ORIGINAL ARTICLE

Usage of methods polarization-phase mueller-matrix introscopy for early diagnosis of endometriosis based on study of dehydrated films of peritoneal fluid

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ABSTRACT

Aim: To assess the effectiveness of early diagnosis of endometriosis using polarization-phase Muller-matrix introscopy methods of scattering dehydrated films of peritoneal fluid.

Materials and Methods: Two groups of samples were studied: peritoneal fluid obtained during diagnostic laparoscopy – control group 3.1 - 68 samples; peritoneal fluid obtained during diagnostic laparoscopy in women with endometriosis associated with infertility – experimental group 3.2 - 59 samples.

Results: By statistical analysis of a series of thesiograms of the distributions of the optical anisotropy parameters of biological preparations, the following most effective markers for the diagnosis of endometriosis by the method of polarization-phase Muller-matrix introscopy were experimentally established. Dehydrated films of peritoneal fluid:linear birefringence - unsatisfactory (– 74.6% - 80.1%) diagnostic accuracy - groups "3.1" - "3.2"; circular birefringence - excellent (– 97.6% - 98.4%) and good (– 88.1% - 88.9%) diagnostic accuracy - groups "3.1" - "3.2"; linear dichroism - good (– 90.5%) diagnostic accuracy of endometriosis - groups "3.1" - "3.2"; circular dichroism - very good (– 90.5% - 94.5%) diagnostic accuracy - groups "3.1" - "3.2

Conclusions: The conducted cycle of stusies of the diagnostic effectiveness of the new in biomedical practice method polarization-phase Muller-matrix introscopy of the polycrystalline component of biological preparations (peritoneal fluid) revealed a high level of accuracy of early diagnosis of genital endometriosis.

KEY WORDS: endometriosis, assisted reproductive technologies, infertility, polarization-phase Muller-matrix introscopy

INTRODUCTION

While efforts are underway to develop biomarker-based tests and improve non-invasive imaging, the current diagnostic pathway remains a complex interplay of clinical assessment and surgical confirmation, underscoring the urgent need for advancements to reduce diagnostic timelines.

Given the high accuracy of the results obtained with polarimetry in transparent media, a search was started for modifications of the method to obtain high-quality results in tissues and biological fluids with different densities. To increase the contrast and improve the ability to visualize tissues, optical visualization was used using a multiply scattering (depolarizing) component of the light beam, which gave a positive result and the ability to evaluate various biological media [1-3]. The results depend on the polarization state of the incident light beam. Thus, a number of modifications have been developed, including linear or circular polarization, Stokes polarimetry or Muller matrix

polarimetry, detection geometry (transmission versus reflection), spectroscopic methods for studying light, such as point spectroscopy and spectral imaging (using different wavelengths, diffuse reflection, fluorescence, Raman scattering) [1,4,5], interferometric methods, polarization-guided imaging, optical polarization, laser polarimetry. Each method has its own characteristics. When using different techniques, the anisotropy of biological objects is taken into account, since almost all biological tissues have optical anisotropy [2]. Birefringence of biological tissues is mainly due to the linear anisotropy of fibrous structures that form extracellular environments. The refractive index is more important along the fibers than across them. In this case, we have parallel cylinders forming a uniaxial birefringent medium with an optical axis that is parallel to the axis of the cylinders (shape birefringence), and is characteristic of many biotissues, such as the cornea, cartilage, tendons, sclera, dura mater, muscles, nerves, retina, bone, teeth, and other

biotissues with uniaxial and/or biaxial birefringent structures [5].The traditional microscopic description of the morphological structure of biological tissues of human organs was first developed and supplemented in the practice of biomedical research in systematic studies of polarization, phase and laser (fluorescence) microscopy. As a result, a new direction for biomedical and clinical diagnostics was formed - polarization-phase introscopy of the morphological structure of biological preparations of human organ tissues.

The foundations of this diagnostic direction are based on determining the relationships between polarization, Stokes-polarimetric and Muller-matrix microscopic images of the polycrystalline structure of biological preparations of human organ tissues (thesiograms) and various pathological conditions of human organs [1-5].

AIM

To assess the effectiveness of early diagnosis of endometriosis using polarization-phase Muller-matrix introscopy methods of scattering dehydrated films of peritoneal fluid.

MATERIALS AND METHODS

Two groups of samples were studied: peritoneal fluid obtained during diagnostic laparoscopy – control group 3.1 - 68 samples; peritoneal fluid obtained during diagnostic laparoscopy in women with endometriosis associated with infertility – experimental group 3.2 - 59 samples.

DATA PROCESSING

Fundamentals of statistical analysis

For an objective evaluation of complex, coordinately inhomogeneous distributions of the magnitude of all types of thesiograms (hereinafter we will denote these sets Q), we used statistical analysis, which consists of the following steps:

Definition of histograms of distributions of the value Q.

Calculation of the set of central statistical moments of the 1st, 2nd, 3rd and 4th orders, which characterize the average (Z_1), dispersion (Z_2), asymmetry (Z_3) and kurtosis (Z_4) distributions Q by the number of discrete pixels P.

1st order statistical moment Z_1 or the mean of the set Q determines its average value

$$Z_1 = \frac{|Q_1| + |Q_2| + ... + |Q_{p-1}| + |Q_p|}{P} \quad (1)$$

2nd order statistical moment Z_2 or the variance of a set of values Q determines the degree of its deviation from the mean value Z_1 (ratio (1)).

$$Z_2 = \sqrt{\frac{Q_1^2 + Q_2^2 + ... + Q_{p-1}^2 + Q_p^2}{P}} \quad (2)$$

3rd order statistical moment Z_3 or asymmetry characterizes the deviation from normality of random values Q

$$Z_3 = \sqrt{\frac{Q_1^3 + Q_2^3 + ... + Q_{p-1}^3 + Q_p^3}{P}} \Bigg/ \left(\sqrt{\frac{Q_1^2 + Q_2^2 + ... + Q_{p-1}^2 + Q_p^2}{P}}\right)^3 \quad (3)$$

The value of this statistical parameter Z_3 characterizes the dynamics of changes in the parameters of thesiograms of optical anisotropy.

4th order statistical moment Z_4 or kurtosis characterizes the dynamics of changes in the distributions of the magnitude of local values of the set of thesiogram points Q

$$Z_4 = \sqrt{\frac{Q_1^4 + Q_2^4 + ... + Q_{p-1}^4 + Q_p^4}{P}} \Bigg/ \left(\sqrt{\frac{Q_1^2 + Q_2^2 + ... + Q_{p-1}^2 + Q_p^2}{P}}\right)^4 \quad (4)$$

ETHICS

Ethical approval for this study was obtained from the Medical Ethics Committee of the Bukovinian State Medical University, Chernivtsi, Ukraine (approval ID: No. 6 from 8.10.2024).

RESULTS

The series of fragments in Fig. 1 presents algorithmically reproduced thesiograms and 3D distributions of the linear birefringence value of samples of dehydrated films of peritoneal fluid of patients from control group 3.1 (fragments (1),(2)) and experimental groups 3.2 (fragments (3),(4))

Installed:
• the presence of linear birefringence of supramolecular networks of tertiary and quaternary structure of proteins of dehydrated films of peritoneal fluid of patients from all groups (Fig. 1, fragments (1), (3));
• increase in the value of linear birefringence of dehydrated films of peritoneal fluid of patients with endometriosis (group 3.2), - (Fig. 1, fragments (2) (4)).

Statistical analysis of the structure of thesiograms of the linear birefringence distributions of supramolecular protein networks of peritoneal fluid of patients from all groups is given in Table 1.

A slight decrease in linear birefringence was found in patients with endometriosis due to the destruction of

Table 1. Statistical moments of the 1st – 4th orders, which characterize the coordinate distributions of the linear birefringence of dehydrated films of peritoneal fluid of patients

Parameters	Group 3.1	Group 3.2
$SM_1 \times 10^{-3}$	0.08±0.006	0.06±0.004
p_2	$p \leq 0.05$	
$SM_2 \times 10^{-3}$	0.06±0.003	0.04±0.002
p_2	$p \leq 0.05$	
SM_3	1.27±0.069	1.55±0.081
p_2	$p \leq 0.05$	
SM_4	1.82±0.097	2.19±0.12
p_2	$p \leq 0.05$	

Source: compiled by the authors of this study

Table 2. Specificity, sensitivity, accuracy of the method for statistical analysis of linear birefringence thesiograms of peritoneal fluid films of patients

| Parameters | Groups "1 – 2" | | |
	Sensitivity,Se,% N=57	Specificity,Sp,% H=69	Precision,Ac,% N+H=126
SM_1	A=44	B=52	A+B=96
	77.2	75.3	76.2
SM_1	A=43	B=51	A+B=94
	75.4	73.9	74.6
SM_3	A=46	B=54	A+B=100
	80.7	78.3	79.4
SM_4	A=47	B=55	A+B=102
	82.5	79.7	80.1

Note. SM1, SM2, SM3, SM4 – unsatisfactory accuracy
Source: compiled by the authors of this study

tertiary and quaternary proteins of the peritoneal fluid of patients from the experimental group 3.2. Higher-order statistical moments can be used as diagnostic markers of endometriosis, which turned out to be quite sensitive to changes in the tertiary and quaternary structure of proteins in samples of dehydrated films of peritoneal fluid.

Higher-order statistical moments, which have been shown to be sufficiently sensitive to changes in the tertiary and quaternary structure of proteins in samples of dehydrated peritoneal fluid films, can be used as diagnostic markers for endometriosis.

OPERATIONAL CHARACTERISTICS OF THE DIAGNOSTIC POWER OF THE METHOD OF STATISTICAL ANALYSIS OF LINEAR BIREFRINGENCE THESIOGRAMS OF SUPRAMOLECULAR PROTEIN NETWORKS OF DEHYDRATED FILMS OF PERITONEAL FLUID

The diagnostic and clinical effectiveness of using a set of statistical markers of algorithmically reproduced thesiograms of coordinate distributions of the magnitude of linear birefringence in detecting pathological changes - destruction of the tertiary and quaternary structure of supramolecular protein networks of samples of dehydrated polycrystalline films of peritoneal fluid of patients is illustrated by the values of the operating characteristics, the values of which are given in Table 2.

We have established the following ranges of the diagnostic power of the method of polarization-phase Muller matrix introscopy of linear birefringence of supramolecular protein networks of patients' peritoneal fluid:

•unsatisfactory (– 74.6% - 80.1%) accuracy of endometriosis diagnosis - groups "3.1" – "3.2"

Thus, it can be stated that the method of polarization-phase Muller matrix introscopy of changes in linear birefringence of supramolecular networks of dehydrated films of patients' peritoneal fluid did not show sufficient efficiency for diagnosing endometriosis, as well as for accurately assessing the effectiveness of its treatment. Therefore, the next step was to study the effectiveness of this polarization-optical technique by determining other markers that characterize the optical activity or chiral properties of molecular complexes of patients' peritoneal fluid.
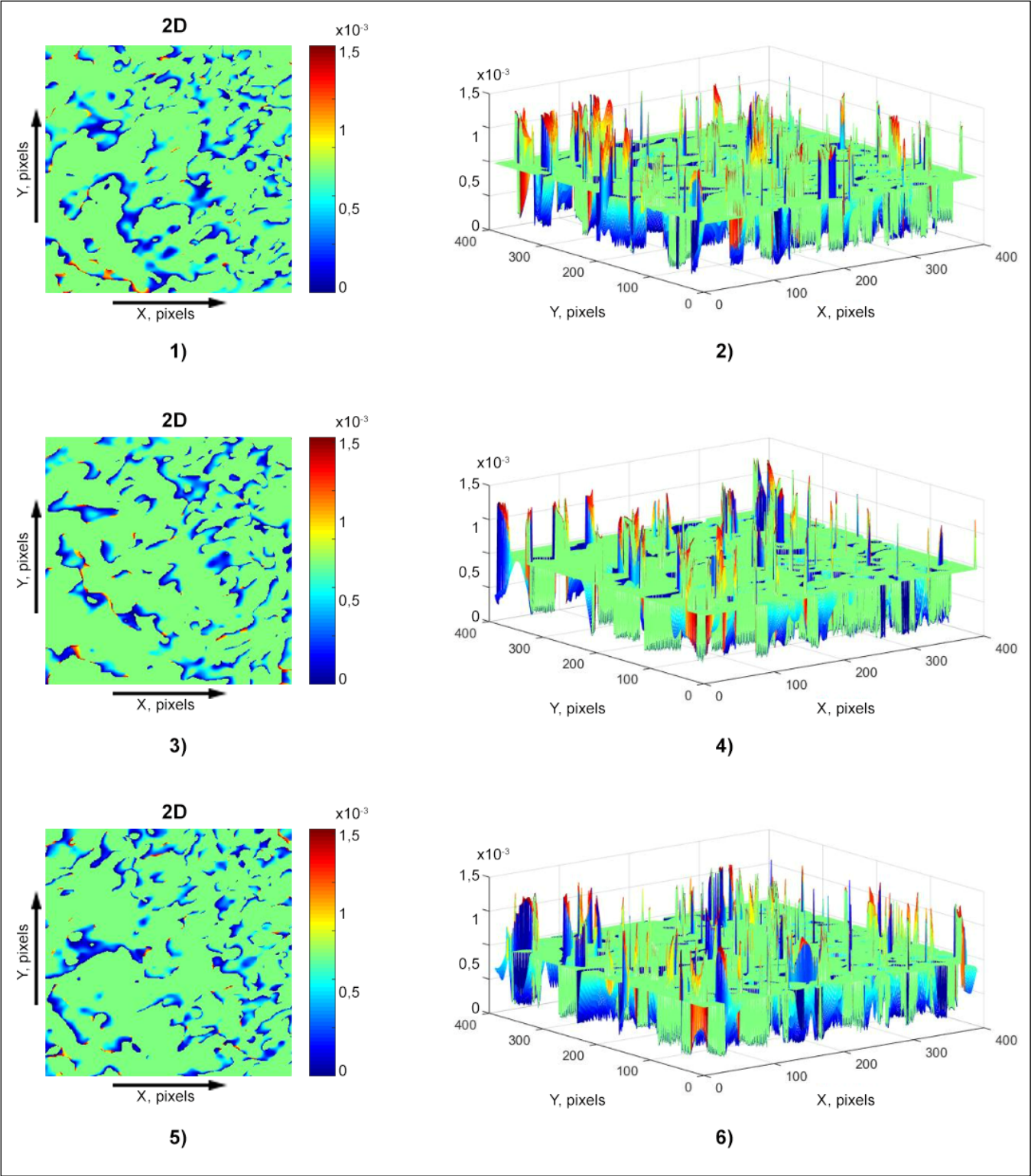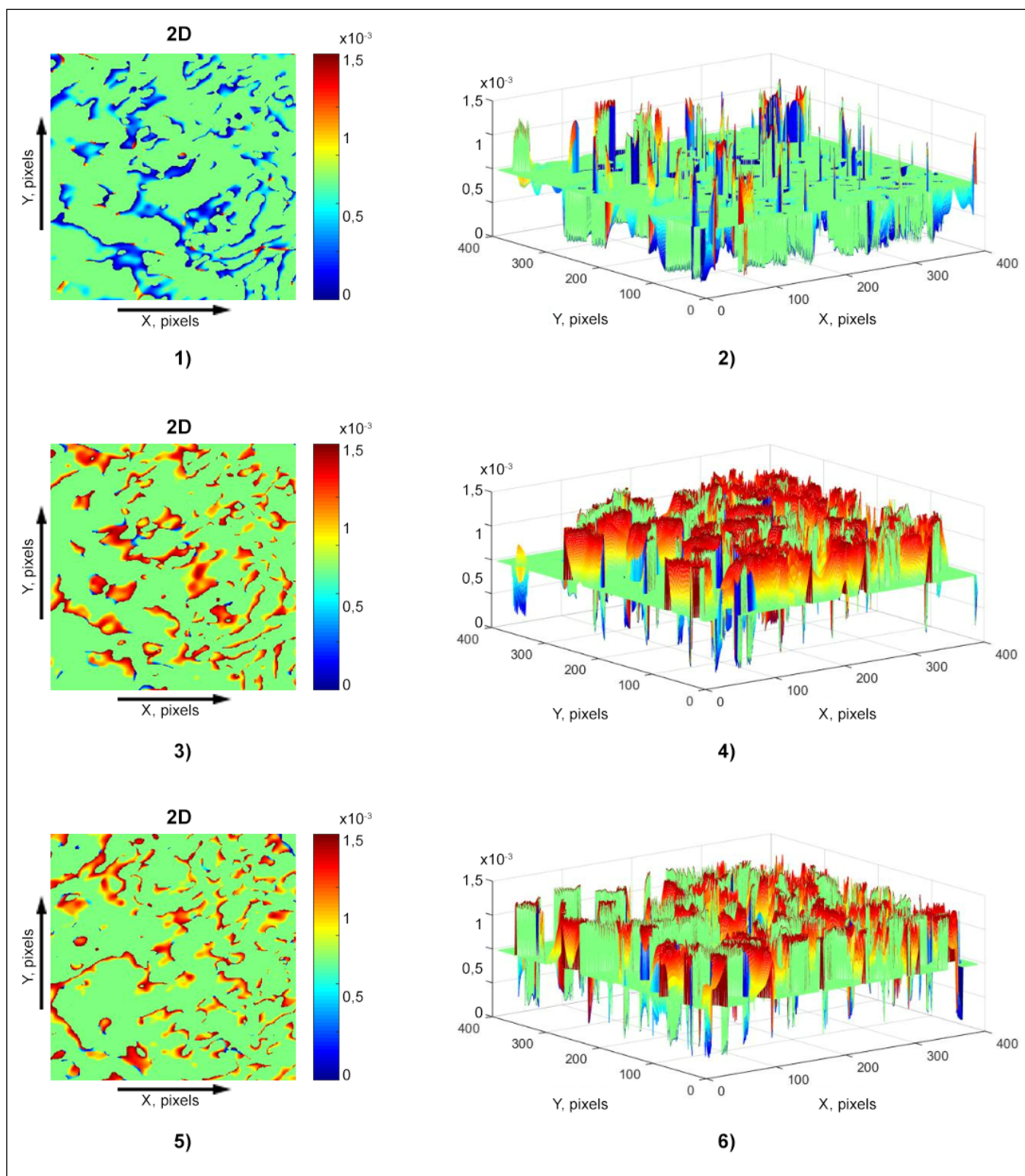
Fig. 1. Thesiograms ((1),(3), and 3D (2),(4),) of the distribution of the linear birefringence value of dehydrated films of peritoneal fluid of patients from group 3.1 ((1),(2)), group 3.2 ((3),(4))
Picture taken by the authors

CIRCULAR BIREFRINGENCE THESIOGRAMS OF DEHYDRATED PERITONEAL FLUID FILMS

In this section, we used the following model approximation. Leukocytes, which are part of the peritoneal fluid of patients, are spherical protein formations and have manifestations of circular birefringence. A reduced or increased number of leukocytes in the peritoneal fluid of patients is an important clinical indicator of the presence of a pathological process. Therefore, an increase in the level of circular birefringence of the dehydrated

Fig. 2. Thesiograms ((1),(3)) and 3D ((2),(4)) of the circular birefringence value distributions of chiral molecular complexes of dehydrated films of peritoneal fluid of patients from group 3.1 ((1),(2)), group 3.2 ((3),(4))
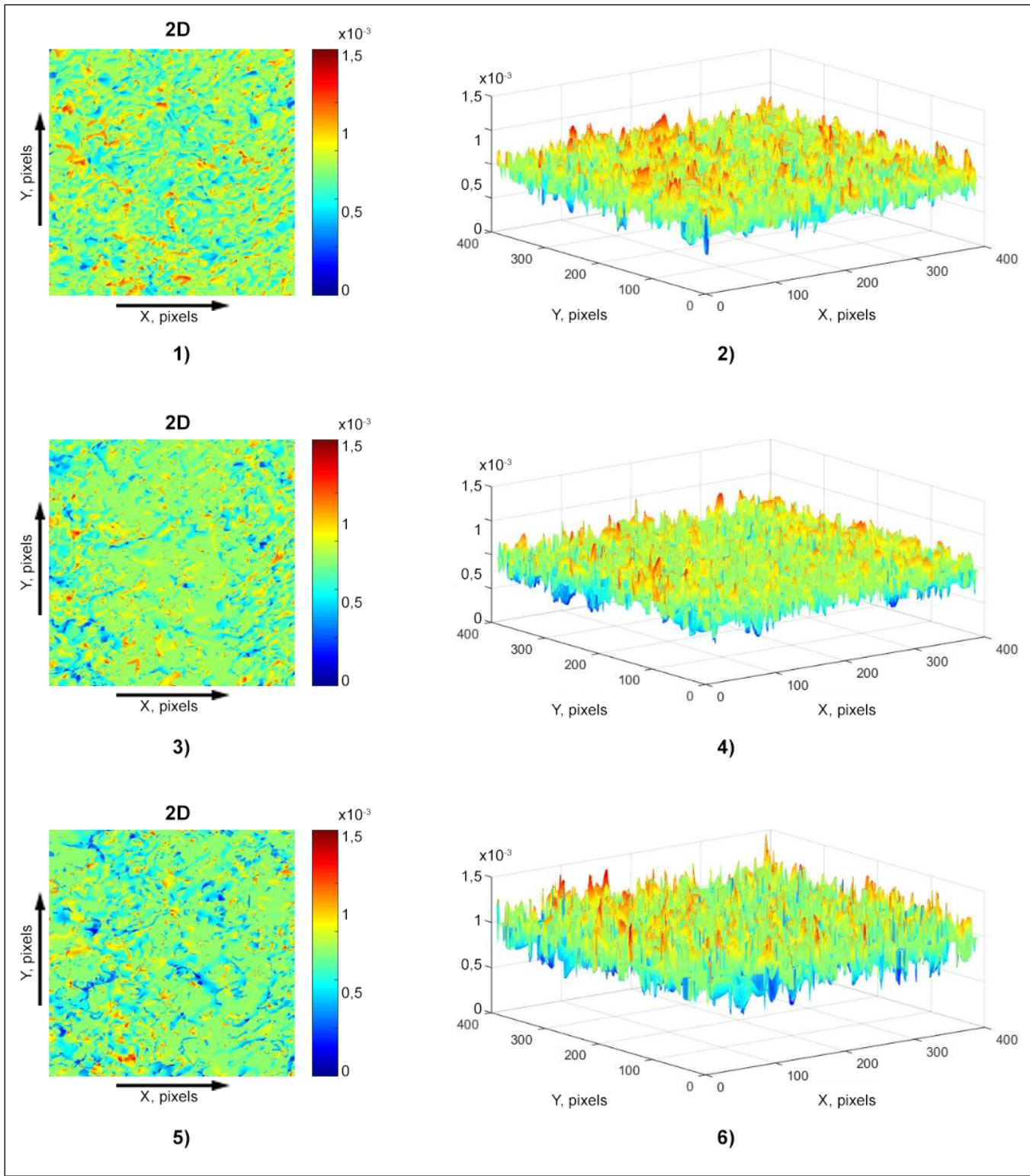*Picture taken by the authors*

film of peritoneal fluid can serve as additional objective criteria for endometriosis.

Algorithmically reproduced thesiograms and 3D distributions of the circular birefringence of chiral protein complexes of samples of dehydrated films of peritoneal

fluid of patients from control group 3.1 (fragments (1),(2)) and experimental groups 3.2 (fragments (3),(4)) are shown in a series of fragments in Fig. 2.
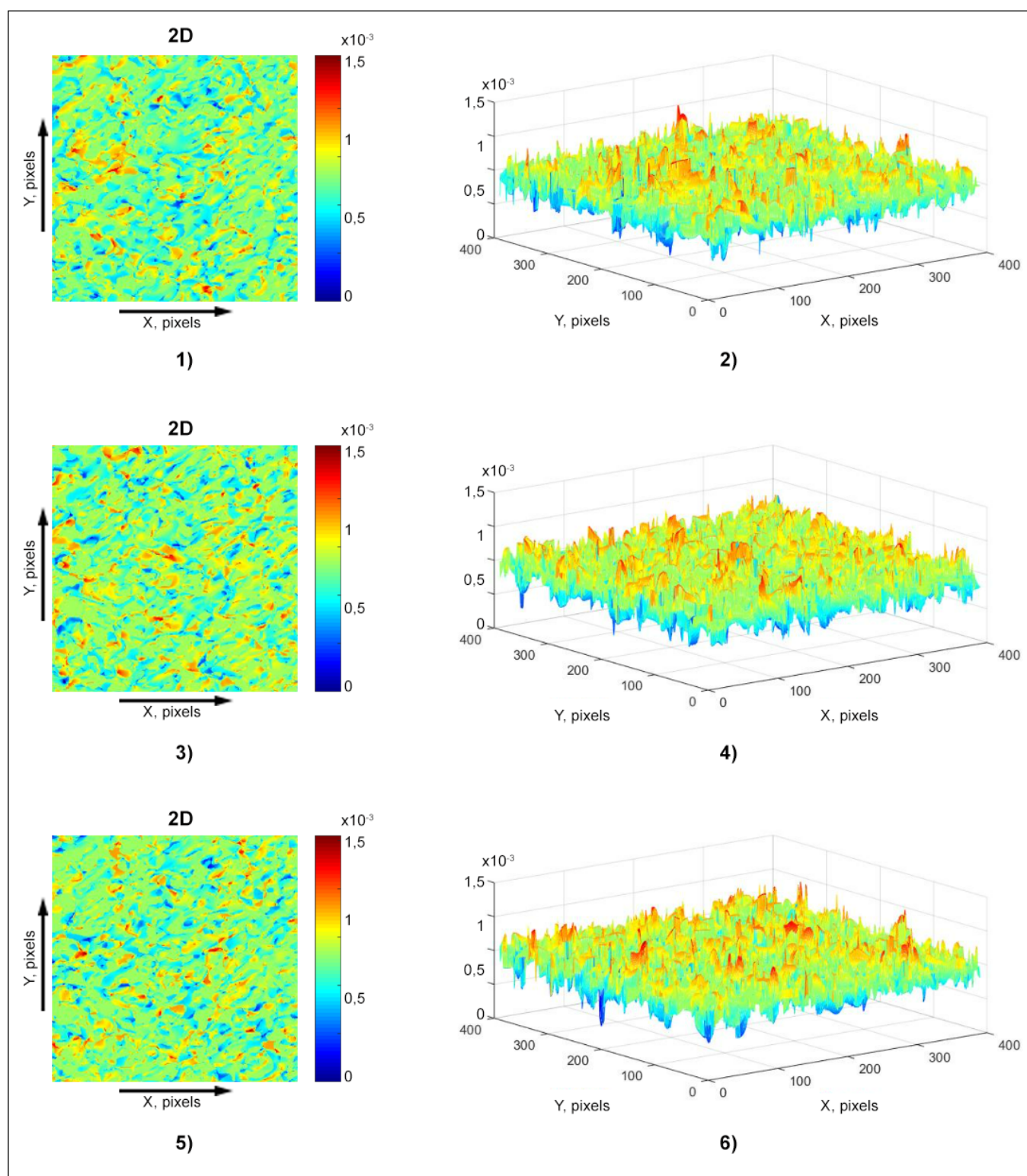
Analysis of the obtained experimental data revealed the presence of:

Fig. 3. Thesiograms ((1),(3)) and 3D ((2),(4)) distributions of the linear dichroism value of samples of dehydrated films of peritoneal fluid of patients from control group 3.1 (fragments (1),(2)) and experimental groups 3.2 (fragments (3),(4))
Picture taken by the authors

- coordinate distributions of the circular birefringence value of the supramolecular polycrystalline chiral structure of leukocytes of dehydrated films of peritoneal fluid of patients from all groups (Fig. 2, fragments (1), (3));

- increase in the level of circular birefringence of optically active supramolecular structures of peritoneal fluid samples from patients with endometriosis (Fig. 2, fragments (2), (4)).

Objectively, the differences between the maps of thesiograms of coordinate distributions of the

Fig. 4. Thesiograms ((1),(3)) and 3D ((2),(4)) distributions of the circular dichroism value of samples of dehydrated films of peritoneal fluid of patients from control group 3.1 (fragments (1),(2)) and experimental groups 3.2 (fragments (3),(4))
Picture taken by the authors

magnitude of circular birefringence of dehydrated films of peritoneal fluid of patients illustrate the average and spread of the values of the set of central statistical moments of the 1st - 4th orders, which are given in Table 3.

The following scenarios were identified:
• changes in the polycrystalline structure of supramolecular networks of leukocytes in the peritoneal fluid of patients and increased circular birefringence in endometriosis.

Table 3. Statistical moments of the 1st – 4th orders, which characterize the distributions of the magnitude of circular birefringence of dehydrated films of peritoneal fluid of patients

Parameters	Group 3.1	Group 3.2
$SM_1 \times 10^{-3}$	0.07±0.004	0.12±0.007
p_2	$p \leq 0.05$	
$SM_2 \times 10^{-3}$	0.05±0.003	0.08±0.005
p_2	$p \leq 0.05$	
SM_3	1.44±0.088	1.13±0.062
p_2	$p \leq 0.05$	
SM_4	2.33±0.13	1.98±0.104
p_2	$p \leq 0.05$	

Source: compiled by the authors of this study

Table 4. Specificity, sensitivity, and accuracy of the method for statistical analysis of circular birefringence maps of peritoneal fluid films

Parameters	Groups "1 – 2"		
	Sensitivity, N=57	Specificity, H=69	Precision, N+H=126
SM_1	*A=56*	*B=68*	*A+B=124*
	98.3	98.6	98.4
SM_2	*A=56*	*B=67*	*A=B=123*
	98.3	97.1	97.6
SM_3	*A=51*	*B=61*	*A+B=112*
	89.5	88.4	88.9
SM_4	*A=51*	*B=60*	*A+B=111*
	89.5	87	88.1

Note. SM_1, SM_2 – excellent accuracy; SM_3, SM_4 – good accuracy
Source: compiled by the authors of this study

- Diagnostic, statistically significant markers of this pathological process are the increase in the mean and variance of the circular birefringence thesiograms.

- Similarly, a set of 1st–2nd order statistical moments can be used to monitor the effectiveness of endometriosis treatment.

- excellent (– 97.6% - 98.4%) and good (– 88.1% - 88.9%) accuracy of endometriosis diagnosis - groups "3.1"–"3.2"

We have already noted that biological films also have optically anisotropic absorption. Therefore, we will consider the effectiveness of the method of polarization-phase Muller matrix introscopy of linear and circular dichroism of dehydrated films of peritoneal fluid.

OPERATIONAL CHARACTERISTICS OF CIRCULAR BIREFRINGENCE THESIOGRAM ANALYSIS OF DEHYDRATED PERITONEAL FLUID FILMS

The diagnostic effectiveness of using statistical markers of the distribution of the circular birefringence value of dehydrated films of peritoneal fluid of patients in detecting pathological changes is illustrated by the values of the operational characteristics (Table 4).

The following parameters of the diagnostic power of statistical analysis of algorithmically reproduced thesiograms were experimentally established:

The following parameters of the diagnostic power of statistical analysis of algorithmically reproduced thesiograms were experimentally established:

LINEAR DICHROISM THESIOGRAMS OF SUPRAMOLECULAR ALBUMIN NETWORKS OF DEHYDRATED PERITONEAL FLUID FILMS

The anisotropically absorbing components of peritoneal fluid include aantibodies, immunoglobulins. The tertiary and quaternary structure of an antibody in most cases includes two heavy chains and two light chains. As a result, they acquire the properties of linear dichroism.

The series of fragments in Fig. 3 presents algorithmically reconstructed by the Muller matrix introscopy method thesiograms and 3D distributions of the linear dichroism value of supramolecular networks of dehydrated films of peritoneal fluid of

Table 5. Statistical moments of the 1st – 4th orders, which characterize the linear dichroism distributions of dehydrated peritoneal fluid films

Parameters	Group 3.1	Group 3.2
$SM_1 \times 10^{-3}$	0.07±0.004	0.12±0.007
p_2	$p \leq 0.05$	
$SM_2 \times 10^{-3}$	0.05±0.003	0.08±0.005
p_2	$p \leq 0.05$	
SM_3	1.44±0.088	1.13±0.062
p_2	$p \leq 0.05$	
SM_4	2.33±0.13	1.98±0.104
p_2	$p \leq 0.05$	

Source: compiled by the authors of this study

patients from control group 3.1 (fragments (1),(2)) and experimental groups 3.2 (fragments (3),(4)).

The Muller matrix introscopy method revealed the mechanisms of optically anisotropic absorption of dehydrated films of peritoneal fluid, which is illustrated by algorithmically reproduced linear dichroism thesiograms (Fig. 3, fragments (1), (3)).

For dehydrated films of peritoneal fluid from patients with endometriosis (Fig. 3, fragments (2), (4)), a decrease in the linear dichroism of supramolecular polycrystalline networks was found (Table 5).

The results of statistical analysis of linear dichroism thesiograms revealed:

• reduction in the value of linear dichroism due to the destruction of tertiary and quaternary proteins of the peritoneal fluid of patients with endometriosis (study group 3.2).

The following diagnostic statistical markers of endometriosis have been established - asymmetry and excess of the tertiary and quaternary structure of proteins in samples of dehydrated films of peritoneal fluid.

OPERATIONAL CHARACTERISTICS OF THE DIAGNOSTIC POWER OF THE METHOD OF STATISTICAL ANALYSIS OF LINEAR DICHROISM THESIOGRAMS OF PERITONEAL FLUID FILMS

The parameters of the effectiveness of the differential diagnosis of endometriosis, as well as monitoring the effectiveness of its treatment, illustrate the values of the operational characteristics, which are given in Table 6.

The following parameters of the diagnostic power of the method of polarization-phase Muller matrix reconstruction of linear dichroism thesiograms of supramolecular protein networks of dehydrated peritoneal fluid films were experimentally established:

• good (– 90.5%) and very good (– 92.1% - 93.7%) accuracy of endometriosis diagnosis - groups "3.1" – "3.2".

CIRCULAR DICHROISM THESIOGRAMS OF SUPRAMOLECULAR ALBUMIN NETWORKS OF DEHYDRATED PERITONEAL FLUID FILMS

Experimentally determined thesiogram maps and 3D distributions of the circular dichroism value of chiral protein complexes of supramolecular polycrystalline networks of dehydrated films of peritoneal fluid of patients from control group 3.1 (fragments (1),(2)) and experimental group 3.2 (fragments (3),(4)) are shown in a series of fragments in Fig. 4.

The presence of a polycrystalline chiral structure of optically anisotropic absorption of molecular complexes of samples of dehydrated films of peritoneal fluid of patients from all groups was established (Fig. 4, fragments (1), (3)). It was found that for samples of dehydrated films of peritoneal fluid of patients with endometriosis there is a slight increase in the level of circular dichroism of molecular structures. Quantitatively, the processes of change in circular dichroism are illustrated by statistical moments of the 1st - 4th orders, which characterize thesiograms of supramolecular networks of dehydrated films of peritoneal fluid (Table 7).

Analysis of algorithmically reproduced thesiograms of supramolecular networks of dehydrated peritoneal fluid films revealed a correlation of the prognostic scenario of changes in optically anisotropic (chiral) absorption of protein complexes and an increase in the value of circular dichroism in the presence of endometriosis. At the same time, statistically significant (markers of this pathological process are an increase in the value of the central statistical moments of the 1st and 2nd orders.

OPERATIONAL CHARACTERISTICS OF THE DIAGNOSTIC POWER OF THE METHOD OF STATISTICAL ANALYSIS OF CIRCULAR DICHROISM THESIOGRAMS OF SUPRAMOLECULAR GLOBULIN NETWORKS OF DEHYDRATED PERITONEAL FLUID FILMS

Experimental results of information analysis of circular dichroism thesiograms of dehydrated peritoneal fluid films are given in Table 8.

Table 6. Specificity, sensitivity, accuracy of the method of statistical analysis of linear dichroism maps of peritoneal fluid films

Parametersz	Sensitivity, Se, % N=57	Specificity, Sp, % H=69	Precision, Ac, % N+H=126
SM_1	A=54 94.7	B=64 92.8	A+B=118 93.7
SM_2	A=53 92.3	B=63 91.3	A+B=116 92.1
SM_3	A=52 91.2	B=62 89.9	A+B=114 90.5
SM_4	A=53 92.3	B=63 91.3	A+B=116 92.1

Note. SM_1, SM_2, SM_4 – very good accuracy; SM_3 – good accuracy
Source: compiled by the authors of this study

Table 7. Statistical moments of the 1st – 4th orders, which characterize the distributions of the circular dichroism value of dehydrated films of peritoneal fluid

Parameters	Group 3.1	Group 3.2
1	2	3
SM_1 10^{-3}	0.067±0.004	0.11±0.007
p_2		$p \leq 0.05$
SM_2 10^{-3}	0.035±0.003	0.068±0.005
p_2		$p \leq 0.05$
SM_3	1.57±0.089	1.21±0.065
p_2		$p \leq 0.05$
SM_4	2.52±0.14	2.19±0.12
p_2		$p \leq 0.05$

Source: compiled by the authors of this study

The following parameters of the diagnostic power of the method of statistical analysis of circular dichroism thesiograms of supramolecular networks of dehydrated films of peritoneal fluid were established (Table 8):

•very good (– 90.5% - 94.5%) accuracy of early diagnosis of endometriosis - groups "3.1" – "3.2".

DISCUSSION

In our work, we will use the basic principles of the theory of Muller matrix thesiography of optically anisotropic macro-, micro- and molecular structures of biological tissues in application to the development of objective criteria (markers) for early (preclinical) diagnosis of endometriosis and assessment of the effectiveness of its treatment.Peritoneal fluid is composed of water, electrolytes, antibodies, leukocytes, and biochemicals.

According data other authors [1,3], antibodies, immunoglobulins are large globular proteins secreted by plasma cells of the immune system. They have a Y-shaped shape, at two ends of the molecule there are two identical antigen binding sites, and the third end can be one of several types, depending on which antibodies are classified into one or another class. The tertiary and quaternary structure of one antibody in most cases includes two heavy chains and two light chains. As a result, they acquire the properties of linear birefringence and dichroism.

• The parameters of these anisotropy mechanisms, which form the thesiogram of the hydrated peritoneal fluid film, represent a set of early (pre-clinical) signs of the presence of endometriosis.

• Leukocytes are spherical protein formations and exhibit circular birefringence and circular dichroism.

• A decreased or increased number of leukocytes in the blood is an important clinical indicator of the presence of a pathological process. Therefore, an increase in the level of circular birefringence and circular dichroism of the thesiogram of the hydrated film of peritoneal fluid can serve as additional objective criteria for endometriosis.

Peritoneal fluid is composed of water, electrolytes, antibodies, leukocytes, and biochemicals. Leukocytes are spherical protein formations and have manifestations of circular dichroism. A reduced or increased number of leukocytes in the blood is an important clinical indicator of the presence of a pathological process. Therefore, an increase in the level of circular dichroism of the

Table 8. Specificity, sensitivity, and accuracy of the method for statistical analysis of circular dichroism maps of dehydrated peritoneal fluid films

Parameters	Groups "1 – 2"		
	Sensitivity Se (%) N = 57	Specificity Sp (%) H = 69	Precision Ac (%) N + H = 126
SM$_1$	A = 55 96.5	B = 64 92.8	A + B = 119 94.4
SM$_2$	A = 54 94.7	B = 64 92.8	A + B = 118 93.7
SM$_3$	A = 52 91.2	B = 62 89.9	A + B = 114 90.5
SM$_4$	A = 52 91.2	B = 62 89.9	A + B = 114 90.5

Note. SM$_1$, SM$_2$, SM$_3$, SM$_4$ – very good accuracy
Source: compiled by the authors of this study

dehydrated film of perineal fluid can serve as additional objective criteria for endometriosis. These data have correlation with our research.

The highest level of linear birefringence for histological sections of endometrial biopsy; the minimum level of optical anisotropy of this type for dehydrated films of peritoneal fluid.

The growth of phase shift dispersion due to extracellular matrix anisotropy is accompanied by reversed changes in the statistical moments of the 3rd and 4th orders.

On this basis, the principles of Jones-matrix classification of the polarization-phase properties of the basic types of histological sections of biological tissues according to the ranges of change of a set of statistical moments characterizing the corresponding matrix elements are established and substantiated.

By statistical analysis of a series of thesiograms of the distributions of the optical anisotropy parameters of biological preparations, the following most effective markers for the diagnosis of endometriosis by the method of polarization-phase Muller-matrix introscopy were experimentally established. Dehydrated films of peritoneal fluid: linear birefringence - unsatisfactory (– 74.6% - 80.1%) diagnostic accuracy - groups "3.1" - "3.2"; circular birefringence - excellent (– 97.6% - 98.4%) and good (– 88.1% - 88.9%) diagnostic accuracy - groups "3.1" - "3.2"; linear dichroism - good (– 90.5%) diagnostic accuracy of endometriosis - groups "3.1" - "3.2"; circular dichroism - very good (– 90.5% - 94.5%) diagnostic accuracy - groups "3.1" - "3.2.

CONCLUSIONS

The conducted cycle of stusies of the diagnostic effectiveness of the new in biomedical practice method polarization-phase Muller-matrix introscopy of the polycrystalline component of biological preparations (peritoneal fluid) revealed a high level of accuracy of early diagnosis of genital endometriosis.

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