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PROBLEMS OF THE DIAGNOSIS AND TREATMENT OF PATIENTS WITH BURN INJURIES AND SEPSIS

ПРОБЛЕМИ ДІАГНОСТИКИ ТА ЛІКУВАННЯ ХВОРИХ З ОПІКОВОЮ ТРАВМОЮ ТА СЕПСИСОМ

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Despite modern advances in prevention and treatment, sepsis remains the leading cause of death in patients with severe burn injuries. At the same time, the development of the systemic inflammatory response begins during the first days of the burn disease. This significantly distinguishes burn sepsis from sepsis in the general population and complicates its diagnosis and treatment [1]. The early diagnosis of sepsis is very important for rapid initiation of adequate treatment.

An infection or trauma causes the systemic inflammatory response of a patient to the infection. It is characterized with the complex interaction of cytokines, chemokines, complement and coagulation factors, as well as inflammatory and immunoregulatory cells. It is difficult to predict whether this response will be adequate and whether sepsis will develop. Early diagnosis is difficult due to the lack of early biomarkers [2].

Numerous clinical studies of the level of human serum albumin (HSA) in the blood have proven its important diagnostic value for assessing the severity of the patient's condition and predicting the course of the disease [3]. This is due to the ability of albumin to form complexes with toxins that provide its detoxification function [4]. The reverse side of the sorption of toxins by albumins is the change of their structural state and blocking of their binding centers, which leads to the inhibition of the transport function

of proteins. The syndrome of endogenous intoxication (EI) is caused by the release of toxins into the vascular bed.

Natural detoxification combines three interconnected systems: monooxygenase, immune and excretory. The immune system ensures the elimination of only the high-molecular substances with the molecular weight of at least 5000 Da, and no immune response is produced to the low-molecular compounds. Endogenous toxins of the hydrophobic low- and medium-molecular fraction are eliminated by the transportation of proteins and/or blood cells to the liver and lungs, where albumins along with toxins are biotransformed with the participation of the monooxygenase system. The elimination of the low molecular weight toxins is provided by blood transport proteins [5].

The main aim of this paper is to present the pathogenetic concept of the diagnostic and treatment model of purulent-inflammatory diseases and sepsis.

At the first stage of diagnostic studies of purulent-inflammatory diseases and sepsis within the framework of MFS, the pathogenetic processes occurring in patients' bodies at the molecular level were not studied [6]. The pathogenetic concept of diagnostic and treatment model of purulent-inflammatory diseases and sepsis was proposed for the first time [7]. It is based on the fact that in diseases accompanied by EI, part of the albumin molecules in the blood of patients are blocked by toxins.

The presence of albumin in the blood does not always reflect the completeness of its transport function. Its binding centers can be blocked by the toxic ligands, due to which the transport capacity is sharply reduced. As a result, there are two types of albumin molecules in the blood: normal (concentration: X) and blocked by toxins /pathological (concentration: 1-X). So, pathological albumin molecules lose the ability to perform their basic functions, namely transport and detoxification. This allowed us to assume that the presence of albumin and its functional state can influence the course of burn disease and the development of sepsis. The proposed diagnosis of sepsis consists in the definition of X*, i.e. the limit value of normal albumin concentration in patients with sepsis. If X is more than X*, this ensures the viability of the organism to some extent. The analysis of the obtained experimental results for the spectral-fluorescence characteristics of BS of patients with sepsis and with burn injury based on the proposed concept made it possible to determine the peculiarities of their behavior during the progression of the disease, including when the septic state is approaching, as well as during the recovery process [8].

The primary model of sepsis is the immune response to endotoxin, LPS, which has been found in the cell walls of gram-negative bacteria. Endotoxin is an example of the pathogen-associated molecular pattern (PAMP). Innate immune cells, such as macrophages have receptors that recognize different types of PAMPs. When interacting with bacterial ligands, these receptors stimulate macrophages to produce TNF-α, IL-1β та IL-6. It is these pro-inflammatory cytokines that cause the systemic inflammatory response. Consequently, the state of prolonged systemic inflammation leads to the burn immunosuppression, which leads to even greater susceptibility to infections and sepsis. Combinations of pro- and anti-inflammatory biomarkers may help to identify patients who develop sepsis before organ dysfunction progresses too far. After recognizing the importance of CARS, which is caused by the hyperinflammatory state in patients with sepsis, biomarkers of the immunosuppressive phase of sepsis deserve considerable attention. Sepsis develops on the background of decreased concentrations of pro-inflammatory cytokines (TNF, IL-1) and increasing of anti-inflammatory (IL-4); septic shock is accompanied by increased activity of pro-inflammatory (TNF, IL-1, IL-6) and reducing the activity of anti-inflammatory cytokines (IL-4) [9]. As the sepsis paradigm has evolved over time, as various therapeutic approaches to sepsis have been tested, various biomarkers other than cytokines have been used to diagnose, monitor and treat sepsis.

When the septic state approaches, dysfunctions appear in the patient's body and the liver stops producing albumin molecules. At the same time, IL-6 promotes the production of CRP by the liver [10]. When the patient's condition worsens, other biomarkers appear and the system can switch to CARS. With the noticeable increase in the number of bacteria and the content of endogenous toxins, moleculs of albumin are unable to overcome the growing infectious process. As a result, the immune system is activated, eliminating high-molecular pathological formations, which corresponds to the transition to the SIRS state described above.

That is to say: $X^{*}>0$ and this contributes to maintaining the effective functioning of the patient's body. This leads to the very strong conclusion about the importance of using donor albumin solution infusions in this case. At the same time, it is necessary to measure the spectral-fluorescence characteristics of blood serum (BS) and to study biomarkers within the framework of MFS. After the number of sessions of albumin infusions, the spectral-fluorescence characteristics of the patient's BS normalize, and the biomarkers gradually change.

Conclusions. It is established that the spectral-fluorescence characteristics of the blood serum of patients with purulent-inflammatory diseases and sepsis are universal markers of the severity of their condition. The identified changes in the spectral-fluorescence characteristics of blood serum in patients with septic conditions were in most cases recorded 24-48 hours before the appearance of obvious clinical and laboratory signs of significant changes in the general somatic status of patients. Regardless of the etiological factors of the occurrence of sepsis, the pathogenetic mechanisms of septic complications are unified. The obtained results of using the method of fluorescence spectroscopy were significantly ahead of the results of other research methods that are currently widely used for diagnostics in health care institutions. It is fundamentally important to ensure the optimal quality of medical care for patients with purulent-septic complications in the critical condition in health care institutions, and comprehensive experimental studies of BS patients by using MFS and the method of biomarkers with the use of infusions of the donor albumin solution.

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