DOI 10.26724/2079-8334-2023-1-83-138-143
UDC 616.12-008.331.1:616.9-071

G.V. Nevoit, A.S. Korpan[1], O.E. Kitura[1], T.V. Nastroga[1], N.L. Sokolyuk[1], N.A. Lyulka[1], M.M. Potiazhenko[1]
Lithuanian University of Health Sciences, Kaunas, [1] Poltava State Medical University, Poltava

ELECTRO-PHOTONIC EMISSION ANALYSIS IN PATIENTS WITH NONCOMMUNICABLE DISEASES: ESSENTIAL HYPERTENSION

e-mail: ganna,nevoit@lsmu.lt

78 polymorbid patients with essential hypertension and 85 functionally healthy respondents were obtained by the method of electro-photonic emission analysis. Patients with essential hypertension had significant differences in all physical and mathematical parameters of electro-photonic emission analysis compared to functionally healthy young respondents, which testifies to a different course of metabolic processes in them. The electro-photonic emission analysis method is a modern, high-tech, accessible, valid instrumental method for assessing ultra-weak photon emission and indirect research of mitochondrial function, which can provide an opportunity to objectively assess the course of energy processes at the tissue level of metabolism, determine the level of stress, the parameters of the balance of the body's functioning. The electro-photonic emission analysis method can be recommended as promising for use in scientific research and in clinical practice during the objective examination of patients.

Key words: noncommunicable diseases, objective structured clinical examination, mitochondrial dysfunction, electro-photonic emission analysis, ultra-weak photon emission, essential hypertension.

Г.В. Невойт, А.С. Корпан, О.Є. Кітура, Т.В. Настрога, Н.Л. Соколюк, Н.О. Люлька, М.М. Потяженко

АНАЛІЗ ЕЛЕКТРОФОТОННОЇ ЕМІСІЇ У ХВОРИХ НА НЕІНФЕКЦІЙНІ ЗАХВОРЮВАННЯ: ЕССЕНЦІАЛЬНУ ГІПЕРТЕНЗІЮ

Методом аналізу електрофотонної емісії було обстежено 78 поліморбідних хворих на гіпертонічну хворобу та 85 функціонально здорових респондентів. Хворі на гіпертонічну хворобу мали достовірні відмінності за всіма фізико-математичними параметрами аналізу електрофотонної емісії відносно функціонально здорових респондентів молодого віку, що свідчить про різний перебіг метаболічних процесів у них. Метод аналізу електрофотонної емісії – це сучасний, високотехнологічний, доступний, дієвий інструментальний метод оцінки надслабкого фотонного випромінювання та непрямого дослідження функції мітохондрій, який може надати можливість об’єктивно оцінити перебіг енергетичних процесів у тканинах, рівень обміну речовин, визначити рівень стресу, параметри балансу функціонування організму. Метод аналізу електрофотонної емісії можна рекомендувати як перспективний для використання в наукових дослідженнях і в клінічній практиці при об'єктивному обстеженні пацієнтів.

Ключові слова: неінфекційні захворювання, загально-клінічне об’єктивне обстеження, мітохондріальна дисфункція, аналіз електрофотонної емісії, надслабка емісія фотонів, есенціальна гіпертензія

The study is a fragment of the research project “Development of algorithms and technology for introducing a healthy lifestyle in patients with non-communicable diseases based on the study of functional status”, state registration No. 0121U108237.

Noncommunicable diseases (NCDs) are a significant medical and social problem. NCDs have a pandemic level of morbidity and are characterized by polymorbidity with gradual involvement of all organs and systems in the continuum of chronic disease. A long-term study of the pathogenesis of diseases of internal organs by fundamental science revealed mitochondrial dysfunction, which is one of the universal pathogenetic mechanisms of NCDs. Further scientific progress of fundamental science in the 21st century opened new functions of mitochondria, new phenomena of their functioning and energy. It has now been scientifically proven that the electromagnetic processes of mitochondrial membranes and cytoplasm form the basis of mitochondrial and cell functioning [6, 7, 14, 15]. Violation of these processes leads to gradual qualitative and quantitative degradation of the mitochondrial pool and causes the development of the NCDs continuum due to the occurrence of various forms of tissue hypoxia, etc. [14]. Modern science has established that the electromagnetic processes of metabolic reactions in mitochondria are accompanied by the release of energy in the light range of the spectrum in the form of photons. The phenomenon is called photon emission. This process of emitting photons is not visible to the human eye, so the term ultraweak photon emission (UPE) is often used in science. The German biophysicist Fritz-Albert Popp in the 70s of the twentieth century was the founder of the scientific study of the phenomenon and brought data about it to the required level of scientific evidence [1–3, 10, 11]. Now the spectral components and a number of basic physical parameters of UPE are sufficiently studied in the simplest organisms and in humans. UPE parameters are considered as indicators of mitochondrial functions. UPE analysis is proposed by a number of scientists as a promising non-invasive method for assessing tissue metabolism and the functional state of the human body [4, 8, 9, 12, 13]. UPE can be used in an electromagnet field. This is called electro-photonic emission and the method is called electro-photonic emission analysis (EPEA). The use of modern compact digital software and hardware systems EPEA for non-invasive study of integral indices of metabolism and mitochondrial function can open up new technical possibilities and new prospects for the study and practical use of UPE in medicine during the clinical examination of patients with NCDs [4–7].

The purpose of the study was to investigate the phenomenon of electro-photonic emission by the method of electro-photonic emission analysis in patients with noncommunicable diseases with essential hypertension and functionally healthy respondents for a further thorough diagnosis and loss of fundamental knowledge of the etiology and pathogenesis of disease of internal organs.

Materials and methods. 163 people were included in an open, non-randomized, controlled study. Group 1 consisted of patients (G1, n=78, the median age – 60 (32; 86), men – 68 %) with NCDs with a verified diagnosis of essential hypertension, stage 2–3 as the main disease in combination with other comorbid pathology. Group 2 (control) consisted of functionally healthy young respondents (G2, n=85, the median age – 24 (23; 26), men – 58%). 39 patients (subgroup G1 (UW), median age – 24 (23; 25) years) and 44 functionally healthy respondents (subgroup G2 (UW), median age – 24 (23; 25) years) were examined before the war in Ukraine. 39 patients (subgroup G1 (DW), median age – 24 (23; 25) years) and 41 functionally healthy respondents (subgroup G2 (DW), median age – 23 (23; 26) years) were examined during the war in Ukraine. Thus, it became possible to compare EPEA parameters before and during the war.

EPEA was performed on a digital software-certified measuring hardware device Bio-Well 2.0 (United States). All study participants underwent a full scan in the alternate photo registration mode with the Bio-Well device of ten fingers: thumb left (1L), index left (2L), middle left (3L), ring left (4L), little left (5L), thumb right (1R), index right (2R), middle right (3R), ring right (4R), little right (5R). The parameters were evaluated: 1) area is number of pixels of the glow image (GI); 2) area (C) is ratio of area of the finger glow to the area of glow of calibration cylinder (for sector or whole image); 3) normalized area is the ratio of GI area to the area of the inner oval; 4) intensity is average intensity of all the pixels from the GI; 5) inner area is overall number of pixels in the inner oval; 6) energy is energy of glow in $*10^{-2}$ Joules; 7) form coefficient (FC) is calculated according to the formula: $FC=L^2/S$, where L is the length of the GI external contour and S is the GI Area; 8) entropy coefficient (EC) is the ratio of outer contour to the inner contour lengths; 9) inner contour length in pixels; 10) inner contour radius in pixels; 11) outer contour length in pixels; 12) outer contour radius in pixels; 13) stress (c.u.) is a numerical assessment of the patient's psycho-emotional and functional state on the basis of determining the curvature of the outer contour of the radiation of photons of the fingers; 14) energy (E, Joule/J, the total energy level for the whole body) is a numerical estimate of the light energy of the photographed photon radiation, multiplied by the area, intensity and correction factor; 15) balance (B, %), balance left and right (BL and BR, %) are indices of the difference between of the left and right hands [4, 5].

The study was approved by the Ethics Committee. All applicable ethical rules have been observed. Statistical analysis was performed using the Prism 5.0 software package. The data obtained are presented as mean values with their mean error (M±m). Mann-Whitney U-test was used to compare and determine the statistical significance of differences between groups. The differences were considered significant at $p<0.05$.

Results of the study and their discussion. We obtained significantly different EPEA parameters in the comparison groups. The results of EPEA digital images of each finger in the study groups are shown in Tables 1 and 2.

Group analysis of energy levels found a significant decrease ($p<0.0001$) the E in the group G1 (51.02±18,88 J) compared to the group G2 (54.22±14.87 J). The scale of clinical interpretation of the E was as follows: E – 0-20 J – it's low level, 20-40 J – it's low level, 40–70 J – it's optimal level, 70–90 J – it's increased level, 90–100 J – it's high level.

Group analysis of the stress level index did not establish a significant difference between groups G1 (3.84±1 c.u.) and G2 (3.58±0.55 c.u.). Stress was at the level of anxiety in both groups according to the scale of clinical interpretation: 0–2 c.u. – it's calm state, 2–3 c.u. – it's optimal condition, 3–4 c.u. – it's anxiety, 4–6 c.u. – it's average condition, 6–8 c.u. – it's increased stress levels, 8–10 c.u. – it's distress. Comparison of the level of stress in subgroups before and during war events did not reveal significant differences: the level of stress before the war in subgroup G1 (UW) was 3.69±0.8, the level of stress in subgroup G1 (DW) was 3.99±1.16 ($p=0.0598$); the stress level before the war in subgroup G2 (UW) was 3.47±0.46; the level of stress in subgroup G2 (DW) was 3.70±0.62 ($p=0.0598$).

Group analysis of photon emission balance parameters established a significant difference ($p<0.0001$) in BL between groups G1 (82±13.28 %) and G2 (90.47±7.35 %). The B in the G1 group was 95.1±5.4 % and in the G2 group was 96.73±3.17 % ($p=0.1484$). The BR in the G1 group was 89.4±8.3 % and in the G2 group was 91.8±5.7 % (p=0.2023). The scale of clinical interpretation of balance indicators was as follows: B – 0-50 % – it's very low balance; 50–90 % – it's low balance; 90–100 % – it's optimal balance; BL, % 0–5% – it's optimal balance; 5–10 % – it's average imbalance; 10 % – >15% – it's severe imbalance; BR, % – 0–5 % – it's optimal balance; 5–10 % – it's average imbalance 10 % – >15 % – it's severe imbalance.

Table 1

Comparative characteristics of the physical and mathematical parameters of EPEA in study groups: part 1

P	Area			Area (C)			Normalized Area		
F/G	G1	G2	P value	G1	G2	P value	G1	G2	P value
1L	11323±3090	11487±1974	0.006	-0.025±0.782	0.056±0.479	0.0007	1.274±0.630	1.664±0.626	<0.0001
2L	10473±2595	10951±1895	0.0001	0.081±0.717	0.178±0.492	0.0052	1.752±1.021	2.373±0.977	<0.0001
3L	10778±2855	11117±2059	0.0006	0.064±0.737	0.177±0.517	0.0021	1.802±1.25	2.104±0.767	<0.0001
4L	10621± 3021	10905±1913	<0.0001	-0.031±0.814	0.002±0.485	0.0037	2.149±1.091	2.428±0.923	0.013
5L	10793±3313	10883±1793	0.0004	-0.093±0.850	-0.514±0.484	0.0003	2.749±1.739	3.203±1.246	0.0008
1R	11114±3489	11566±2077	0.0005	-0.104±0.869	0.082±0.482	<0.0001	1.103±1.185	1.610±0.656	<0.0001
2R	10713±3451	10995±1955	<0.0001	0.097±0.884	0.165±0.492	<0.0001	1.787±0.865	2.276±0.965	<0.0001
3R	10695± 3205	11059±1915	<0.0001	0.032±0.859	0.147± 0.475	0.0002	1.742±1.035	2.131±0.931	<0.0001
4R	10646± 3024	11003±1863	0.0003	-0.402±0.829	0.048±0.466	0.0015	2.309±1.517	2.436±0.788	0.0024
5R	10422±2649	10828±1967	<0.0001	-0.173±0.733	-0.075±0.470	<0.0001	2.816±1.516	3.096±1.209	0.0273
P	Intensity			Inner area			Energy		
F/G	G1	G2	P value	G1	G2	P value	G1	G2	P value
1L	88.57±12.16	95.96±7.426	<0.0001	10395±3905	7768±2863	<0.0001	4.482±2.085	4.813±1.28	<0.0001
2L	93.04±11.47	98.32±7.511	<0.0001	6952±2503	5312± 228	<0.0001	4.328±1.803	4.707±1.333	<0.0001
3L	93.58±11.88	98.38±6.65	<0.0001	7236±2655	5822±1874	<0.0001	4.499±1.985	4.781±1.367	<0.0001
4L	96.41±11.87	99.94±6.933	<0.0001	5683±2268	5018±1742	0.1367	4.572±2.121	4.762±1.312	<0.0001
5L	98.07±12.68	102.2±7.682	<0.0001	4895± 2267	3926±1677	0.0034	4.723±2.228	4.857±1.287	<0.0001
1R	87.54±13.44	94.78±7.27	<0.0001	10698±4252	8139±3032	<0.0001	4.396±2.311	4.79±1.317	<0.0001
2R	93.65±12.19	98.35±7.441	<0.0001	6823±2580	5544±2302	0.0004	4.511±2.307	4.722±1.313	<0.0001
3R	93.56±12.23	98.58±6.906	<0.0001	7133±2417	5839±1965	0.0003	4.4.88±2.193	4.762±1.248	<0.0001
4R	96.48±12.25	99.76±6.925	<0.0001	5713± 2414	4920±1633	0.0152	4.581±2.09	4.796±1.276	<0.0001
5R	98.77±12.45	101.5±7.164	<0.0001	4433± 847	4054±1733	0.124	4.584±1.965	4.802±1.344	<0.0001

Note: P is short forms of the Parameter; F/G is short forms of the Finger/Group; P value – the difference Mann-Whitney test between the characteristics of the study groups.

Table 2

Comparative characteristics of the physical and mathematical parameters of EPEA in study groups: part 2

P	Form Coefficient			Entropy Coefficient			Inner contour length		
F/G	G1	G2	P value	G1	G2	P value	G1	G2	P value
1L	2.41±0.226	2.468±0.306	0.3565	1.846±0.248	1.947±0.237	0.0144	477.4±80.94	382±62.66	0.0004
2L	2.501±0.398	2.588±0.342	0.0182	1.981±0.336	2.166±0.296	<0.0001	360.8±62.54	320.6±57.5	<0.0001
3L	2.512±0.341	2.583±0.276	0.0626	1.994±0.368	2.086±0.242	0.0035	367±65.93	338±47.99	0.0012
4L	2.572±0.279	2.634±0.292	0.1695	2.099±0.326	2.179±0.271	0.0517	330.8±59.61	316.7±49.34	0.2672
5L	2.625±0.403	2.692±0.366	0.0307	2.283±0.524	2.403±0.371	0.0131	304.9±68.8	280.3±56.28	0.0185
1R	2.572±0.510	2.506±0.325	0.5542	1.9± 0.361	1.951±0.266	0.0529	431.5±81.42	388.7±66.39	0.0002
2R	2.461± 0.315	2.574±0.365	0.0145	1.977±0.304	2.132±0.308	0.0011	356.8±61.7	327.9±59.51	0.0027
3R	2.556±0.413	2.56±0.286	0.124	2.014±0.351	2.094±0.308	0.0605	362.9±61.22	337.1±54.19	0.0047
4R	2.592±0.387	2.626±0.387	0.2349	2.131±0.376	2.174±0.282	0.1674	328.9±66.63	316.5±46.5	0.1265
5R	2.656±0.493	2.65±0.353	0.5858	2.317±0.535	2.358±0.394	0.1424	293.1±58.76	285.2±56.91	0.2456
P	Inner contour radius			Outer contour length			Outer contour radius		
F/G	G1	G2	P value	G1	G2	P value	G1	G2	P value
1L	56.34±10.75	48.78±8.855	<0.0001	771.5±72.83	731.5±66.38	0.0001	78.98±8.74	74.22±7.419	0.005
2L	46.2±8.302	40.19±7.982	<0.0001	698.1±68.97	680.1±61.11	0.1389	70.17±6.906	67.44±6.757	0.0082
3L	47.09±8.822	42.41±6.722	<0.0001	711.9±65.24	695.1±49.89	0.0415	71.54±6.902	69±5.741	0.0136
4L	41.69±7.905	39.29±6.681	0.1281	679.1±60.42	678.9±51.63	0.9048	67.57±7.456	66.81±5.401	0.8337
5L	38.37±8.914	34.51±6.978	0.0028	668±76	655.9±65.34	0.5711	65.87±8.632	63.66±5.795	0.1277
1R	57.08±11.42	49.94± 9.07	<0.0001	799.2±97.95	743.9±67.28	0.0001	79.17±8.572	74.95±7.352	0.0007
2R	45.75±8.474	41.09±8.031	0.0003	691.2±70.83	684±57.81	0.6395	70.26±8.239	68.03±6.824	0.097
3R	46.88±8.177	42.4±7.158	0.003	714.3±78.6	691.5±52.68	0.0353	71.24±7.304	68.95±5.918	0.0248
4R	41.59±9.125	39.02±6.072	0.0138	680.4±76.4	677±48.28	0.8329	67.51±8.16	66.68±5.22	0.434
5R	36.71±7.709	35.11±7.198	0.726	653.6±62.15	653.1±57.47	0.726	64.28±7.327	64.02±6.148	0.8264

Note: P is short forms of the Parameter; F/G is short forms of the Finger/Group; P value – the difference Mann-Whitney U-test between the characteristics of the study groups.

During the individual analysis, it was established that during the war the level of stress increased in some patients, while it did not change in functionally healthy individuals. 13 % (5/39) of patients had an optimal level of stress in subgroup G1 (UW). The level of anxiety was in 64 % (25/39) of patients, the average level of stress was in 21 % (8/39) of patients, the high level of stress was in 2 % (1/39) of patients. The level of distress was not determined in patients of subgroup G1 (UW). The optimal level of stress in subgroup G1 (DW) was in 11 % (4/39) of patients. The level of anxiety was in 51 % (20/39) of patients, the average level of stress was in 35 % (14/39) of patients. The level of distress was diagnosed in 2 % (1/39) of patients in the G1 (DW) subgroup. The optimal level of stress in G2 (UW) was in 11 % (5/44) of respondents, the level of anxiety was in 75 % (33/44) of respondents, the average level of stress was in 14% (6/44) of respondents. A high level of stress and distress was not diagnosed in the respondents of subgroup G2 (UW). The optimal level of stress in subgroup G2 (DW) was 7 % (3/41) of respondents, the level of anxiety was 72 % (30/41) of respondents, the average level of stress was 21 % (8/41) of respondents. A high level of stress and distress was not diagnosed in the respondents of subgroup G2 (DW).

The established significant difference in all physical and mathematical parameters of EPEA between the comparison groups indicates a different level of activity of metabolic processes in sick and functionally healthy young people. This is due to varying degrees of mitochondrial activity and photon generation in the cells of healthy people and patients. UPE, according to some scientists, plays the role of communication between cells in tissues [1, 2, 13]. Therefore, the results obtained may also indicate a difference in signaling processes in the tissues of patients and functionally healthy people.

The group analysis of the index of the level of total energy established a significantly lower level of total energy according to EPEA calculations in patients compared to healthy respondents, although the average indices in both groups were within the normal range. The level of total energy in the normal range was diagnosed in all patients in subgroup G1 (UW) before the war. The optimal energy level was diagnosed in the G1 (DW) subgroup in 77 % (30/39) of patients, in 5 % (2/39) of patients a decrease in the overall energy level was diagnosed, and in 18 % (7/39) of patients there was an increase in the overall energy level. All respondents of subgroup G2 (UW) were diagnosed with a level of total energy in the normal range before the war as well. An optimal energy level in the G2 (DW) subgroup was diagnosed in 90 % (37/41) of respondents and in 10 % (4/41) of respondents an increase in total energy was diagnosed. It can be assumed that the increase in energy during registration during the war can be explained by nervous tension – “manager's syndrome”.

A balance study in groups G1 and G2 established probable differences in photon emission on the left arm (Table 2). This needs further study to explain in the future. There were no significant differences in balance indicators between subgroups G1 (UW) and G1 (DW), subgroups G2 (UW) and G2 (DW). It was found that in the G2 (UW) subgroup, 30 % (13/44) of respondents had an average left imbalance, 31 % (14/44) had an average right imbalance, and 36 % (16/44) had a significant left imbalance respondent, 14 % (6/44) of respondents had a significant imbalance on the right. 45 % (19/41) of respondents in the G2 (DW) group had an average left imbalance, 51 % (21/41) had an average right imbalance, 32 % (13/41) had a significant left imbalance, a significant imbalance it was the case in 32 % (13/41) of respondents in the G2 (DW) group. This indicates the presence of lateralization phenomena in them and is a sign of vegetative imbalance and a preclinical predictor of pathology.

A photon is a fundamental particle, a quantum of electromagnetic radiation in the visible range of the spectrum, which has the form of transverse electromagnetic waves and is a carrier of electromagnetic interaction. A photon is a massless particle that can exist only when moving at the speed of light. The electric charge of a photon is zero. A photon is the final stage of energy exchange in living organisms and is a component of information system interaction in living organisms. Therefore, it is possible to indirectly evaluate the levels of metabolism and activity of mitochondria during the study of living organisms according to the physical and mathematical parameters of the UPE. The energy level is a key integral indicator of the EPEA method, as it demonstrates the intensity of intermolecular transport of excited electrons and energy migration of electrical excitation of living tissues. EPEA reflects the intensity of electromagnetic components of chemical reactions of metabolism at all levels of the morphological hierarchy (from subatomic to organismic). Therefore, it is possible to obtain objective information about the levels of metabolism in different patients and healthy people [2–5, 13].

This study continued our study of UPE parameters in patients with NCDs. Our results are consistent with the results of a previous study of EPEA parameters in patients with coronary heart disease. And this confirms the fact that there is a different level of metabolism and activity of mitochondria in the tissues of healthy people and patients with NCDs [6, 7].

For a long time, the level of stress in medicine was assessed by testing patients using questionnaires. The method of determining the level of stress using a questionnaire has an insufficient level of objectivity, since the patient can give false answers to the questions. EPEA allows you to study the level of stress objectively according to the UPE parameters of tissues. Chronic stress through changes in metabolic regulation affects the course of chemical reactions and the nature of UPE, so the level of stress can be objectively determined by calculating EPEA indicators. Activation of the sympathoadrenal system affects metabolic processes, metabolism, and accordingly changes the nature of the contour of the glow border in the photograph. The hardware and software complex calculates mathematical parameters and, using the formula, calculates the objective level of stress as a physiological response of tissues to a complex of external and internal stress influences. The EPEA can be considered as a simple and affordable method for use in clinical conditions during the Objective Structured Clinical Examination of patients. It has proven validity and in various modifications of the equipment has long been used for scientific purposes to assess the functional state, level of adaptation and objective determination of the level of stress [1, 4, 5, 10].

Indices of energy balance and clinical assessment of UPE on the right and left halves of the body are important for clinical interpretation. A significant difference between UPE indices on the left and right can indicate disorders in the functioning of organs and be a topical reference point for pathology. The phenomenon of significant energy asymmetry (lateralization syndrome) is a manifestation of autonomic nervous system dysfunction and an objective sign of reduced adaptation reserves, energy homeokinesis disorder [4, 5].

According to the literature, in recent years, interest in the further study and application of UPE has begun to grow, as there are significant prospects in evaluating changes in UPE parameters in various NCDs: oncopathology, diabetes, symptomatic and arterial hypertension, etc. [4, 9–10, 12]. This was facilitated by the discovery of new functions and the importance of mitochondria and mitochondrial dysfunction in the pathogenesis of NCDs [11, 13]. Therefore, it is undoubtedly promising to continue the study of UPE parameters in diseases of internal organs with the aim of objective intravital non-invasive assessment of metabolic processes at the tissue level.

Conclusions

1. Patients with NCDs with essential hypertension had significant differences in all physical and mathematical parameters of EPEA compared to functionally healthy young respondents, which testifies to a different course of metabolic processes in them.

2. The EPEA method is a modern, high-tech, accessible, valid instrumental method for assessing UPE and indirect research of mitochondrial function, which can provide an opportunity to objectively assess the course of energy processes at the tissue level of metabolism, determine the level of stress, the parameters of the balance of the body's functioning.

3. The EPEA method can be recommended as promising for use in scientific research and in clinical practice during the objective examination of patients.

References

1. Burgos RCR, Schoeman JC, Van Winden LJ, Červinková K, Ramautar R, Van Wijk EPA, et.al. Ultra-weak photon emission as a dynamic tool for monitoring oxidative stress metabolism. Scientific RepoRts. 2017; 1–9. doi: 10.1038/s41598-017-01229-x

2. Calcerrada M, García-Ruiz C. Human ultraweak photon emission: key analytical aspects, results and future trends - a review. Crit. Rev. Anal. Chem. 2019; 49(4) :368–381. doi: 10.1080/10408347.2018.1534199

3. Kobayashi M, Iwasa T, Tada M. Polychromatic spectral pattern analysis of ultra-weak photon emissions from a human body. J. Photochem. Photobiol. B. 2016; 159 :186–190. doi10.1016/j.jphotobiol.2016.03.037

4. Korotkov K. Review of EPI papers on medicine and psychophysiology published in 2008-2018. Int J Complement Alt Med. 2018; 11(5) :311–315. doi 10.15406/ijcam.2018.11.00417

5. Korotkov KG. Principles of the human body functioning and their applications in integrative medicine (review). J Appl Biotechnol Bioeng., 2018; 5(6) :346–348. doi:10.15406/jabb.2018.05.00163

6. Nevoit GV, Potiazhenko MM, Mintser OP, Babintseva LYu. Electro-Photonic Emission Analysis and Hardware-Software recoding of Heart Rate Variability during an Objective Structured Clinical Examination. The World of Medicine and Biology. 2020; 4 :107–111. doi: 10.26724/2079-8334-2020-4-74-107-111.

7. Nevoit GV, Minser OP, Potiazhenko MM, Babintseva LYu. Electro-photonic emission analysis in functionally health respondents and patients with non-communicable diseases. Wiadomości Lekarskie. 2021; 6(74) :1439–1444. doi: 10.36740/WLek202106128

8. Ortega-Ojeda F, Calcerrada M, Ferrero A, Campos J, Garcia-Ruiz C. Measuring the Human Ultra-Weak Photon Emission Distribution Using an Electron-Multiplying, Charge-Coupled Device as a Sensor. Sensors (Basel). 2018; 18(4) :1152. doi: 10.3390/s18041152.

9. Sun M, Van Wijk E, Koval S, Van Wijk R, He M, Wang M, et.al. Measuring ultra-weak photon emission as a non-invasive diagnostic tool for detecting early-stage type 2 diabetes: a step toward personalized medicine J. Photochem. Photobiol. B. 2017; 166 :86–93. doi: 10.1016/j.jphotobiol.2016.11.013

10. Tsuchida K, Kobayashi M. Oxidative stress in human facial skin observed by ultraweak photon emission imaging and its correlation with biophysical properties of skin. Sci. Rep. 2020; 10 :9626. doi: 10.1038/s41598-020-66723-1

11. Van Wijk R, Van Wijk EPA, Pang J, Yang M, Yan Y, Han J. Integrating Ultra-Weak Photon Emission Analysis in Mitochondrial Research. Front. Physiol. 2020; 11 :717. doi: 10.3389/fphys.2020.00717
12. Yang M, Ding W, Liu Y, Fan H, Bajpai RP, Fu J, et.al. Ultra-weak photon emission in healthy subjects and patients with type 2 diabetes: evidence for a non-invasive diagnostic tool. Photochem. Photobiol. Sci. 2017; 16 :736–743. doi: 10.1039/c6pp00431h
13. Zapata F, Pastor-Ruiz V, Ortega-Ojeda F, Montalvo G, Ruiz-Zolle AV, García-Ruiz C. Human ultra-weak photon emission as non-invasive spectroscopic tool for diagnosis of internal states – A review. Journal of Photochemistry and Photobiology B: Biology. 2021; 216 :1011–1344, doi.org/10.1016/j.jphotobiol.2021.112141.
14. Zhdan VM, Holovanova IA, Khorosh MV, Tovstiak MM, Zinchuk AM. Comparative analysis of the dynamics of modified risk factors of non-communicable diseases among the population of China and Ukraine. Wiad Lek. 2019; 72(5 cz 2) :1108–1116. PMID: 31175754.
15. Zhunina OA, Yabbarov NG, Grechko AV, Starodubova AV, Ivanova E, Nikiforov NG, Orekhov AN The Role of Mitochondrial Dysfunction in Vascular Disease, Tumorigenesis, and Diabetes.Front. Mol. Biosci. 2021; 8 :671908. doi: 10.3389/fmolb.2021.671908

Стаття надійшла 30.01.2022 р.

DOI 10.26724/2079-8334-2023-1-83-143-147
UDC 618.19-006.6-06:616.428-076]-091

R.P. Nikitenko, V.M. Kosovan, K.O. Vorotyntseva, E.A. Koichev, S.P. Degtyarenko, O.M. Kvasha, V.K. Likhachov[1]
Odesa National Medical University, Odesa
[1]Poltava State Medical University, Poltava

IMPROVEMENT OF THE ALGORITHM FOR INTRAOPERATIVE DIAGNOSTICS OF BREAST CANCER METASTASIS USING SENTINEL LYMPH NODE STAINING

e-mail: vladimir.lihachev@gmail.com

Lymphatic metastasis is one of the most important causes of local BC recurrence and an unfavourable prognosis factor. With the beginning of application in the surgical practice of staining sentinel lymph nodes using modern dyes (Patent Blue, ICG), the approach to determining the extent of surgical intervention has changed radically Performing the staining of sentinel lymph nodes in breast tumours allows for reducing the trauma of surgical intervention as much as possible (due to the refusal of axillary lymph node dissection), as a result of which the number of postoperative complications is minimised. The purpose of the study was to improve the algorithm for intraoperative detection of sentinel lymph nodes in patients with breast cancer**.** Between 2016 and 2021, 200 patients with T1-T3N0M0 breast cancer were operated on at the Odesa Regional Clinical Hospital using two dyes: Patent Blue and ICG. The proposed algorithm for diagnosis and treatment of breast cancer allows most cases to abandon traumatic operations in favour of organ-preserving operations with biopsy of sentinel lymph nodes.

Key words: breast cancer, sentinel lymph nodes, intraoperative staining of lymph nodes, biopsy.

Р.П. Нікітенко, В.М. Косован, К.О. Воротинцева, Є.А. Койчев, С.П. Дегтяренко, О.М. Кваша, В.К. Ліхачов

УДОСКОНАЛЕННЯ АЛГОРИТМУ ІНТРАОПЕРАЦІЙНОЇ ДІАГНОСТИКИ МЕТАСТАЗУВАННЯ РАКУ МОЛОЧНОЇ ЗАЛОЗИ ШЛЯХОМ ФАРБУВАННЯ «СТОРОЖОВИХ» ЛІМФОВУЗЛІВ

Лімфогенне метастазування є однією з найважливіших причин виникнення місцевого рецидиву раку молочної залози та несприятливим фактором прогнозу. З початком застосуванням в хірургічній практиці методики фарбування сторожових лімфовузлів з використанням сучасних барвників (Patent Blue, ICG), кардинально змінися підхід до визначення обсягу оперативного втручання. Виконання фарбування сторожових лімфовузлів при пухлинах молочної залози дозволяє максимально зменшити травматичність хірургічного втручання (за рахунок відмови від аксилярної лімфодиссекції), внаслідок чого мінімізується кількість післяопераційних ускладнень. Метою даної роботи було удосконалення алгоритму інтраопераційного виявлення «сторожових» лімфовузлів у хворих на рак молочної залози**.** У період з 2016 по 2021 р. на базі Одеської обласної клінічної лікарні було прооперовано 200 пацієнток з раком молочної залози T1-T3N0M0, з використанням двох барвників: Patent Blue та ICG. Запропанований алгоритм діагностики та лікування раку молочної залози дозволяє в переважній більшості випадків відмовитися від травматичних операцій на користь органозберігаючих операцій з біопсією «сторожових» лімфовузлів.

Ключові слова: рак молочної залози, сторожові лімфовузли, інтраопераційне фарбування лімфовузлів, біопсія.

The study is a fragment of the research project "Development and implementation of new methods of intraoperative diagnosis of sentinel lymph nodes in patients with stomach and uterine cancer", state registration No. 0119U003578.

Breast cancer (BC) is women's most common oncological disease in various countries and ranks first among other forms of female oncology [1, 2, 14]. Despite the early diagnosis of oncological diseases, and the presence of screening programs for the detection of breast cancer, more than 20 % of patients at the time of detection of this disease already have signs of metastasis of the tumour process [2, 4].