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Immune-Metabolic Stress In Purulent Inflammatory Diseases Salpingo-Oophoritis.

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ABSTRACT

The last decade has been characterized by the increase of purulent inflammatory diseases of the female reproductive system. These events result from the decreased immunity. This article describes changes of immunological and metabolic parameters in women, as well as their correlations, with further formalization of the obtained results presented as diagnostic formulas. Special attention is paid to the changes of laboratory tests in patients with chronic and complicated course of salpingo-oophoritis.

Keywords: salpingo-oophoritis, immunologic and metabolic parameters, correlation relationships.

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INTRODUCTION

Currently a large number of females are exposed to inflammatory diseases of the female reproductive system. Due to structural peculiarities of the female reproductive system, infection rapidly travels from the vagina to the internal genitalia. This is a reason why purulent inflammatory diseases remain one of the most acute challenges in the present-day gynecology. Disturbances of non-specific and specific, regional and systemic mechanisms of anti-infectious resistance are of great importance in defining pathogenesis of the disorders [1]. Treatment of women suffering from these diseases is complicated by two significant pathognomonic factors: high antibiotic resistance of the causative microflora and aggravation of the immunopathology resulted from the application of conventional therapeutic preparations. Stable disbalance of protective reactions ultimately leads to the decreased body resistance to infectious and other risk factors, induction of chronic pathological processes and their relapses [2].

MATERIALS AND METHODS

The study included more than 160 women suffering from acute and chronic salpingo-oophoritis; combinations of chronic salpingo-oophoritis with chronic pyelonephritis, chronic salpingo-oophoritis with chronic cystitis, chronic salpingo-oophoritis with bacterial vaginosis, chronic salpingo-oophoritis and cervicitis, chronic salpingo-oophoritis and endometritis. Research subjects and healthy sporadic donors were categorized into 8 equal randomized groups, 20-25 people in each group, based on their age and clinical variations of the disease, and exposed to the conventional laboratory examination.

The number of hematologic markers of inflammation – the content of leukocytes, lymphocytes, granulocytes, monocytes and erythrocyte sedimentation rate (ESR) – was estimated in all patients using routine techniques. Clones and subclones of lymphocytes were identified in the immunological study by the NAVIOS Beckman Coulter flow cytofluorometry using monoclonal antibodies CYTO-STATtetraCHROM; phagocytic absorbing and metabolic capacity was also characterized; the content of circulating immune complexes (CIC) was determined spectrophotometrically by Haskova technique using polyethylene glycol; serum immune globulins of the main classes (Ig) were determined by a turbidimetric method on the biochemical analyzer Chospitec, Holland; pro- and anti-inflammatory cytokines were determined by the immunoenzyme method using sets of reagents of the “Protein contour” company (“Proteinovyikontur” – Russian version) [3].

Spectro photometry methods, fluorescence techniques, reactions with 2-thiobarbituric acid and others [4, 5] allowed specifying the following parameters: free radical oxidation parameters of lipids and proteins – diene conjugates, ketodienes, malondialdegyde (MDA), bi-tyrosine linkages, Schiff’s bases, – and parameters of the antioxidant defense system – superoxide dismutase (SOD), catalase, vitamin E, systemic thiols, protein thiols, non-protein thiols, plasma anti-oxidative activity.

Generally accepted statistical analysis of the obtained data included application of the modern panel of planning methods (randomization, representativeness of the sample according to L.E. Kholodov, V.P. Yakovlev formula [6], statistical analysis of the obtained results using parametric (Student’s) and non-parametric (Wilcoxon-Mann-Whitney) criteria depending on the normal distribution of the parameters.

Additional methods of the mathematical analysis of the results: Coefficient of diagnostic consideration (Kj) was calculated on the formula [7],

$$Kj = \frac{2 \cdot (\delta_1^2 + \delta_2^2)}{(M_2 - M_1)^2}$$

where $^2_1$ и δ^2_2 – mean root square deviations, M_1, M_2 – mean values of the parameters of the compared groups; this allowed estimating key laboratory tests. The latter were formalized into the standard formulas of the immune system disorders and metabolic disorders calculated with reference to normal values in healthy people.

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Association of the key immunologic and metabolic parameters was characterized by determining the number of strong correlations of formulas summands and a coefficient > 0.6. [6].

Summarized (Σ), stimulated (+), suppressed (-) variations were grouped by the methods of parameter investigations – hematologic, immunologic, metabolic – and by the components of the immunity system – cellular, B-dependent, phagocytic, cytokine, as well as by the parameters of free radical oxidation and the antioxidant defense system. Integral assessment of the variations was ranked on the scale into insignificant (the 3rd rank) under the relevant variation of the parameter value in 0-33% of patients, average (the 2nd rank) - in 34-66% of patients, significant (the 1st rank) – in more than 66% [8].

RESULTS

Changes of laboratory findings obtained in the research subjects were compared with the normal findings of healthy people, analyzed and summarized in Table 1.

Table 1: Frontal analysis of the relevant variations of laboratory findings from the norm in patients suffering from salpingo-oophoritis

Parameters	Acute salpingo-oophoritis	Chronic salpingo-oophoritis	Chronic salpingo-oophoritis+ chronic pyelonephritis	Chronic salpingo-oophoritis+ chronic cystitis	Chroncsalpingo-oophoritis + bacterial vaginosis	Chronic salpingo-oophoritis+cervicitis	Chronic salpingo-oophoritis+endometritis
Hematologic							
Leukocytes	+	+	+	+	+	+	+
Lymphocytes	-	-	-	-		-	-
Stab	+	+		+	+		
Segmentonuclear	+	+	+	+	+	+	
Eosinophils	+	+	+	+		+	+
Monocytes		+	+	+	+	+	
Erythrocyte sedimentation rate (ESR)	+	+	+	+	+	+	
Cellular							
T	-	-	-		-	-	-
T-helpers	-	-	-	-	-	-	-
T-cytotoxic		+	+	+	+	+	-
T-regulatory			+	-			-
T-activated	+	+	+	+	+	-	-
$NK_{T\text{-dependent}}$	+	+	+	+			+
$NK_{regulatory}$				+	+		
$NK_{cytotoxic}$						+	
B-dependent							
B	+	+	+		+	+	+
IgM	+	+	+	+	+	+	+
IgG			-	-	+	+	+
IgA	+	+	-	-	-		+
Circulatingimmunecomplexes(CIC)	+	+	+	+	+		+
Medium weight molecules (MWM)	+	+	+	+	+		
Phagocytic							
CD11b		-		-			
CD18		+					

Phagocytic index (PhI)		-	-	-	-	-	-
Phagocyticnumber (PhN)	+		-	-	-	-	
Nitro Blue Tetrozolium spontaneous (NBT_{spont})	-	-	-	-	+	-	
Nitro Blue Tetrozolium activated (NBT_{activ})	-		-	-	-	-	-
Cytokine							
IL2		+	-		-		-
IL4				-	-		-
IL6			+			+	+
IL8	+	+	+		+	+	+
IL10							-
Tumor necrosis factor (TNF)	+	+		+	+	+	+
Free radical oxidation of lipids and proteins							
Malondialdegyde (MDA)	+	+	+	+		+	+
Diene conjugates	-	-	+	+	+	+	+
Ketodienes		+		+	+	+	+
Schiff's bases		+	+	+	+		
Bi-tyrosine linkages			+	+	+		+
Anti-oxidant defense							
Plasma antioxidative activity	-	-	-	-	-	-	-
Vitamin E		+	-	-		-	-
Superoxidedismutase (SOD)		-	-	-		-	-
Ceruleoplasmin	+	+		-	+	+	-
Systemic thiols			-	-	-		-
Non-protein thiols	+		-	-	-	-	-
Protein thiols	-		-	-	-	-	
Catalase		-	-	-	-	-	-

Notes: +/- relevantly stimulated/ suppressed parameters compared to the normal level.

Hematologic parameters were estimated to vary quantitatively by 100% in patients with chronic salpingo-oophoritis, chronic salpingo-oophoritis + chronic cystitis; by 86% in patients with acute salpingo-oophoritis, chronic salpingo-oophoritis + chronic pyelonephritis, chronic salpingo-oophoritis + cervicitis; by 43% in patients with chronic salpingo-oophoritis + endometritis.

Qualitatively, absolutely complete variations of hematologic markers of inflammation – leukocytosis, limphopenia, accumulation of mature and immature granulocytes, eosinophils, monocytes, accelerated ESR – were observed only in women with chronic salpingo-oophoritis and its combination with cystitis. The reaction appeared to be cleaved in all the other cases. For instance, stab leukocytes appeared to be intact in chronic salpingo-oophoritis + chronic pyelonephritis, chronic salpingo-oophoritis + cervicitis; monocytes appeared to be intact in acute salpingo-oophoritis; lymphocytes, eosinophils etc. appeared to be intact in chronic salpingo-oophoritis + bacterial vaginosis.

Table 1 also demonstrated that the relevant variation of the immunologic parameters 54-58% from the norm level was registered in patients with acute salpingo-oophoritis and exacerbation of chronic cystitis with cervicitis; the relevant modification of the immunologic parameters 69-73% from the norm level was registered in patients with exacerbation of chronic salpingo-oophoritis+bacterial vaginosis, exacerbation of chronic salpingo-oophoritis, exacerbation of chronic salpingo-oophoritis + exacerbation of chronic pyelonephritis; the relevant modification of the immunologic parameters 77% from the norm level was registered in patients with combination of chronic cystitis with endometritis.

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Qualitatively, the content of T-cells, T-helpers, NBT_{spont}, NBT_{active} decreased, and the content of two NK subpopulations, five of 6humoral tests, PhN and anti-inflammatory IL8 increased compared to the norm level in patients with acute salpingo-oophoritis. In chronic salpingo-oophoritis the indicated modifications were accompanied by the decreased content of cells with the CD11 marker, by the decreased number of PhI, and by the accumulation of T-cells, the number of CD18 and IL2 carriers; this proved aggravation of variations of cellular, phagocytic and cytokine parameters. In combination of chronic salpingo-oophoritis with chronic pyelonephritis or chronic cystitis the proportion of the suppressed parameters increased in the following way: 2 cellular, 2 humoral, 4 and 5 phagocytic, one cytokine parameters, and the proportion of stimulated parameters increased in the following way: 4 cellular, 4 and 3 humoral parameters. In turn, aggravation of chronic salpingo-oophoritis by bacterial vaginitis or cervicitis resulted in the differently variant suppression or stimulation, respectively – 2 – 3 or 3 – 2 cellular; 1 or 5 – 3 humoral; 3 – 4 or 1 phagocytic; 2 or 2 – 3 cytokine parameters. Finally, the most severe composition of chronic salpingo-oophoritis with endometritis caused suppression of the two regulatory subpopulations of T-cells and natural killer cells, the standard increase of five B-dependent parameters, the decrease of two tests of absorbing and metabolic phagocytic capacity and the complete disbalance of three pro- and three anti-inflammatory cytokines.

Qualitative analysis of metabolic parameters demonstrated the most variations from the norm in 100% of tests in patients with chronic salpingo-oophoritis + chronic cystitis; the most variations from the norm in 85% of tests in patients with chronic salpingo-oophoritis + endometritis, chronic salpingo-oophoritis + chronic pyelonephritis; the most variations from the norm in 77% of tests in patients with chronic salpingo-oophoritis, chronic salpingo-oophoritis + bacterial vaginosis, chronic salpingo-oophoritis + cervicitis;the most variations from the norm in 46% of tests in patients with acute salpingo-oophoritis.

A universal reaction was registered in all nosoforms of purulent inflammatory diseases – predominant stimulation of free radical oxidation parameters of highly-molecular substrates in 96% and suppression – in 4 % of cases; the situation was different in relation to the summands of the anti-oxidant defense – 13 and 87%.The results of metabolic immunity in patients with salpingo-oophoritis are presented in Table 2.

Table 2: Metabolic immunity in patients with salpingo-oophoritis

Parameters	Norm	Acute salpingo-oophoritis	Chronic salpingo-oophoritis	Chronic salpingo-oophoritis + chronic cystitis	Chronic salpingo-oophoritis+ endometritis	Chronic salpingo-oophoritis + bacterial vaginitis	Chronic salpingo-oophoritis + cervicitis	Chronic salpingo-oophoritis + chronic pyelonephritis
Free radical oxidation of lipids and proteins								
MDA, µ/l	1.36+-0.1	2.2+-0.13*	1.8+-0.2*	2.6+-0.7*	2.0+-0.3*	1.5+-0.9	1.88+-0.5*	3.0+_1.2*
Diene conjugates, relative density units/ ml	30.3+-0.04	31.3+-0.9*	28.6+-0.05*	33.5+-0.2*	33.0+-0.3*	37.1+-0.09*	32.4+-0.1*	35.4+-0.3*
Ketodienes «-«	19.2+-0.02	19.9+-0.02	23.3+-0.02*	26.6+-0.6*	24.2+-0.7*	28.2+-0.9*	27.0+-0.6*	20.4+-1.3
Schiff's bases «-«	30.04+-2.9	33.3+-3.5	42.4+-3.1*	35.0+-1.9*	37.9+-7.9	33.2+-1.1*	31.1+-2.2	39.7+-4.5*
Bi-tyrosine linkages, relative units/ml	0.3+-0.012	0.3+-0.005	0.34+-0.09	0.36+-0.07*	0.35+-0.01*	0.38+-0.05*	0.31+-0.1	0.44+-0.2*
Antioxidant system								
Plasma	65.3+-	49.3+-	20.0+-	44.4+-	38.1+-	27.8+-	37.2+-	30.0+-

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antioxidative activity, µ/l	1.3	0.9*	0.3*	2.5*	0.9*	1.1*	2.0*	1.8*
Viamin E, µ/l	20.9+-3.8	22..3+-2.5	41.8+-4.3*	13.0+-2.0*	15.4+-2.3*	18.1+-1.2	16.6+-2.7*	14.9+_1.5*
SOD, µM/ml	0.9+-0.03	1.1+-0.2	0.4+-0.09*	0.55+-0.08*	0.7+-0.06*	0.8+_0.1	0.7+_0.05*	0.3+-0.01*
Ceruleoplasmin, µ/l/min	264.2+-29.9	299.0+-17.3*	312.8+-16.3*	220.7+-22.4*	211.0+-15.6*	360.0+-27.3*	281.9+_11.1*	272.1+-20.9
Systemic thiols, mM/l	44.52+-0.85	41.6+-4.4	31.1+-1.5*	34.6+-4.3*	30.5+-1.2*	25.1+-1.7*	42.0+-3.5	31.3+-0.9*
Non-protein thiols, mM/l	23.86+-0.71	28.6+-2.0*	24.7+-1.0	19.9+-0.6*	19.8+-0.8*	21.1+-0.5*	20.0+-1.3*	19.5+-0.6*
Protein thiols, mM/l	38.8+-0.82	31.5+-0.4*	39.2+-1.4	31.1+-0.4*	37.7+-1.3	32.3+-1.3*	26.5+-0.9*	21.3+-1.7*
Catalase, µ/l/min	31.1+-1.43	30.7+-1.1	25.2+-1.3*	26.9+-1.4*	26.9+-2.3*	21.8+-3.6*	20.2+-3.7*	25.4+-1.1*

Notes: *significance of deviations from the norm, P<0.05.

The detailed reaction of certain free-radical oxidation parameters revealed the following: 100% responsiveness to the diene conjugate pathology; 86% responsiveness of malondialdegyde; 57% responsiveness of Schiff's bases and bi-tyrosine linkages. The changes of the anti-oxidant defense system parameters were as follows: modifications of plasma anti-oxidative activity were observed in 100% of cases; modifications of ceruleoplasmin, non-protein thiols, catalase - in 86% of cases; modifications of vitamin E, superoxide dismutase, systemic thiols, protein thiols – in 71% of cases.

Totally, formalized dynamics of the immune metabolic parameters is given in Table 3.

Table 3: Total formalized rank assessment of the immune metabolic parameters in patients with salpingo-oophoritis

Parameter	Frontal analysis			Grouped parameters									CL	Σ of ranks	variations
	Σ	+	-	H	I	M	Detailed values								
							C	B	Ph	Cy	F	A			
Acute salpingo-oophoritis	2	2	3	1	2	2	2	1	2	2	2	2	2/6	29	VI
Chronic salpingo-oophoritis	1	2	3	1	2	1	2	1	2	2	1	2	3/5	25	V
Chronic salpingo-oophoritis + chronic pyelonephritis	1	2	3	1	1	1	1	1	1	2	1	1	8/1	17	I
Chronic salpingo-oophoritis + chronic cystitis	1	2	2	1	1	1	1	1	1	2	1	1	7/2	17	I
Chronic salpingo-oophoritis + bacterial vaginosis	2	2	3	1	1	1	2	1	1	1	1	1	5/4	21	III
Chronic salpingo-oophoritis + cervicitis	1	2	2	1	2	1	1	2	1	2	2	1	5/4	22	IV
Chronic salpingo-oophoritis + endometritis	1	2	2	2	1	1	1	1	2	1	1	1	6/3	19	II

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Notes: Σ/+/- sum/stimulating/suppressed parameters; H-hematologic, I-immunologic, M-metabolic, C-cellular, B - B-dependent, Ph – phagocytic, Cy – cytokine components of the immunity; F – free radical oxidation, A – antioxidant defense system – grouped parameters; CL – correlation links; 1/2/3 – sufficient/moderate/insufficient rank of variations; I-IV – decreasing total levels of parameter variations.

As defined, totally maximal relevant changes of the laboratory tests were observed in patients with chronic and complicated course of salpingo-oophoritis. The changes were moderate only in acute salpingo-oophoritis and in combination of chronic salpingo-oophoritis with bacterial vaginosis. Stimulating orientation of these variations was moderate in all cases, suppressing – in combinations of chronic salpingo-oophoritis + chronic cystitis, chronic salpingo-oophoritis + cervicitis, chronic salpingo-oophoritis + endometritis.

The reaction of grouped hematologic and metabolic markers of inflammation appeared to be monotonously high, except for chronic salpingo-oophoritis aggravated by endometritis in the first case and acute salpingo-oophoritis in the second case. Immunologic reaction to purulent inflammatory diseases was limiting in combination of chronic salpingo-oophoritis with chronic pyelonephritis, chronic salpingo-oophoritis with chronic cystitis, chronic salpingo-oophoritis with bacterial vaginosis, chronic salpingo-oophoritis with endometritis, and moderate – in all the other cases.

Free radical oxidation and anti-oxidant defense system detected relevance of detailed parameter changes in four immunity components, but it was expressed differently. In most cases the relevance was expressed significantly – in chronic salpingo-oophoritis with chronic pyelonephritis, chronic salpingo-oophoritis with chronic cystitis, chronic salpingo-oophoritis with bacterial vaginosis, chronic salpingo-oophoritis with endometritis; it was expressed insignificantly in chronic salpingo-oophoritis with cervicitis, chronic cystitis and acute salpingo-oophoritis.

Total decreasing difference of the laboratory parameters from the norm values in 13 types of mathematical analysis was stated as follows: limiting in chronic salpingo-oophoritis with chronic cystitis, chronic salpingo-oophoritis with chronic pyelonephritis; then - chronic salpingo-oophoritis with endometritis, chronic salpingo-oophoritis with bacterial vaginosis, chronic salpingo-oophoritis with cervicitis; next – chronic salpingo-oophoritis and acute salpingo-oophoritis.

In general, the data obtained proved that, when pathological inflammatory processes in the urinary tract changed from acute into chronic, from mono into combined, immunologic parameter changes increased and differentiatedquantitatively-qualitatively; this conformed with the expressed variations of the metabolic summands of the anti-oxidant stress or vice versa. Methods of detection of key parameters were used to prove correlation of the indicated mechanisms. The analysis of these correlations is presented in Table 4.

Table 4: Signaling tests of the key formulas of immune-metabolic disorders and their correlations in patients with salpingo-oophoritis

Diseases	Formula of the immune system disorders	Formula of the metabolic disorders	Correlations
Acute salpingo-oophoritis	$TNF^{+}{}_{3}ClC^{+}{}_{3}IgM^{+}{}_{3}$	$MDA^{+}{}_{2}PAA^{-}{}_{1}PT^{-}{}_{1}$	$ClC^{+}{}_{3}$ **-CP**; $IgM^{+}{}_{3}$ **+BL.**
Chronic salpingo-oophoritis	$T^{-}{}_{3}IgM^{+}3IL6^{+}{}_{3}$	$VE^{+}{}_{1}PAA^{-}{}_{1}ScB^{+}{}_{2}$	$T^{-}{}_{3}$**+ScB**; $IgM^{+}{}_{3}$**+CP**; $IL6^{+}{}_{3}$**+C**
Chronic salpingo-oophoritis + chronic cystitis	$IgA^{+}{}_{3}Tac^{+}{}_{2}NBTac^{-}{}_{3}$	$MDA^{+}{}_{3}SOD^{-}{}_{2}PAA^{-}{}_{2}$	$IgA^{+}{}_{3}$**–MDA,+PAA**;$Tac^{+}{}_{2}$**+CP,+ST**; $NBTac^{-}{}_{3}$**+BL,+SOD, +C.**
Chronic salpingo-oophoritis + bacterial vaginosis	$Th^{-}{}_{2}ClC^{+}{}_{3}Tac^{+}{}_{3}$	$CP^{+}{}_{2}ST^{-}{}_{2}PAA^{-}{}_{2}$	$ClC^{+}{}_{3}$**+KD,+ScB,+BL**;$Tac^{+}{}_{3}$**+SOD,+ST**
Chronic salpingo-oophoritis +	$IgG^{+}{}_{2}NKc^{+}{}_{2}IgM^{+}{}_{2}$	$KD^{+}{}_{2}BL^{-}{}_{2}C^{-}{}_{2}$	$IgG^{+}{}_{2}$**-KD,-PAA**;$IgM^{+}{}_{3}$**-DC,+NPT, +PT**

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cervicitis			
Chronic salpingo-oophoritis + chronic pyelonephritis	$M^{+}_{3}B^{+}_{3}NBT_{sp}^{-}{}_{2}$	$BL^{+}_{2}SOD^{-}_{2}PT^{-}_{2}$	M^{+}_{2}-**VE,-ST**;B^{+}_{3}–**MDA,-BL**,-**C, +SOD**; $NBTsp^{-}_{2}$+KD**,-CP**
Chronic salpingo-oophoritis + endometritis	$T^{-}_{2}NK^{+}_{3}$тIgA$^{+}_{3}$	$ST^{-}_{2}VE^{-}_{3}PAA^{-}_{2}$	T^{-}_{2}+**VE,+CP,+C**;NK^{+}_{3}-KD**;** IgA$^{+}_{3}$+**MDA,+PAA**

As defined, tumor necrosis factor α, auto-aggressive CIC, IgM, and MDA, plasma anti-oxidant activity, bi-tyrosine linkages were stated to be the signaling tests of the formula of the immune system disorders and the formula of metabolic disorders, respectively. Correlative analysis revealed strong correlations of the CIC level with the non-drug factor of the anti-oxidant defense system – ceruleoplasmin – and immune globulins M with the free radical oxidation parameter – bi-tyrosine linkages.

Predominant decrease of T-cell level with accumulation of high-molecular-weight immune globulins and anti-inflammatory IL6 was registered in chronization of inflammation in the uterine adnexa. Activation of formation of vitamin E and Schiff's bases, and reduction of plasma anti-oxidative activity was observed simultaneously with these processes. Moreover, key tests of the formula of the immune system disorders were reported to be associated with two parameters of the free radical oxidation – Schiff's bases and ketodienes, and one parameter of the anti-oxidant defense system – ceruleoplasmin.

Complication of chronic salpingo-oophoritis by chronic cystitis caused modification of the qualitative composition of the formulas of the immune and metabolic disorders. Patients manifested hyper immune globulinemia A, excess of T-activated lymphocytes, decreased amount of the neutrophil oxygen exchange, stimulation of MDA concentration against decrease of superoxide dismutase and plasma anti-oxidative activity. Basic immunologic tests of the formula of the immune system disorders changed consistently: IgA$^{+}_{3}$ - with MDA level,+plasma anti-oxidative activity;Tac$^{+}_{2}$ - - +ceruleoplasmin,+systemic thiols; NBTactiv$^{-}_{3}$ - +bi-tyrosine linkages,+SOD, +catalase.

Bacterial vaginosis resulted in the predominant decrease of the T-helpers level; increase of CIC, T-active lymphocytes, a free radical oxidation factor – ceruleoplasmin; suppression of the anti-oxidant defense system parameters – SOD and plasma anti-oxidative activity. Correlative analysis reported relevant dependence of CIC on the content of free radical oxidation products – ketodienes, Schiff's bases, bi-tyrosine linkages; correlative analysis also reported relevant dependence of T-active cells on the anti-oxidant defense system factors – SOD and systemic thiols.

Differences of the laboratory findings from the norm level in patients with purulent inflammatory disorders are given as formalized assessment in Table 5, andas correlations of signaling tests – in Table 6.

Table 5: Formalized assessment of differences of the laboratory parameters from the norm level in patients with purulent inflammatory disorders

Parameters	Frontal analysis			Grouped parameters									CL	Σ of ranks	variations
	Σ	+	-	H	I	M	Detailed values								
							К	В	Ф	Ц	С	А			
Acutepurulent pyelonephritis	2	2	3	1	2	2	2	1	2	2	2	2	4/V	27	27 XII
Acutecystitis	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**3**	**2**	**2**	3/VI	32	32 XII
Exacerbationofchronic cystitis	2	3	3	3	2	1	2	2	3	2	2	2	3/VI	33	33 XIII
Acute pyelonephritis	2	3	3	2	2	2	2	2	1	3	2	2	3/VI	32	32 XII
Exacerbation of chronic pyelonephritis	1	2	3	1	1	1	1	1	1	3	1	1	3/VI	23	23 VII

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Combined purulent inflammatory disorders															
Exacerbation of chronic cystitis + Exacerbation of chronic pyelonephritis	1	2	2	1	1	1	1	1	1	1	1	1	5/IV	18	18 II
Acute salpingo-oophoritis	2	2	3	1	2	2	2	1	2	2	2	2	2/VII	27	2 XII
Exacerbation of chronic salpingo-oophoritis	1	2	3	1	2	1	2	1	2	2	1	2	3/VI	25	25 IX
Exacerbation of chronic salpingo-oophoritis+Exacerbation of chronic pyelonephritis	1	2	3	1	1	1	1	1	1	2	1	1	8/I	24	24 VIII
Exacerbation of chronic salpingo-oophoritis+ Exacerbation of chronic cystitis	1	2	2	1	1	1	1	1	1	2	1	1	7/II	17	17 I
Exacerbation of chronic pyelonephritis + МКБ	1	2	3	1	1	1	1	1	1	1	2	1	6/III	19	19 III
Exacerbation of chronic salpingo-oophoritis+bacterial vaginosis	2	2	3	1	1	1	2	1	1	1	1	1	5/IV	21	21 V
Exacerbation of chronic salpingo-oophoritis+cervicitis	1	2	2	1	2	1	1	2	1	2	2	1	5/IV	22	22 VI
Exacerbation of chronic salpingo-oophoritis**+endometritis**	1	2	2	2	1	1	1	1	2	1	1	1	6/III	19	19 III
nocturia+ benign prostatic hypertrophy	1	2	2	1	1	2	1	1	1	1	1	2	6/III	19	19 III
Purulent infection of soft tissues	2	2	3	2	2	1	1	1	2	2	1	1	3/VI	26	26 X

Table 6: Correlations of signaling tests of the immune metabolic disorders key formulas

Disorder	Formula of the immune system disorders	Formula of metabolic disorders	Correlations
Mono purulent inflammatory disorders			
Acute purulent pyelonephritis	$CIC^{+}{}_{3}NKcyt^{+}3IL6^{+}{}_{3}$	$VE^{+}{}_{3}MDA^{+}{}_{2}PAA^{-}{}_{2}$	$CIC^{+}{}_{3}$**+ScB.-CP**; $NKcyt^{+}{}_{3}$ **+PAA**; $IL6^{+}{}_{3}$**+KD**
Acute pyelonephritis	**$PhI^{+}{}_{2}MWM^{+}{}_{3}Tcyt^{+}{}_{3}$**	$C^{-}{}_{1}PAA^{-}{}_{2}VE^{-}{}_{1}$	$PhI^{+}{}_{2}$**–MDA,+ScB;** $MWM^{+}{}_{3}$**-PAA**
Exacerbation of chronic pyelonephritis	**$B^{+}{}_{3}MWM^{+}{}_{3}NBTsp^{-}{}_{2}$**	$ScB^{+}{}_{2}SOD^{-}{}_{2}MDA^{+}{}_{3}$	$B^{+}{}_{3}$**+MDA**; $Tcyt^{+}{}_{3}$**-VE,-SOD**;
Acute salpingo-oophoritis	**$TNF^{+}{}_{3}CIC^{+}{}_{3}IgM^{+}{}_{3}$**	$MDA^{+}{}_{2}PAA^{-}{}_{1}PT^{-}{}_{1}$	$CIC^{+}{}_{3}$ **-CP**; $IgM^{+}{}_{3}$ **+BL.**
Exacerbation of chronic salpingo-oophoritis	**$T^{-}{}_{3}IgM^{+}{}_{3}IL6^{+}{}_{3}$**	$VE^{+}{}_{1}PAA^{-}{}_{1}ScB^{+}{}_{2}$	$T^{-}{}_{3}$**+ScB**;$IgM^{+}{}_{3}$**+CP**; $IL6^{+}{}_{3}$**+C**
Acute cystitis	**$Tcyt^{+}{}_{3}IgM^{+}{}_{3}$ $MWM^{+}{}_{3}$**	$PAA^{-}{}_{2}C^{-}{}_{1}SOD^{-}{}_{1}$	$Tcyt^{+}{}_{3}$ **–BL,-KD** ; $MWM^{+}{}_{3}$ **–VE**

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Exacerbation of chronic cystitis	**$Th^{-}_{2}IgA^{-}_{2}$ $IL8^{+}_{3}$**	$CP^{+}_{2}ST^{-}_{3}PAA^{-}_{2}$	Th^{+}_{2}**+DC;**$IL8^{+}_{3}$ **–VE,-ST**.
Purulent infection of soft tissues	$Tcyt^{+}_{3}IL8^{+}_{3}B^{-}_{2}$	$PAA^{-}_{3}KD^{+}_{2}MDA^{-}_{1}$	$Tcyt^{+}_{3}$**+MDA;**B^{-}_{2}**+PAA+C**
Combined purulent inflammatory disorders			
Exacerbation of chronic cystitis+ Exacerbation of chronic pyelonephritis	$L^{+}_{3}T^{-}_{3}PhN^{-}_{3}$	$KD^{+}_{2}MDA^{+}_{2}SOD^{-}_{2}$	L^{+}_{3} **+DC**; T^{-}_{3}**+ScB,-SOD**; PhN^{-}_{3}-C**,-NPT**
Exacerbation of chronic cystitis + Exacerbation of chronic salpingo-oophoritis	$IgA^{+}_{3}Tac^{+}_{2}NBTac^{-}_{3}$	$MDA^{+}_{3}SOD^{-}_{2}PAA^{-}_{2}$	IgA^{+}_{3} **–MDA,+PAA**;Tac^{+}_{2}**+CP,+ST**; $NBTac^{-}_{3}$**+BL,+SOD, +C.**
Exacerbation of chronic salpingo-oophoritis + endometritis	$T^{-}_{2}NK^{+}_{3}$тIgA$^{+}_{3}$	$ST^{-}_{2}VE^{-}_{3}PAA^{-}_{2}$	T^{-}_{2} **+VE,+CP,+C**; NK^{+}_{3}**-CD;** IgA^{+}_{3}**+MDA,+PAA**
Exacerbation of chronic salpingo-oophoritis + bacterial vaginosis	$Th^{-}_{2}CIC^{+}_{3}Tac^{+}_{3}$	$CP^{+}_{2}ST^{-}_{2}PAA^{-}_{2}$	CIC^{+}_{3}**+KD,+ScB,+BL**;Tac^{+}_{3}**+SOD,+ST**
Exacerbation of chronic salpingo-oophoritis + cervicitis	$IgG^{+}_{2}NKcyt^{+}_{2}IgM^{+}_{2}$	$KD^{+}_{2}BL^{-}_{2}C^{-}_{2}$	IgG^{+}_{2} **-KD,-PAA**; IgM^{+}_{3}**-DC,+NPT, +PT**
Exacerbation of chronic salpingo-oophoritis + Exacerbation of chronic pyelonephritis	$M^{+}_{3}B^{+}_{3}NBTsp^{-}_{2}$	$BL^{+}_{2}SOD^{-}_{2}PT^{-}_{2}$	M^{+}_{2}**-VE,-ST**; B^{+}_{3} **–MDA,-BL**,**-C, +SOD**; $NBTsp^{-}_{2}$**+KD,-CP**
Exacerbation of chronic pyelonephritis + kidney stone disease	$B^{+}_{3}CIC^{+}_{3}Th^{+}_{2}$	$MDA^{+}_{3}ScB^{+}_{2}PAA^{-}_{3}$	B^{+}_{3}**-ScB,+PAA,+MDA,-C**; CIC^{+} **CP,-ST**
nocturia+benign prostatic hypertrophy	$Tcyt^{-}_{3}CIC^{+}_{3}IL6^{-}_{2}$	$DC^{-}_{2}MDA^{-}_{1}ST^{-}_{3}$	$Tcyt^{+}_{3}$ **+KD.-MDA,+BL**;CIC^{+}_{3}**-CP;** IL^{-}_{2}**-KD,+PAA**

Notes: Tcyt – T cytotoxic, IgM - immune globulins of class M, MWM - medium weight molecules, Th – T-helpers, IgA – immune globulins of class A, IL8 – interleukins 8, L – leukocytosis, M – monocytes, T – T-cells, PhN – phagocytic number, PhI – phagocytic index, Tac – T active, NBTac – Nitro Blue Tetrazolium activated, NBTsp - Nitro Blue Tetrazolium spontaneous, AOD – anti-oxidant defense system, C – catalase, SOD – superoxide dismutase, CP – ceruleoplasmin, ST – systemic thiols, PAA – plasma anti-oxidative activity, KD – ketodienes, MDA – malondialdegyde, BL – bi-tyrosine linkages, VE – vitamin E, DC – diene conjugate, ScB – Schiff's bases, NPT – non-protein thiols.

Results of the frontal analysis of the laboratory findings in patients with purulent inflammatory disorders are summarized in Table 7.

Table 7: Frontal analysis of the relevant differences of laboratory findings from the normal level in patients with purulent inflammatory disorders

Parameters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Hematologic																
Leukocytes	+			+	+	+	+	+	+	+	+	+	+	+	+	
Lymphocytes	+				-	-	-	-	-	-	-		-	-	-	
Stab				+	+	+	+	+		+		+			+	+
Segmentonuclear	+				+	+	+	+	+	+	+	+	+		+	+
Eosinophils	+				+	+	+	+	+	+	+		+	+	+	+
Monocytes	+			+	+	+		+	+	+	+	+	+		+	+
ESR	+			+	+	+	+	+	+	+	+	+	+		+	
Cellular																
T	-	-	-		-	-	-	-	-		-	-	-	-	-	-
Th	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-

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Tc	-		-		-	-		+	+	+	+	+	+	-	+	+
Tregul	-				+	-			+	-	+			-	-	
Tac		+	-	+	+	+	+	+	+	+		+	-	-		-
$NK_{T\text{-dependent}}$		+		+		+	+	+	+	+	+			+		
NK_{regul}		+	+	-	+	+				+		+			+	
$NK_{cytotoxic}$	-	+	+	+		+					+		+		+	-
B-dependent																
B		+	+		+	+	+	+	+		+	+	+	+	+	-
IgM	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
IgG	+	+			+	+			-	-	+	+	+	+	-	-
IgA		+	-			+	+	+	-	-	-	-		+	-	
CIC	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+
MWM	+			+	+	+	+	+	+	+	+	+			+	+
Phagocytic																
CD11b					+			-		-					-	
CD18				+				+								
Phagocytic index (PhI)	-	+	-	+	+	+		-	-	-	+	-	-	-	-	-
Phagocytic number (PhN)	-	+	-	+		+	+		-	-	+	-	-		+	
NBT_{sp}	-	-		-	-	-	-	-	-	-	-	+	-		-	-
NBT_{ac}	-		-		-	-	-		-	-	-	-	-	-	-	-
Cytokine																
IL2						-		+	-		-	-		-		
IL4			-			-				-	-	-		-	-	-
IL6	+		+		+	+			+		+		+	+	+	
IL8		+			+	+	+	+	+		+	+	+	+		+
IL10											-			-	-	+
Tumor necrosis factor (TNF)			+	+		+	+	+		+	+	+	+	+	+	
Free radical oxidation of lipids and proteins																
Malondialdegyde (MDA	+		+	+	+	+	+	+	+	+	+		+	+	+	+
Diene conjugates					-	-	-	-	+	+	-	+	+	+	-	+
Ketodienes	+		+	+	+	-		+		+		+	+	+	+	+
Schiff's bases	+	+			+			+	+	+	+	+				+
Bi-tyrosine linkages		+	+	-		-			+	+		+		+	+	
Anti-oxidant defense																
Plasma antioxidative activity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vitamin E	+		-	-	+	-		+	-	-	+		-	-	+	-
Superoxide dismutase (SOD),	-	-	+		-			-	-	-	-		-	-	-	+
Ceruleoplasmin			+	+	+	-	+	+		-	+	+	+	-		+
Systemic thiols		-	-		-				-	-	-	-		-		-
Non-protein thiols						-	+		-	-		-	-	-		
Protein thiols	-					-	-		-	-		-	-		-	
Catalase	-	-	-	-	-	-		-	-	-	-	-	-	-		-

Notes: 1-acute purulent pyelonephritis, 2-chronic cystitis, 3-exacerbation of chronic cystitis, 4-acute pyelonephritis, 5 –exacerbation of chronic pyelonephritis, 6- exacerbation of chronic cystitis + exacerbation of chronic pyelonephritis, 7- acute salpingo-oophoritis, 8-exacerbation of chronic salpingo-oophoritis, 9-exacerbation of chronic salpingo-oophoritis + exacerbation of chronic pyelonephritis, 10- exacerbation of chronic salpingo-oophoritis + exacerbation of chronic cystitis, 11 – exacerbation of chronic pyelonephritis + kidney stone disease, 12 – exacerbation of chronic salpingo-oophoritis + bacterial vaginosis, 13— exacerbation of chronic salpingo-oophoritis + cervicitis, 14- exacerbation of chronic salpingo-oophoritis + endometritis, 15-nocturia+benign prostatic hypertrophy, 16-purulent infection of soft tissues.

CONCLUSIONS

To sum up, the data obtained proved that, when pathological inflammatory processes in the urinary tract changed from acute into chronic, from mono into combined, immunologic parameter changes increased and differentiated quantitatively-qualitatively; this conformed with the expressed variations of the metabolic summands of the anti-oxidant stress or vice versa.

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