСТАТЕЛЬНОЙ ЖЕЛЕЗЫ В ЗАВИСИМОСТИ ОТ ОСНОВНОЙ ЛОКАЛИЗАЦИИ

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Резюме. В статье изложены результаты исследования, проведенного с целью определить эффективность применения ультразвукового обследования в дифференциальной диагностике рака предстательной железы. Проведен ретроспективный анализ результатов трансректального УЗИ у 49 мужчин раком и у 67 – доброкачественной гиперплазией простаты (ДГП). Установлено, что гипоехогенный участок в периферической зоне железы при раке простаты (РП) выявлен в 83,7%, а при ДГП – в 67,2% случаев ($p < 0,05$). При этом чувствительность этого симптома в диагностике РП составила 81,3%, специфичность 55,6%, точность 75,6%. Наличие микрокальцификатов внутри гипоехогенного участка выявлено в 59,2% случаев, участков васкуляризации – в 69,4% случаев, соответственно. Чувствительность симптома локального гипоехогенного участка с наличием микрокальцинатов в диагностике РП составила 84,0, специфичность 70,8%, точность 77,6%, соответственно. Эти же показатели для симптома локального гипоехогенного участка с наличием сосуда составили 85,3%, 73,3% и 81,6%, соответственно.

Чувствительность, специфичность и точность эластографического определения плотности внутри гипоехогенного участка с наличием сосуда составили 93,1%, 100,0% и 93,5%, соответственно.

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