MEDICAL SCIENCES

QUALITY OF LIFE AND ADHERENCE TO TREATMENT IN PATIENTS WITH HEART FAILURE DURING EXTREME TEMPERATURES (HEAT) IN VINNITSIA REGION

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Abstract

Many studies demonstrate the negative impact of various weather conditions on the human body. This also applies to high temperatures, which can cause increased synthesis of interleukins, fluctuations in blood pressure, increased manifestations of coronary heart disease, edema, electrolyte disturbances, and an increase in the frequency of treatment side effects. However, there are insufficient data to indicate changes in the quality of life of patients with heart failure (HF) under the influence of high temperatures and changes in treatment adherence in such patients with optimally selected therapy to high temperatures.

The aim was to assess the impact of heat on the quality of life and adherence to treatment in patients with heart failure.

Materials and methods. We examined 44 patients (mean age 64.25±0.26 years) with stage C HF with a slightly reduced ejection fraction ranging from 40-50%, who had an average but not less than 7 points and high adherence to treatment before the study. The treatment of HF and other comorbidities in patients was performed according to the protocols and patients were in the phase of clinical compensation on the background of optimally selected pharmacological treatment at the time of the study. All emergencies associated with blood pressure fluctuations and coronary symptoms occurred in patients who smoked, which amounted to 27.3%. Patients who smoked but were not hospitalized during the observation period accounted for 13.64%, which was not significant. No significant blood glucose fluctuations were noted in the patients included in the study.

Results and discussion. When assessing quality of life indicators, they significantly deteriorated: from 14.68 ± 0.22 points before the study to 33.45 ± 0.75 (p<0.001) after the study. The most pronounced changes were observed in obese patients, especially due to edema syndrome, blood pressure fluctuations, and it is important that patients with different degrees of obesity were more prone to depression. An important component of the deterioration in the quality of life was a violation of adequate sleep, which was manifested in 100% of patients, impaired concentration, increased treatment costs, increased difficulty walking, increased fatigue, increased heart rate, shortness of breath. In 42 (90.9%) patients, treatment required changes. The number of hospitalizations or ambulance calls increased from 100% of patients to 18.2% (p<0.001) who had 7 or more points on the adherence questionnaire, and after two weeks there was not a single patient who had satisfactory adherence.

Conclusions. In view climate change, which is a serious problem for the entire humanity, it is important to note that the health status of patients with HF, even with optimally selected treatment, remains important, which contributes to a deterioration in the quality of life of such patients and a marked decrease in adherence to treatment, increased costs of treatment, treatment regimens, as well as the occurrence of impaired concentration, a tendency to depression, which requires additional control examinations, correction of treatment regimens and the prescription of additional drugs. Reduced adherence to treatment significantly increases the incidence of morbidity and complications, which in turn increases disability and mortality, even in a short period of time. It is also important that the duration of weather anomalies has a negative impact on treatment adherence. It has been noted that complications of various diseases are more common in smokers, and adherence to treatment is lower in obese patients, although these data need to be clarified in a larger cohort of patients. In accordance with the identified changes, it is recommended to draw up a treatment plan more carefully, to communicate with the patient in case of a violation of the general condition and to correct the identified changes more quickly, to develop a strategy for correcting the patients' condition, taking into account the manifestations of the underlying disease and the development of comorbid conditions, such as sleep disturbance, impaired attention, and the development of depression. It is the professional timely correction of the detected symptoms that will mitigate the impact of abnormal temperatures and preserve public health.

Keywords: quality of life, adherence to treatment, heart failure, extreme temperature, heat

In the last few years, the planet's climate has been changing more and more, and the air temperature has been rising, which is explained by global warming. As you know, climate change affects the human body, changing the functioning of all systems and organs. Rising temperatures are associated with an increase in morbidity and mortality from cardiovascular (CV) pathologies, which is observed in different segments of the population and in different geographical regions [1].

First of all, the disorder occurs due to endothelial damage at high temperatures, which causes its dysfunction. This leads to a decrease in the synthesis of nitric oxide, an increase in the production of inflammatory cytokines, especially interleukins 1 and interleukins 6 [3], and the development of systemic inflammation. It is also important that these processes are more pronounced in older people than in younger people, regardless of additional pathological factors. Another important cause of CV system dysfunction is dehydration and increased thrombosis, which is especially important for patients with atherosclerotic vascular disease. In addition, the production of free radicals and toxic substances at the cellular level increases due to impaired ATP and oxygen storage. A 2016 meta-analysis showed that a 1°C increase in temperature increases cardiac mortality by 4.15% and cerebrovascular mortality by 2.59% within two days of swimming in people over 65 years of age. Changes in the cardiovascular system under the influence of high temperatures begin within the first week [2]. The vulnerability of the elderly can be explained by comorbid pathologies, the use of a large number of medications, and a decrease in thermoregulation due to deterioration of blood flow in the skin and sweating rate [2]. Another factor in the effect of temperature on older people is that with age, the sensitivity of temperature receptors throughout the body that transmit a signal to the hypothalamus, which regulates body temperature, is impaired. Accordingly, with age, the perception of signals by the hypothalamus also decreases significantly. As a result, older people have a reduced ability to detect temperature changes and initiate appropriate physiological responses to maintain a stable body temperature [8].

Heart failure (HF) is an independent prognostic factor for mortality, which is associated with the effects of high temperatures on the human body. Such patients have an increased cardiac workload due to increased heart rate and rhythm disturbances, increased edema syndrome, which leads to an increase in sudden death and in-hospital mortality. Studies have shown that heart rate can increase by an average of 8.5 beats per minute for every 1°C increase in body temperature. This hyperdynamic state is often associated with impaired diastolic function and, as a result, a decrease in stroke volume [7]. Such patients have higher levels of natriuretic peptide and C-reactive protein. These two markers are associated with a worse prognosis and severity of HF [4]. Also important is the impact of hot weather on the absorption, distribution and excretion of drugs and, accordingly, the impact on their therapeutic effect, and the increase in side effects. For example,

heat increases vasodilation, which leads to an increase in the effect of antihypertensive drugs. Clinically, this can manifest itself in loss of consciousness, increased myocardial ischemia, and fall injuries. The use of diuretics can lead to electrolyte imbalance (i.e., hypomagnesemia). hypokalemia, increased dehydration, which can also increase the risk of cardiac arrhythmias [5, 7]. A study of 345 patients hospitalized with heat stroke during the 2003 heat wave in France found that diuretic use was associated with a higher risk of in-hospital mortality [6]. Extreme temperatures have the potential to increase the likelihood of developing diabetes mellitus (DM) and worsen glycemic control in patients with pre-existing DM. High annual average temperatures are associated with elevated fasting plasma glucose, insulin resistance, and increased incidence and prevalence of diabetes. Short-term fluctuations in temperature are also associated with fluctuations in blood pressure (BP) [7]. In addition, several studies have shown a significant correlation between an increase in average temperature and lipid profile changes, as evidenced by a decrease in plasma high-density lipoprotein levels and an increase in plasma low-density lipoprotein levels. In addition, elevated temperature is associated with reduced time spent on physical activity, potentially increasing the long-term risk of CVD [8].

There are many publications describing the effects of weather conditions on the human body, including high temperatures. However, the problem of changes in quality of life and adherence to treatment in patients with HF under the influence of high temperatures is not sufficiently covered, given that before the exposure they were stable with optimally selected treatment. In addition, changes in the clinical picture in this category of patients remain poorly understood.

The aim is to evaluate the impact of heat on the quality of life and adherence to treatment in patients with heart failure.

Residents of Vinnytsia region were informed about the increase in air temperature during the week. During the study period, from July 08 to July 21, 2024, inclusive, the maximum air temperature ranged from 31-39°C, which is 15°C higher than the maximum temperature of the climatic norm for this region (Vinnytsia region) according to meteorological sites [8].

Study design. The quality of life of patients with HF was assessed by the Minnesota Living with Heart Failure Questionnaire (MLHF) before a sharp increase in air temperature and after 2 weeks. Adherence to treatment was also assessed using the 8-item Morisky Medication Adherence Scale (MMAS), adapted to HF pharmacotherapy before the weather worsened, after 1 and 2 weeks. Additionally, the presence of obesity, hypertension, DM, and atrial fibrillation and the dynamics of the symptoms of these diseases were indicated. Patients also provided information about smoking. During the examination period, patients were treated on an outpatient basis. Temperature was measured by the patients and recorded in the observation diary at 9 am, 3 pm, and 9 pm.

Study inclusion criteria: patients with stage C HF with a slightly reduced ejection fraction ranging from 40-50%, who had an average but not less than 7 points before the study, and high adherence to treatment. Patients were treated for HF and other comorbidities according to protocols and were in the phase of clinical compensation with optimally selected pharmacologic treatment at the start of the study. Patients had to be 60 years of age or older. **Exclusion criteria:** severe mental and cognitive disorders, decompensated state of any disease, chronic kidney disease of stages IV-V, age over 75 years.

Materials and methods. We examined 44 patients, including 24 men and 20 women, the average age was 64.25 ± 0.26 years. Among the examined patients, the presence of hypertension was observed in 43, diabetes mellitus - in 8, permanent atrial fibrillation - in 10, paroxysmal atrial fibrillation - in 2, patients with stable angina were 4, obesity of I or II degree - in 18 patients and in 4 patients - of III degree. The study was conducted in compliance with the basic provisions of the "Rules for Ethical Principles for Scientific Medical Research Involving Human Subjects" approved by the Declaration of Helsinki (1964-2013), ICH GCP (1996), EEC Directive 609 (24.11.1986), and orders of the Ministry of Health of Ukraine No. 690 of 23.09.2009, No. 944 of 14.12.2009, and No. 616 of 03.08.2012. Each patient signed an informed consent to participate in the study. Statistical analysis was performed using the MS Excel for Windows XP program, using methods of clinical, descriptive and mathematical statistics.

Results and discussion. When assessing quality of life indicators, they significantly deteriorated: from 14.68 ± 0.22 points before the study to 33.45 ± 0.75 (p<0.001) after the study. Of course, the deterioration of quality of life indicators was expected, but the most pronounced changes were observed in obese patients, especially due to edema syndrome, blood pressure fluctuations, and it is important that patients with different degrees of obesity were more prone to depression. An important component of the deterioration in quality of life was a violation of adequate sleep, which was manifested in 100% of patients, impaired concentration, increased treatment costs, increased difficulty walking, increased fatigue, increased heart rate, shortness of breath against the background of treatment that was optimally selected before the onset of air temperature rise. In addition, in 42 (90.9%) patients, treatment required changes: reducing the dose of antihypertensive drugs, intensifying diuretic therapy, and increasing the dose of beta-blockers to control heart rate. The number of hospitalizations or ambulance calls increased. When assessing the causes of hospitalization, the most common were palpitations as a manifestation of atrial fibrillation in 6 (13.64%) patients, a drop in blood pressure with syncope and a complicated hypertensive crisis with pulmonary edema in 4 (9.1%) patients for each pathology, acute cerebrovascular accident and acute coronary syndrome in 2(4.55%) patients for each emergency condition. An interesting observation was that all emergencies associated with blood pressure

fluctuations and coronary symptoms occurred in patients who smoked, which amounted to 27.3%. Patients who smoked but were not hospitalized during the observation period accounted for 13.64%, which was not significant. It should be noted that no significant fluctuations in blood glucose were observed in the patients included in the study. It is known that treatment adherence in HF is 50% worldwide, which depends on many reasons, including the large number of drugs that need to be taken on a regular basis [10]. Another important factor that leads to treatment adherence failure is high air temperature. The following data were obtained: after a week of exposure to high temperatures, treatment adherence decreased from 100% of patients to 18.2% (p<0.001) who had 7 or more points on the adherence questionnaire, and after two weeks, there was not a single patient who had satisfactory adherence. The main reasons for treatment adherence were reduced doses of drugs that affect blood pressure, increased doses of diuretics, which also had an effect on blood pressure, which further contributed to treatment failure. In addition, patients missed taking some medications and could not resume the HF treatment regimen on their own, as changes in weather conditions required correction. There was also a disturbance in concentration, which prompted patients to spend more time following the medication algorithm. No significant differences between patients were noted during the data analysis, although according to the literature [10], adherence to treatment is higher in patients with a history of hypertension. It should be noted that 97.7% of patients enrolled in the study were diagnosed with hypertension. Perhaps this factor was crucial in achieving patient compliance at the beginning of the study. When exposed to high temperatures during the study, patients with blood pressure fluctuations had low adherence to treatment and a high rate of hospitalization with complications.

Conclusions. In view climate change, which is a serious problem for the entire humanity, it is important to note that the health status of patients with HF, even with optimally selected treatment, remains important, which contributes to a deterioration in the quality of life of such patients and a marked decrease in adherence to treatment, increased costs of treatment, treatment regimens, as well as the occurrence of impaired concentration, a tendency to depression, which requires additional control examinations, correction of treatment regimens and the prescription of additional drugs. Reduced adherence to treatment significantly increases the incidence of morbidity and complications, which in turn increases disability and mortality, even in a short period of time. It is also important that the duration of weather anomalies has a negative impact on treatment adherence. It has been noted that complications of various diseases are more common in smokers, and adherence to treatment is lower in obese patients, although these data need to be clarified in a larger cohort of patients. In accordance with the identified changes, it is recommended to draw up a treatment plan more carefully, to communicate with the patient in case of a violation of the general condition and to correct the identified changes more quickly, to

develop a strategy for correcting the patients' condition, taking into account the manifestations of the underlying disease and the development of comorbid conditions, such as sleep disturbance, impaired attention, and the development of depression. It is the professional timely correction of the detected symptoms that will mitigate the impact of abnormal temperatures and preserve public health.

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