Evaluation of sonoelastography in differential diagnostics of endometrial hyperplastic processes

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ABSTRACT
The article presents a description of complex ultrasound diagnostics of endometrial pathology using qualitative and quantitative echography. The parameters of changes in subendometrial and intraendometrial hemodynamics were identified and the average values of rigidity were calculated endometrium in benign and malignant endometrial pathology. The obtained results indicate the high efficiency of the method of qualitative and quantitative assessment of endometrial rigidity in identifying the characteristic features of malignant transformation, which plays an important role in clarifying diagnostics and choosing treatment tactics.

Introduction. Pathology of the endometrium, including hyperplastic processes, occupies one of the leading places in the structure of reproductive function disorders along with inflammatory diseases of the pelvic organs, contributing to infertility in 80% of cases and irregular menstrual cycle in 40–43%. Publications of recent years indicate an increase in the frequency of endometrial hyperplastic processes (HP), accompanied by an increase in the proportion of surgical interventions, emphasizing the social aspect of the problem [1][2][3]. The literature emphasizes the comorbidity of endometrial hyperplastic processes and their combination with uterine leiomyoma, adenomyosis, ovarian tumors, pathology of the mammary glands, which are often preceded by inflammatory diseases of the pelvic organs [5]. Comorbidity of gynecological nosologies contributes to the resistance of conservative treatment, a high frequency of relapses and the initiation of malignant neoplasm mechanisms, especially with a long course of the disease. [11-13] [7] . Low efficiency of treatment and preventive measures is due to the lack of etiological focus due to insufficient understanding of the leading mechanisms of proliferative processes [4].

In the last few years, a new direction of ultrasound diagnostics has been intensively developing – ultrasound elastography. Elastography is an innovative method of ultrasound diagnostics, the principle of which is based on computer measurement of tissue elasticity, in which minimal differences in tissue rigidity are mapped using computer processing of the ultrasound signal. There are two types of the technique – compression elastography and shear wave elastography. This technology is based on the principle of recording shear waves and determining the speed of their propagation in body tissues, which allows for a qualitative and quantitative assessment of their rigidity[6] [8].

It has been reliably determined that the shear wave elastography technique is characterized by good reproducibility and does not require additional time for the study. In the works of other authors devoted to shear wave elastography of gynecological organs, it is indicated that this technique can become a valuable diagnostic tool for objective quantitative indicators of the rigidity of the anatomical structures of the uterus [9] [14-15].

The aim of this study is to optimize the diagnostic algorithm in patients with endometrial hyperplasia and to determine the qualitative and quantitative indicators of compression elastography and shear wave elastometry in patients with diffuse endometrial pathology[10].

Materials and methods.A comprehensive examination of 107 women aged 45 to 70 years was conducted. The average age was 58 years. The study was conducted at the clinical site of the Department of Ultrasound Diagnostics No. 2 of the Center for the Development of Professional Qualifications of Medical Workers . The comprehensive ultrasound examination was performed on the MINDRAY device .RESONAI 9 with built-in elastography program using a transvaginal sensor with a frequency of 5-7 MHz.

Based on the clinical picture, genital status data and pathomorphological findings, the following study groups were formed: Group 1 (No.1) - 20 (19%) patients with endometrial hyperplasia without atypia; Group 2 (No. 2) - 72 (67%) women with verified endometrial cancer (stage I), 43 of whom had acyclic uterine bleeding. The comparison group included 15 (14%) women from a contingent of relatively healthy patients without gynecological pathology (control group). In the structure of concomitant gynecological diseases: uterine fibroids in 38 (36%) women, ovarian formations in 24 (22%), 60 (56%) patients suffered from obesity.

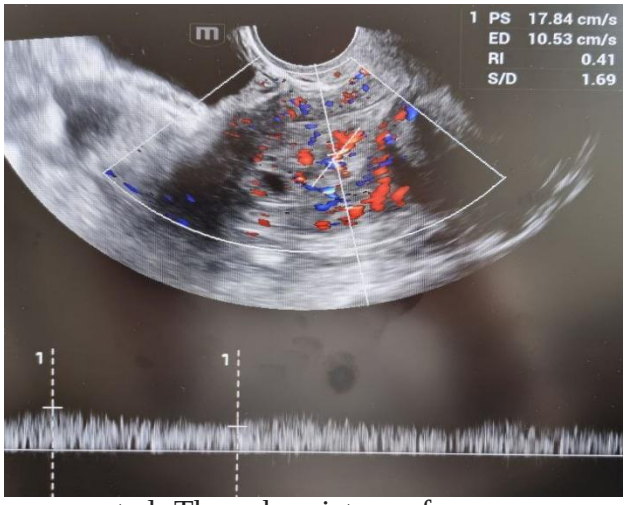
Multiparametric ultrasound examination of the uterus and appendages consisted of several sequentially used modes - two-dimensional grayscale, Doppler, elastographic and elastometric (shear wave) . The study included an assessment of the size of the uterus, structural features of the myometrium, endometrium, structural parameters of the ovaries and qualitative and quantitative indicators of sonoelastography were assessed. To determine the parameters of blood flow in the vessels of the uterus and endometrium and pathological formations, the color Doppler and energy mapping methods were used. To describe the obtained elastograms, the scale of elastographic echocardiograms used in gynecology was used. The results of the complex ultrasound examination with compression sonoelastography were compared with the data of the pathomorphological examination and magnetic resonance imaging. Initially, the thickness, echostructure and echogenicity of the endometrium, its external contours, the thickness of the unchanged uterine wall and the state of the uterine cavity were assessed.

At the second stage, qualitative Dopplerography and quantitative Dopplermetry were performed to assess the velocity of arterial (Vmax) and venous blood flow (VVmax) and the vascular resistance index (RI). Hemodynamics in the subendometrial and intraendometrial zones were also assessed.

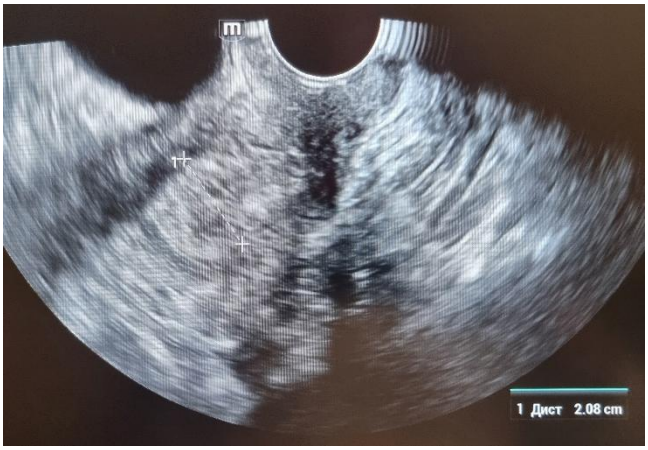
All women then underwent compression elastography. The parameters were determined in real time. During compression elastography, a color map was formed, which was superimposed on the B -mode image. The stiffest and most elastic tissue was marked in blue, and the least stiff tissue was marked in red. Tissues of medium stiffness were displayed in green and yellow tones. When compression elastography is performed in patients with diffuse endometrial change (eg, endometrial cancer), the area of low compression (% blue) increases over time and becomes more complex in shape as the tumor progresses, manifested by invasion of surrounding tissues (myometrium, cervix).

In the elastometric mode, a quantitative assessment of the Young's modulus (rigidity) was performed in different parts of the uterus: in the area of the endometrium, myometrium and cervix. The size of the color window changed depending on the section under study. The diameter of the Q - box during the study of the endometrium corresponded to 2 mm, unchanged myometrium - from 3 to 5 mm, cervix - 2 mm. All measurements were performed in at least

three zones of interest of each section of the organ under study to obtain the following quantitative characteristics of the Young's modulus: average (Emean), maximum (Emax) values and standard deviation (SD). Then their average value was calculated.

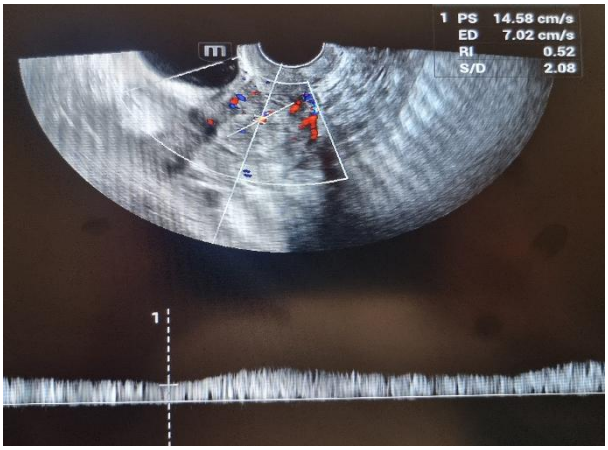


Results. The average endometrial thickness values in women of group 1 were 21 mm, while in patients of group 2 the average endometrial thickness was 27 mm. The echo picture of benign endometrial hyperplasia was characterized by homogeneity of the echostructure, smooth contours, and a non-expanded cavity. In malignant pathology of the endometrium, the contours were uneven, indicating myometrium invasion, and the echostructure was diffusely heterogeneous. In menopausal women with endometrial cancer, expansion of the uterine cavity was noted. The echo picture of qualitative Doppler in patients with benign hyperplasia was characterized by scanty or moderate blood flow (Fig. 1, 2). The blood flow velocity in the basal and spiral arteries was within 12-18 cm/s. Hemodynamics in the radial arteries did not differ significantly from normal values.



a) b)

Fig. 1 (a, b) TVUS: a) gray scale mode b) color Doppler mode. Endometrial hyperplasia. The endometrium is sharply thickened, the echostructure is heterogeneous. Moderate increase in endometrial blood flow is determined



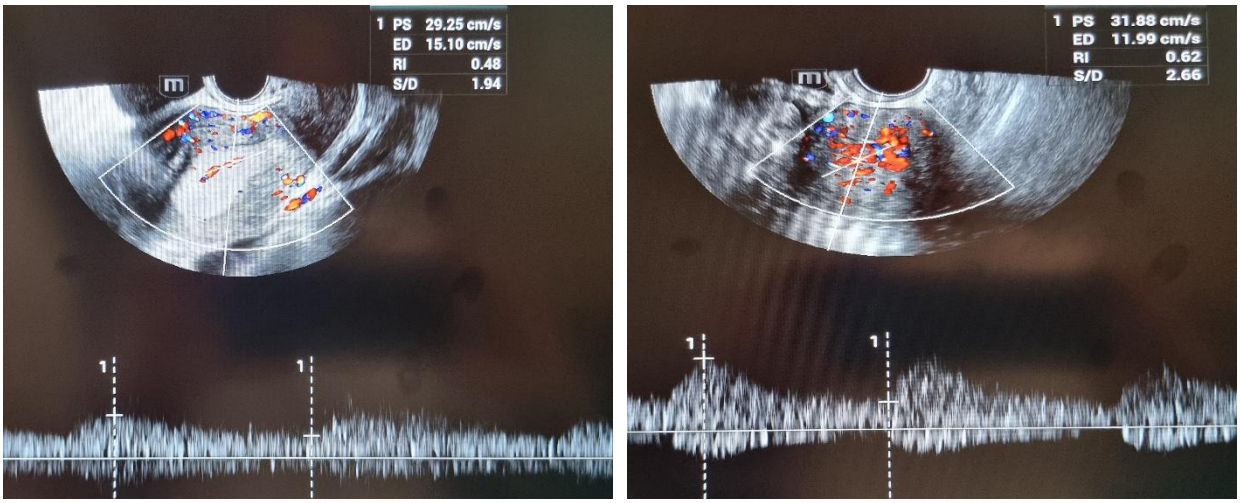
a) b)

Fig. 2 (a, b) TVUS: a) gray scale mode b) color Doppler mode. Endometrial hyperplasia. The endometrium is sharply thickened, the echostructure is heterogeneous due to cystic inclusions. Increased subendometrial and endometrial blood flow is determined

High-speed low-resistance blood flow was detected both at the periphery and in the center of the tumor (Table 1).

Table 1. Doppler characteristics of blood flow in the subendometrial zone in healthy women and in study groups (n= 107)

Research group	Vmax ,(cm/s)	Vmin,(cm/s)	RI
Women with endometrial hyperplasia without atypia, n = 20	12.0-18.3 15.2±0.1	5.0-10.5 7.0±0.2	0.41-0.69 0.55±0.02
Women with endometrial cancer, n = 72	21.8-35.7 28.1±0.2	11.0-18.3 13.5±0.1	0.38-0.62 0.51±0.03
Healthy women, n=15	9.5-10.2 10.0±0.1	4.8-7.3 5.42±0.3	0.56-0.75 0.65±0.05



a) b)

Fig. 3 .(a, b) TVUS a) gray scale mode b) energy mapping. Endometrial cancer stage III. The endometrium is sharply thickened and heterogeneous. Intratumor blood flow and increased endometrial blood flow are determined

The quantitative characteristics of the rigidity of the endometrium and myometrium of the uterine body in healthy women and patients from groups 1 (N.1) and 2 (N2) differed significantly (Table 2).

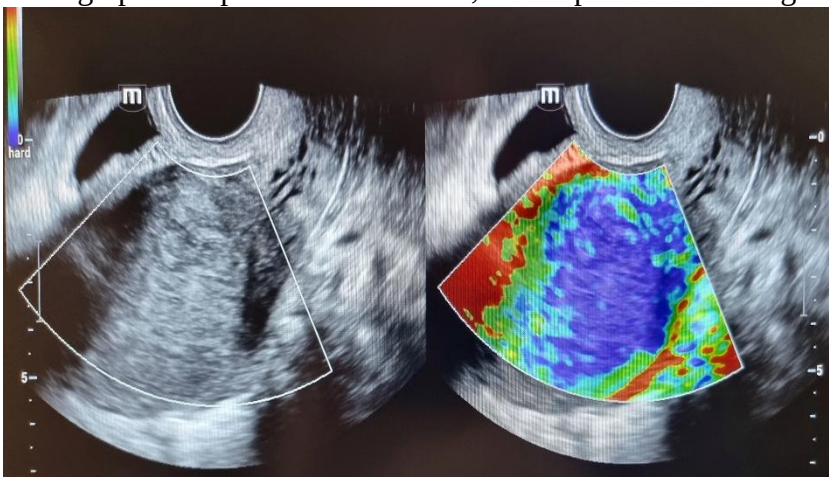
Table 2. Values of Young's modulus of the endometrium in healthy women and in study groups (n= 107)

Research group	Young's modulus, kPa	IQR , kPa *	STD ,kPa **
Women with			

endometrial hyperplasia without atypia, n = 20	6.30-14.6	1.52±0.13	1.20±0.50
Women with endometrial cancer (stageI), n = 72	16.93-18.9	2.41±0.21	0.65±0.32
Healthy women, n=15			

* IQR – interquartile range
** STD – standard deviation

Depending on the presence of various pathological changes, the elastographic maps of the examined patients differed in the prevalence of one or another color range. In patients with endometrial hyperplasia without atypia (n= 20), low-intensity blue-green elastographic maps prevailed. In patients with malignant endometrial lesions (n= 72), unevenly stained elastographic maps were determined, with a prevalence of high-intensity blue color (Fig. 4).



a) b)

Fig. 4 (a, b). a) Compression elastography mode. Elastographic map of malignant endometrial pathology. Shades of blue color range predominate.b) macropreparation

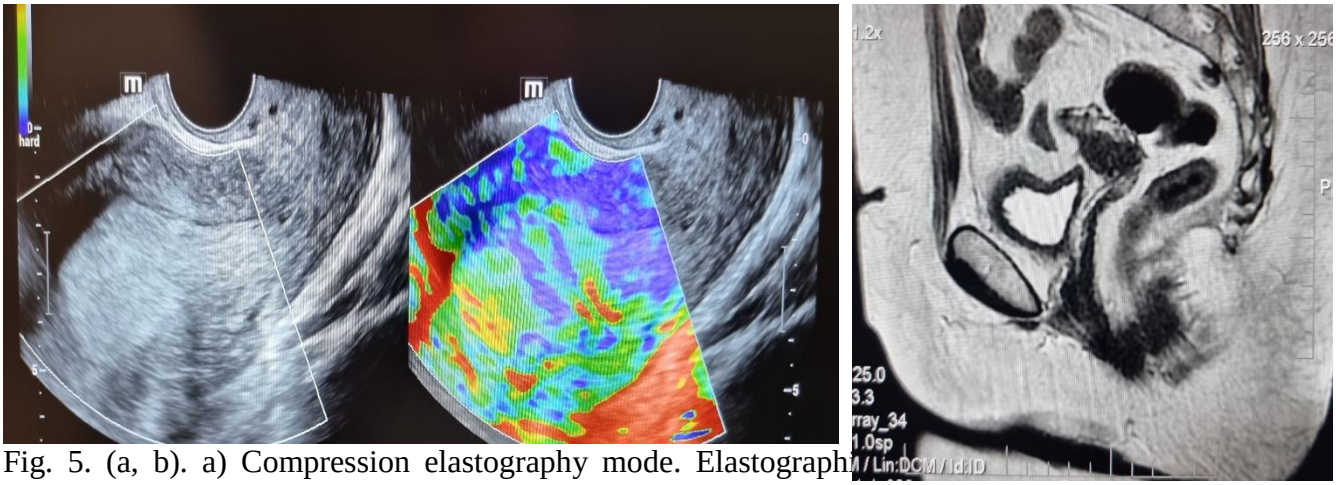


Fig. 5. (a, b). a) Compression elastography mode. Elastographi
hyperplasia. Alternating shades of green and yellow are noted b) MRI study

In healthy women (n= 15), shades of yellow-green were observed .

Conclusions.

The results of the examination showed a reliable difference in the qualitative and quantitative characteristics of endometrial rigidity in patients from groups with benign and malignant endometrial pathology when comparing them with each other and the data of the control group. Elastography as a relatively new diagnostic method in gynecology is a valuable tool for the differential diagnosis of endometrial pathology in women with abnormal uterine bleeding.The results showedthe feasibility of using complex ultrasound as the most accessible, cost-effective method of screening for uterine and endometrial pathology in women of pre- and postmenopausal age.

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