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THERMOGRAPHIC EVALUATION OF GOUT COURSE IN COMBINATION WITH NON-ALCOHOLIC FATTY LIVER DISEASE AND TREATMENT

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SUMMARY. Gout is an urgent problem today, as its prevalence has doubled in recent decades. Disorders of thermoregulation and regional blood flow are an important clinical and pathogenetic manifestation of gout, which can be assessed by recording infrared radiation.

The aim – to evaluate the thermographic semiotics of gout and thermographic indicators of its course in concomitant non-alcoholic fatty liver disease (NAFLD) and the effectiveness of their treatment.

Material and Methods. 74 male gout patients were examined. They were divided into 2 groups. Group I included 38 patients with gout without liver damage, group II – 36 patients with NAFLD. Both groups were divided into subgroups: IA and IIA who received basic therapy, IB and IIB who additionally received carbon enterosorbent. The control group consisted of 20 healthy individuals. Thermographic study was performed using a thermal imager ULIRvision TI 120.

Results. The temperature gradient of symmetrical areas in healthy individuals (control group) was (0.37±0.04) °C. In all patients before treatment thermograms shows a zone of intense hyperthermia with clear contours, which exceeded the size of the visible hyperemia in the affected joint. The temperature gradient in patients with gout without liver damage was (3.99±0.17) °C, and in patients with concomitant NAFLD – (4.41±0.14) °C ($p>0.05$). On thermograms after treatment in most patients of both groups there was still a zone of hyperthermia. It was smaller in area and intensity, the clarity of the contours was lost. Therapy results were significantly better in patients receiving basic therapy with enterosorbent, but they still did not meet the norm ($p<0.05$).

Conclusion. Thermography makes it possible to determine the change in local temperature of the affected joints at gout during exacerbation, to establish the location and prevalence of the pathological process and to assess the effectiveness of treatment.

KEY WORDS: gout; thermography; non-alcoholic fatty liver disease; enterosorbent.

Introduction. Thermographic studies are widely included in medical practice in order to obtain additional data for the diagnosis and differential diagnosis of various diseases, as well as to determine the tactics and effectiveness of treatment [1, 2]. The main advantages of thermographic research are relatively low cost, absence of ionizing radiation or electromagnetic fields, contraindications, absolute non-invasiveness, safety, the ability to diagnose the disease at an early stage, etc. [3, 4]. Thermography in medicine can be used to study the thermal picture of different parts of the body in healthy people, to identify the dynamics of pathological processes [5].

The temperature of the human body is preferably higher than the ambient temperature. Thus, the body emits heat, the main carrier of which is infrared. The distal extremities, the tip of the nose, and the auricles have the lowest temperature (23–30) °C. The highest temperature – in the armpits, perineum, neck, cheeks. Daily fluctuations in human body temperature are on average (0.1–0.3) °C and depend on a number of physiological and psychosomatic factors [6, 7].

In a healthy person, the temperature distribution is symmetrical regarding the midline of the body. Violation of this symmetry is the main criterion for thermographic diagnosis of diseases. Proper assessment of the thermotopography of the study area allows determining the distribution of "hot" and "cold" zones in comparing their location with the allocation of the pathological process, the features of the contours of the focus, its structure and areas of distribution. Quantitative assessment is performed to determine the temperature difference (gradients) of the affected area compared to the symmetrical area.

The physiological basis of thermography is an increase in the intensity of infrared radiation over the pathological focus due to increased blood supply and metabolic processes or a decrease in its intensity in areas with reduced regional blood flow and concomitant changes in surrounding tissues [5].

The method of thermography is widely used in medicine, including oncology, angiology, obstetrics and gynecology, surgery, urology, orthopedics and traumatology, combustiology, ophthalmology, neurology, dermatology, rheumatology and many other specialties [8]. In particular, numerous studies of thermal image in osteoarthritis, rheumatoid arthritis [9, 10]. However, thermography at gout remains poorly known.

Gout is one of the major health problems, as it can lead to a significant deterioration in the condition and disability of patients, which affects their productivity and social activity. Comorbidity is a feature of the modern course of gout [11]. The commonality of pathogenetic mechanisms in the development and progression of gout and non-alcoholic fatty liver disease (NAFLD) was proven. To successfully treat and identify the features of the

joint course of these two pathologies, modern arthrology requires accurate and adequate diagnostic methods. One such method is infrared thermography, which plays an important role in modern practical medicine [12].

The aim of the study – to evaluate the thermographic semiotics of gout and thermographic indicators of its course in concomitant NAFLD and the effectiveness of their treatment.

Material and Methods. The study involved 74 male gout patients aged 29 to 78 years (mean – 57.09±1.32). The diagnosis of gout was made on the basis of the ACR/EULAR criteria of 2015. The diagnosis of NAFLD was established in accordance with the recommendations of EASL-EASD-EASO Clinical practice guidelines for the management of non-alcoholic fatty liver disease [13].

All patients underwent a general clinical examination, determination of pain intensity on a visually analogous scale of pain (VAS), the degree of functional insufficiency of the joints, radiological stage of joint damage, as well as local temperature over the affected joints.

Thermographic examination was performed using a thermal imager ULIRvision TI 120 (Zhejiang Ulirvision Technology Co., China), following the manufacturer's recommendations. Patients were examined in the hospital in the morning, with the patient in a vertical, horizontal or sitting position depending on his condition and location of the lesion. Before the examination, the adaptation of the exposed part of the body, which was subject to thermography, lasted for 25–30 min. The temperature gradient was determined by comparing the temperature above the affected joint and symmetrically healthy one.

During the study, all patients were divided into two groups. Group I included 38 patients with gout without liver damage, group II – 36 people with concomitant NAFLD. The comparison group consisted of 20 healthy males of representative age.

Depending on the treatment received by patients, both groups were divided into subgroups: I A (20 people) and II A (17 patients), who received conventional treatment, which included diet, anti-inflammatory and analgesic drugs, hypouricemic therapy according to EULAR 2016. Subgroups I B (18 patients) and II B (19 examined) additionally took enterosorbent carboline (produced by the Institute of Experimental Pathology, Oncology and Radiobiology named after R. Ye. Kavetskyi, National academy of sciences of Ukraine) in the form of small granules 1 teaspoon 3 times a day for 10 days 2 hours before or after meals or medications.

The ethical approval of the study was given by the Bioethics Committee of I. Horbachevsky Ternopil National Medical University. All patients voluntarily agreed to participate in the study. The study complied with the principles set out in the WMA Declaration of Helsinki.

Statistical processing of the obtained data was performed using the software package Statistica 10.0 ("StatSoft", USA) and the package of statistical functions Microsoft Office Excel 2016 (Microsoft Corp., USA). The arithmetic mean (M) and its error (m) were found. Significance of differences between groups was assessed by Student's t-test for independent samples with normal distribution and Wilcoxon's U-test (Mann-Whitney) under nonparametric results. Differences were considered statistically significant at $p<0.05$.

Results and Discussion. Out of the 74 patients, 53 (71.6 %) had gouty arthritis of the lower extremities, 31 patients (58.5 %) had arthritis of the first metatarsophalangeal joint, 13 (24.5 %) – ankle and small joints of the feet, 9 (17.0 %) had knee arthritis. 21 (28.4 %) patients were diagnosed with gouty arthritis of the upper extremities (11 patients (17.5 %) had arm disease and 5 (7.9 %) patients had the elbow joint problems.

All patients complained of pain in the affected joints, significant restriction of movement in them and edema. An objective examination revealed swelling, defiguration and deformation of the joint, redness of the skin, which was hot to the touch, restriction of movement due to severe pain.

According to the VAS, the intensity of pain was more pronounced in patients with concomitant NAFLD – (6.96±0.15) cm, and in patients without liver damage – (5.61±0.15) cm ($p<0.05$).

Group II was characterized by an increase in the number of patients with severe – 12 (33.0 %) and moderate – 20 (56.0 %) course of the disease and a decrease in the percentage with mild one – 4 patients (11.0 %). At the same time, in group I, severe course was diagnosed in 4 people (11.0 %), moderate-severe – in 26 (68.0 %), mild – in 8 (21.0 %) patients. In patients with gout without liver damage, radiological stage I was detected in 29.0 %, II – in 61.0 % and III – in 10.0 %. In group II, 53.0 % of patients had radiological stage II, 30.0 % – stage III and 17.0 % – stage I.

The temperature gradient of symmetrical areas in healthy individuals (control group) was (0.37±0.04) °C. The thermograms normally show foci of hyper- and hypothermia, which correspond to the thermal image of healthy individuals (Figure 1).

In order to determine the change in local temperature in patients with gout in both groups during the exacerbation, a thermographic examination of the affected joints was performed.

In all patients, the thermograms revealed a zone of intense hyperthermia with clear contours in the form of light spots that exceeded in size the visible hyperemia (Figure 2).

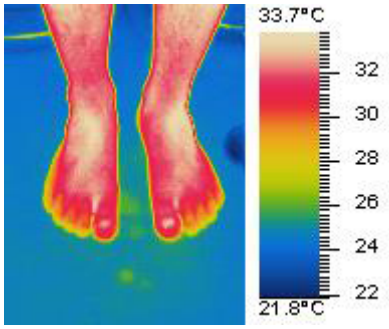


Figure 1: Thermogram of the lower third of the legs and feet of a healthy person.

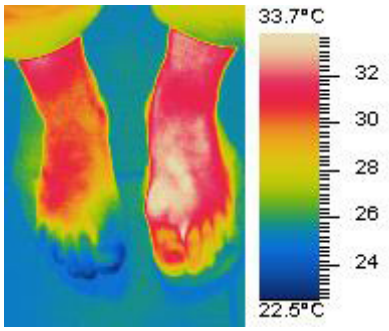


Figure 2: Thermogram of patient H., 48 y.o. Gout, chronic gouty arthritis, exacerbation phase with a predominant lesion of the small joints of the feet, ankles; radiological stage II; functional insufficiency of joints stage II.

Increased heat radiation in the joints of the left foot.

The temperature gradient in patients with gout without liver damage was (3.99±0.17) °C, and in patients with concomitant NAFLD – (4.41±0.14) °C. However, no significant difference between the temperature gradients in these groups was found ($p>0.05$).

The effectiveness of treatment in patients with gout without concomitant NAFLD and with its presence was evaluated.

The temperature gradient in patients of subgroup I A before treatment was (4.05±0.22) °C, after the application of basic therapy – (2.18±0.17) °C ($p<0.05$). In patients who received enterosorbent (subgroup I B) in addition to basic therapy, the temperature gradient decreased from (4.04±0.28) to (1.57±0.19) °C ($p<0.05$). In patients of subgroup II A, the temperature gradient before treatment was (4.47±0.22) °C, after – (2.24±0.12) °C ($p<0.05$). In patients of subgroup II B – decreased from (4.42±0.20) °C to (1.52±0.20) °C ($p<0.05$). The results of treatment in patients of subgroups I B and II B were significantly better than in I A and II A, but in both subgroups did not meet the norm ($p<0.05$).

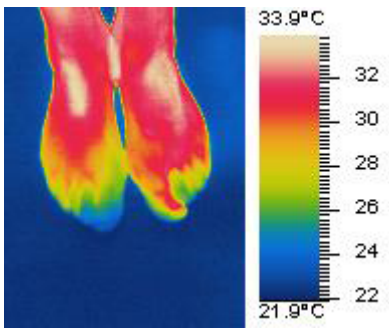
To illustrate, here is a brief extract from the medical card of an inpatient.

Patient N., 63 years old, went to the doctor with complaints of pain in the first toe of the left foot, edema, redness, restricted movement, poor sleep, general weakness, fever up to 37.3 C. He had been suffering from gout for about 15 years. Notes attacks of gouty arthritis 3–4 times a year. The last exacerbation occurred 3 days ago, which is associated with a violation of the diet. Objective examination data: general condition of moderate severity. The skin is pale pink, clean. Pulse 78 per 1 min, rhythmic, satisfactory. The activity of the heart is rhythmic, the tones are sonorous. Vesicular respiration in the lungs. The abdomen is soft, not painful. The liver does not protrude from the edge of the costal arch. Peripheral edema is absent. First metatarsophalangeal joint of the left foot – swollen, hyperemic, painful on palpation, hot to the touch, active and passive movements are severely limited due to pain. Walking is difficult.

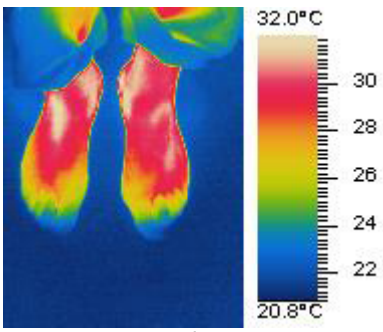
Clinical diagnosis: gout, chronic gouty arthritis, exacerbation phase with lesions of the first metatarsophalangeal joint of the left foot; radiological stage II; functional insufficiency of the joints stage I; tophi in the elbow joints.

Blood test before treatment: leukocytes – 7.18×10^9/l, stab – 11 %, segmental – 53 %, eosinophils – 1 %, monocytes – 10 %, lymphocytes – 25 %, ESR – 26 mm/h, CRP – 12.0 mg/L, uric acid – 462.5 μmoL/L.

The thermogram (Figure 3 a) in the area of the left first metatarsophalangeal joint shows an area of hyperthermia with clear contours. The temperature gradient was 2.6 °C.



a



b

Figure 3: Thermogram of patient N., 63 y.o. Gout, chronic gouty arthritis, exacerbation phase with lesion of the first metatarsophalangeal joint of the left foot; radiological stage II; functional insufficiency of joints stage I; tophi in the elbow joints: a – at hospitalization; b – at discharge.

The patient was prescribed a nonsteroidal anti-inflammatory drug (Meloxicam 1.5 ml) intramuscularly once a day, enterosorbent carboline 1 teaspoon 3 times a day 2 hours before or after meals or medications, allopurinol 300 mg per day, physiotherapy procedures.

After treatment, the patient continued to complain of mild pain when walking. Objectively – the joint is not changed, the skin is normal color, warm to the touch.

Blood test after treatment: leukocytes – 7.0×10^9/l, stab – 5 %, segmental – 53 %, eosinophils – 1 %, monocytes – 10 %, lymphocytes – 31 %, ESR – 12 mm/h, CRP – 6.3 mg/L, uric acid – 354.1 μmoL/L.

On the thermogram (Figure 3 b) the site of hyperemia of small intensity over the investigated joint is observed. The temperature gradient was 0.9 °C, which indicated the subclinical course of the disease.

Gout is a pressing problem today, as its prevalence has doubled in recent decades. This disease becomes even more important due to its comorbidity. The presence of concomitant NAFLD enhances the inflammatory response in the body and significantly complicates the course of the underlying disease [14]. Increased metabolism in the inflammatory process increases blood perfusion and, accordingly, thermal conductivity, which is reflected in the thermogram by the appearance of hyperthermia [5].

Pathological processes, increasing or decreasing infrared radiation, can cause significant changes in the thermographic picture. With the help of thermography, you can detect not only superficial but also deep disorders, which, due to the conductivity of infrared rays, are "projected" on the skin. In gout in the acute stage, the thermograms show areas of intense radiation, which correspond to the places of accumulation of uric acid and its salts in the affected joints, reflecting the inflammation of the surrounding tissues [15].

The level of radiation often depends on the activity of the inflammatory process. Therefore, measuring the temperature gradient can be an objective indirect method to determine the activity of the inflammatory process.

Conclusions. Intense infrared radiation from the affected area of the body was revealed in patients with gout and its combination with NAFLD in the period of exacerbation. A larger temperature gradient was found in severe disease than in moderate and mild. After treatment, in the absence of clinical changes in the affected joint, most convalescents retain elevated local temperature, indicating the presence of subclinical inflammation. The use of carbon enterosorbent carboline in the complex therapy of gout and its combination with NAFLD contributed to a greater reduction in the temperature gradient and the extinction of clinical signs of the disease.

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ТЕРМОГРАФІЧНА ОЦІНКА ПЕРЕБІГУ ПОДАГРИ, ПОЄДНАНОЇ З НЕАЛКОГОЛЬНОЮ ЖИРОВОЮ ХВОРОБОЮ ПЕЧІНКИ, ТА ЕФЕКТИВНОСТІ ЛІКУВАННЯ

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РЕЗЮМЕ. Подагра є актуальною проблемою сьогодення, адже за останні десятиліття її поширеність подвоїлася. Важливим клініко-патогенетичним проявом подагри є порушення терморегуляції та регіонарного кровотоку, які можна оцінити за допомогою реєстрації інфрачервоного випромінювання.

Мета – оцінити термографічну семіотику подагри та термографічні показники її перебігу при супутній неалкогольній жировій хворобі печінки, а також ефективність їх лікування.

Матеріал і методи. Обстежено 74 хворих на подагру чоловічої статі, віком від 29 до 78 років. Їх було поділено на 2 групи. До групи І увійшли 38 пацієнтів з подагрою без ураження печінки, до ІІ – 36 хворих із супутньою НАЖХП. Обидві групи поділено на підгрупи: І А і ІІ А, що отримували базову терапію, І Б і ІІ Б, що додатково приймали вуглецевий ентеросорбент. Контрольну групу склали 20 здорових осіб. Термографічне дослідження здійснювали за допомогою тепловізора ULIRvision TI 120.

Результати. Температурний градієнт симетричних ділянок у здорових осіб (контрольна група) становив (0,37±0,04) °С. У всіх хворих до лікування на термограмах видно зону інтенсивної гіпертермії з чіткими контурами, яка за розмірами перевищувала видиму гіперемію в ділянці ураженого суглоба. Температурний градієнт у пацієнтів з подагрою без ураження печінки становив (3,99±0,17) °С, а в хворих із супутньою НАЖХП – (4,41±0,14) °С ($p>0,05$).

На термограмах після лікування у більшості хворих обох груп все ще спостерігалася зона гіпертермії. Вона була меншої площі й інтенсивності, чіткість контурів втрачалася. Результати терапії були суттєво кращими у пацієнтів, які отримували базову терапію з ентеросорбентом, але вони все ще не відповідали нормі ($p<0,05$).

Висновок. Термографія дає можливість визначити зміну локальної температури уражених суглобів при подагрі в період загострення, встановити локалізацію і поширеність патологічного процесу та оцінити ефективність лікування.

КЛЮЧОВІ СЛОВА: подагра; термографія; неалкогольна жирова хвороба печінки; ентеросорбент.

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