the delivery of oxygen not only to hypoxic, but also to normoxic cells, tissues and organs of the whole organism. This component of hyperbaric oxygenation makes a tangible contribution to the positive outcome of hyperbaric oxygen treatment.

Conclusions. Hyperbaric oxygenation in the treatment of hypoxia is a safe and clearly superior treatment when compared to other methods such as mechanical ventilation and extracorporeal membrane oxygenation for lung oxygenation. When combined with other pharmacological and non-pharmacological therapeutic options, this treatment can reduce infection and mortality in the COVID-19 pandemic.

COVID-19 AND DIABETES MELLITUS: TWO PANDEMICS

Evstratieva A. V., Koshova O. Yu.
National University of Pharmacy, Kharkiv, Ukraine
elenko926734@gmail.com

Introduction. The spread of the new coronavirus SARS COV-2 on almost every continent of the world (except Antarctica) has become an unprecedented challenge to human health around the world. The most vulnerable categories of people prone to this disease are patients with severe chronic diseases such as cardiovascular disease (coronary heart disease, heart failure, hypertension, cerebrovascular disease), chronic obstructive pulmonary disease (COPD), kidney and diabetes (DM). An epidemiological analysis conducted by different groups of scientists from China, Italy and the United States showed a different frequency of confirmed SARS COV-2 infection in patients with diabetes.

Aim of the study was to analyze clinical data on the mutual influence of coronavirus and diabetes mellitus on the course of this two pathologies.

Materials and methods. An analysis of clinical data on the combined course of diabetes mellitus and coronavirus infection was carried out according to Google Scolar and Pub Med

Results and discussion. According to the Centers for Disease Prevention and Control, in China the incidence of diabetes among patients with COVID-19 was 5.3% of 20 892 patients, 10.9% of 7.162 patients in the United States and 35.5% of 355 patients in Italy. A comparison of data on the prevalence of COVID-19 in China and the United States (5.3% and 10.9%, respectively) with the overall prevalence of diabetes in these countries (10.9% and 13.3%, respectively), showed that the number of infected patients with Diabetes mellitus does not exceed the overall prevalence of diabetes in these countries. This means that the risks of developing COVID-19 in patients with diabetes do not exceed such risks in the general population. However, against the background of pre-existing diabetes, infection with the new coronavirus SARS COV-2 has been found to lead to a more severe course of the disease than in patients without diabetes, and the death rate in patients with diabetes is much higher, as confirmed by a number of studies of Chinese scientists. According to the data obtained, the incidence of severe COVID-19 was 1.3-3.9 times, and the incidence of death was 1.5-4.4 times higher in people with diabetes compared to people without diabetes. Published in 2020 in the journal Diabetes Metabolic Syndrome (№14 (4): 395-403), a meta-analysis of 30 studies describing the results of COVID-19 pneumonia confirms that patients with diabetes have significantly

higher risks of severe disease, more frequent development of distress-syndrome and higher mortality than those without diabetes.

The mechanism of SARS-CoV-2 penetration into the cell, as well as the pathogenesis of COVID-19, has not been sufficiently studied, but it is known that the virus must bind to the angiotensin-converting enzyme (ACE2) receptor and other cellular structures, in particular with TMPRSS2 – membrane-bound serine protease with little known biological function. ACE2 receptor expression is known to be high in the oral mucosa, nasopharynx and lung tissues (type 2 alveolar cells). That is why the "gateway" for the virus is the upper respiratory tract, after which the virus easily penetrates the lungs and infects the alveoli, causing the rapid development of pneumonia and respiratory failure. ACE2 expression is also high in enterocyte cells of the colon, myocardial cells, proximal renal tubules, liver, pancreas, which explains diarrhea, olfactory loss, transient hyperglycemia, which first appeared on the background of the disease. After the virus spike binds to its ACE2 receptor on the surface of the target cells, the TMPRSS2 transmembrane serine protease "cuts" the ACE2 receptor, which activates the virus spike, and it is introduced into the cell in which it occurs its subsequent replication. It has been shown that in the presence of hyperglycemia in lung tissue, the process of glycosylation of the ACE2 receptor (ie, binding of protein to glucose) is activated, which increases its affinity for the SARS COV-2 virus. Experimental studies in mice have shown multiple increases in ACE2 expression under conditions of hyperglycemia in a number of organs and tissues (kidney, liver, pancreas). These data suggest that in conditions of diabetes, not only the expression of the receptor (in many tissues), but also the binding to the coronavirus. Both processes lead to greater susceptibility of patients with diabetes to infection with the virus. After the introduction of the virus into the human body, it is recognized by immunocompetent cells and the induction of the so-called "cytokine storm" with the release of a large number of proinflammatory cytokines (TNF, IL-1β, IL-6, IL-8, IL-17 and etc.) and chemokines (MCP1, IP10, MIP1α). Recent studies have shown that the cause of the "cytokine storm" in patients with diabetes is hyperglycemia. The direct dependence of increased expression of IL-6 and IL-8 in patients with viral infection on high blood glucose levels has been proven. It is shown that in the conditions of influenza virus infection in patients with diabetes the activity of inflammatory markers (level of C-reactive protein, ferritin, fibrinogen, IL-6, D-dimer) is significantly higher than in patients without diabetes, which indicates that that against the background of diabetes, the synthesis of cytokines in response to viral infection is much more intense than in normal carbohydrate metabolism, ie glucose is a source of energy for the formation of excessive immunological reactions. It has been found that patients with diabetes with poor glycemic control are prone to higher cytokine storm activity and the risk of an unfavorable prognosis of viral infection. This hypothesis is confirmed by the results of observations of Chinese physicians who summarized the experience of treating SARS in 2002 in patients with diabetes mellitus caused by the first generation coronavirus – SARS COV-2. They showed that in patients with diabetes with fasting plasma glucose levels greater than 8 mmol/l, the risk of mortality was 3 times higher compared with patients with fasting plasma glucose levels less than 6 mmol/l. The epidemic of the new coronavirus SARS COV-2 is characterized by the same patterns. Mortality of people with glycemia 10 mmol/l (180 mg/dl) is 3 times higher than people with glycemia 6.4 mmol/l (116 mg/dl): 28.8% and 6%, respectively.

Another reason for the more severe course of COVID-19 is comorbidity in type 2 diabetes mellitus. Type 2 diabetes is a severe chronic disease that is often combined with pathology of the cardiovascular system (hypertension, coronary heart disease, heart failure, cerebrovascular disease,

chronic kidney disease), which develop either as a manifestation of vascular complications of diabetes or as comorbidities. A recently published meta-analysis by Wang et al., which included 1558 patients with COVID-19, showed that these comorbidities significantly increased the risk of severe viral disease: for example, the presence of hypertension increased these risks 2.3-fold, COPD – 6 times, cardiovascular pathology – 2.9 times, cerebrovascular disease – 3.9 times. However, no such relationship was found with liver disease, cancer and renal pathology. Thus, patients with diabetes in combination with the above diseases have a significantly higher risk of severe new coronavirus infection.

Conclusions. Thus, the presence of SARS COV-2 virus infection is a risk factor for the development of primary diabetes mellitus and a factor that leads to the complication of an existing disease. At present, the question of correction of antidiabetic therapy in the conditions of COVID-19 remains open, because convincing evidence of the benefits or harms of certain groups of antihyperglycemic drugs in a relatively short period of time has not yet been obtained. According to scientists and diabetologists, the main guidelines for prescribing or discontinuing drugs should be instructions for use of these drugs, information about their side effects, as well as recommendations for the treatment of hyperglycemia in severe infectious diseases and in intensive care units.

CALCIUM AS A CAUSE OF CELL DAMAGE

Hajar Lamsaouri
Scientific supervisor: Myronchenko S. I.
National University of Pharmacy, Kharkiv, Ukraine
lamsaouri39@gmail.com

Introduction. Calcium ions are increasingly becoming mediators in mechanisms that cause lethal cell damage under various pathological circumstances. On the one hand, calcium ions are mediators of the functional consequences of damage to the plasma membrane. On the other hand, changes in intracellular calcium homeostasis are involved in mechanisms that cause potentially lethal damage to the plasma membrane.

Aim. The purpose of this review is to provide an overview of the role of calcium ions in the mechanisms of cell damage.

Materials and methods. Data analysis of literature and Internet sources.

Results and discussion. Most mechanisms of cell damage are due to increased concentrations of calcium ions in the cytoplasm. This increase may be based on two mechanisms: excessive intake of calcium ions into the cytoplasm and impaired removal from the cytoplasm. An increased content of intracellular Ca^{2+} causes damage to the cell in several ways: the accumulation of Ca^{2+} in mitochondria leads to the opening of mitochondrial pores and, as a consequence, a change in mitochondrial permeability and insufficient synthesis of ATP; an increased concentration of Ca^{2+} in the cytosol activates several enzymes with potentially destructive effects for the cell: phospholipases (cause damage to membranes), proteases (damage both the membrane and cytoskeletal proteins), endonucleases (responsible for the fragmentation of DNA and chromatin), ATPases (accelerate the depletion of ATP stores); an increased level of intracellular Ca^{2+} induces apoptosis through direct activation of caspases and an increase in mitochondrial permeability. An increase in the concentration of Ca^{2+} in the cytoplasm activates glycolysis phosphorylase, which enhances intracellular acidosis.