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DIABETES MELLITUS - HIGH RISK OF DEVELOPING SURGICAL SOFT TISSUE INFECTION

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Abstract

Diabetes mellitus is characterized by multiple organ damage, but the most common ones occur in soft tissues, against the background of impaired blood circulation. They can be classified as microvascular and macrovascular, which in turn can lead to various types of surgical infections, as a result of decreased resistance to microorganisms, forming a vicious circle. The combination of diabetes mellitus and surgical infection leads to a condition in which the infection negatively affects metabolic processes, and metabolic and microcirculation disorders worsen the course of reparative processes in the lesion. The relevance of necrotic soft tissue infections is manifested by the fact that in diabetes mellitus, mortality remains at high levels, reaching 76%, which is associated with advanced diagnostics and determination of treatment standards. Necrotic soft tissue infections are clinically complex diseases that all doctors should be aware of when rapid diagnostics and early, extensive surgical tactics are required. It can save the patient's life, since the lesions in necrotic lesions progress rapidly, followed by a high probability of sepsis and, accordingly, a high mortality rate.

Keywords: Diabetes mellitus, necrotizing fasciitis, necrotizing cellulitis, phlegmon, sepsis.

Introduction

Diabetes mellitus is a group of chronic metabolic diseases, each characterized by elevated blood glucose levels resulting from the body's inability to produce insulin or from resistance to the action of insulin [1].

This group of conditions includes 4 clinically distinct types:
1. Type 1, occurs as a result of autoimmune destruction of the beta cells of the pancreas and is characterized by a complete lack of insulin production;
2. Type 2, develops when there is abnormally increased resistance to the action of insulin and the body cannot produce enough insulin to overcome the resistance;
3. Gestational diabetes, is a form of glucose intolerance that affects some women during pregnancy;
4. A group of other types of diabetes caused by genetic defects in beta cell function or insulin action, diseases of the pancreas, or the use of drugs or chemicals [1].

Type 2 diabetes is the dominant type. It has become a global public health problem. Analysis of the latest statistics shows that diabetes mellitus has several new epidemiological characteristics. First, the incidence of diabetes continues to rise steadily in developed countries such as the United States and Japan. It is worth noting that it has become a serious problem in developing countries as well. Diabetes mellitus is projected to continue to rise in the next twenty years, with more than 70% of patients appearing in developing countries, with most of them being aged 45-64 years [2]. Even today, seven out of ten countries with the highest number of diabetes patients are low- or middle-income countries, including India, China, Russia, Brazil, Pakistan, Indonesia, and Bangladesh, among which the prevalence rates are 12.1% and 9.7% in India and China, respectively [3,4]. According to Russian researchers, 4,799,352 patients with diabetes mellitus were identified in 2021, with type 2 diagnosed among 4,434,876 patients [21]. Secondly, although old age is a risk factor for the development of diabetes mellitus, the increase in rates among children and adolescents is a serious manifestation of the epidemic and a new public health problem of significant proportions [5].

In 2012, there were 1.5 million deaths directly attributable to diabetes worldwide. Diabetes was the eighth leading cause of death among both sexes and the fifth leading cause of death among women in 2012. According to WHO estimates, 422 million adults aged 18 years and over were diagnosed with diabetes worldwide in 2014, with the global prevalence of diabetes increasing from 4.7% in 1980 to 8.5% in 2014, during which time the prevalence of diabetes in every country either increased or, at best, remained at the same level[8,9,10]. By 2035, according to data provided by the International Diabetes Federation (IDF), the number of people with diabetes worldwide will increase to 592 million people, which is approximately one tenth of the world's population [12,13]. The actual prevalence of type 2 diabetes is 2-3 times higher than that registered based on visits. In half of the cases, it is detected in the 5-7 year from the onset of the disease, therefore, 20-30% of patients have complications

specific to it at the time of detection of diabetes. All this determines its medical and social significance not only among other forms of diabetes, but also among all chronic non-infectious diseases [14,15].

Diabetes mellitus is characterized by polyorgan damage, but the most common ones occur against the background of vascular lesions. They can be classified as microvascular and macrovascular. Microvascular complications include damage to the nervous system (neuropathy), damage to the renal system (nephropathy) and damage to the eyes (retinopathy). Macrovascular complications include cardiovascular diseases, stroke and peripheral vascular diseases, which in turn can lead to various types of surgical infections [1], as a result of decreased resistance to microorganisms.

Currently, diabetes mellitus is considered an autoimmune disease characterized by a violation of cellular and humoral immunity. The mechanism of damage is associated with immunological disorders in the patient's body. A third of patients with diabetes mellitus have cellular antipancreatic hypersensitivity, impaired phagocytic function of lymphocytes, and a decrease in the number of T-suppressors and T-helpers. Neutrophilic leukocytes, phagocytizing pathogens, are a critical component of the body's natural defense. Neutropenia leads to the fact that bacterial and fungal pathogens, entering the internal environment, are able to freely reproduce, form a local focus of soft tissue lesions and cause rapidly progressing sepsis [18-21].

The combination of diabetes mellitus and surgical infection forms a vicious circle, in which the infection negatively affects metabolic processes, and metabolic and microcirculation disorders worsen the course of reparative processes in the lesion [16, 24-26].

A correlation has been established between inflammation parameters and any degree of carbohydrate metabolism disorder and dysfunction of numerous host defense mechanisms under hyperglycemia conditions. This is expressed in the suppression of cellular and humoral immunity, including suppression of leukocyte migration to the infection site and their functional activation, phagocytosis, as well as impaired complement fixation and, possibly, immunoglobulin function due to their irreversible glycation (compound with glucose molecules). Another factor in the increased risk of infections is that a number of pathogens typical for patients with diabetes mellitus have unique virulence mechanisms that are enhanced precisely under hyperglycemia conditions. Thus, an increased concentration of glucose in the environment causes Candida albicans fungi to express a special protein, structurally and functionally homologous to the complement receptor on phagocytes, promoting fungal adhesion and suppressing their phagocytosis by host cells. Weakening of the immune defense

mechanisms in decompensated patients contributes to a significant increase in the carriage of various pathogens, in particular, Candida, group A beta-hemolytic streptococcus, and Staphylococcus aureus [16,23].

The prevalence of necrotic fasciitis in patients with diagnosed diabetes mellitus ranges from 40 to 60% [22,24].

Speaking about the severity and relevance of necrotic soft tissue infections, it should be recalled that in diabetes mellitus, mortality remains high, reaching 76% [27], which is associated with neglected diagnostics and determination of treatment standards. Necrotic soft tissue infections are clinically complex diseases that all physicians should be aware of, requiring rapid diagnosis and early, extensive surgical tactics. It can save the patient's life, since lesions in necrotic lesions progress rapidly, followed by a high probability of sepsis and, accordingly, a high mortality rate. In diabetes mellitus, there is an atypical clinical course, when the zone of visible changes does not correspond to the processes that are detected during surgery. The rarity and scarcity of early pathognomonic signs often lead to the fact that necrotic soft tissue infections are erroneously diagnosed as another pathology and an initial erroneous diagnosis is made [27].

The classic clinical presentation of necrotizing infections includes a triad of symptoms: local pain, swelling, and erythema [28]. Tachycardia (>100 bpm) and fever are the most common abnormalities of vital signs that occur at the height of the disease, followed by hypotension (<100 mmHg) and tachypnea (>20/min) [29]. The infected site shows tenderness, sclerosis, skin necrosis, and hemorrhagic bullae. Depending on the progression of the infection, the clinical picture described above may not always be obvious, especially in the setting of diabetes mellitus. Therefore, two groups of symptoms are considered, namely early and late symptoms[28,29].

The most common early signs are erythema, hyperthermia, and swelling. At the height of the disease, in the acute form of the disease, the patient is in a critical condition with signs and symptoms of severe septic shock and multiple organ dysfunction syndrome. In this case, the clinical picture rapidly worsens within a few hours. In contrast, the subacute form of the disease has a relatively slow clinical course, which can last for several days or weeks. The early clinical status of the subacute form is the result of the existing condition leading to infection. The patient often comes with a banal infection, when there are signs of inflammation at the site of infection, but their intensity varies, especially in patients with diabetes mellitus, due to the presence of angiopathy and neuropathy [28,29]. Pain, especially pain disproportionate to skin manifestations or refractory to analgesia, is a common reason for diagnosing necrotizing fasciitis [30]. However, some patients with diabetes may be painless. In a

study by some authors, 87% of diabetic patients had tenderness, and this is supported by other studies including that of Hsiao et al. [31,32] who reported that only 54.7% of patients had tenderness. Joshi et al. [33] also reported that diabetic patients had fewer systemic signs and less severe symptoms than non-diabetic subjects. This may contribute to the late onset and prolonged duration of symptoms seen in diabetic patients. In many cases, as the infection progresses, the pain becomes more intense. Furthermore, as a consequence of enzymatic and toxic action, tenderness on palpation extends beyond the visible lesion, extending along fascial structures. In addition, the lesion borders are usually indistinct and lymphangitis is rarely present given that the infection is in the deep fascia rather than the cutaneous structures [33,34].

The clinical picture is characterized by symptoms of systemic intoxication including fever, dehydration, confusion, dizziness, diarrhea, nausea, vomiting, weakness and malaise [35]. If the disease is not diagnosed at this stage, the skin symptoms may progress to blisters and bullae, which eventually lead to localized skin necrosis and as the infection progresses, they may become hemorrhagic. Gas formation is possible at this stage, indicating an anaerobic infection such as C. perfringens. This classic skin condition usually does not manifest until the fifth day or later [17,27].

The heterogeneity of clinical features makes it difficult to make an early diagnosis in patients with diabetes mellitus. In studies by different authors, the rate of timely diagnosis varied from 14.6% to 38% of patients. The diagnosis was significantly more likely in non-diabetic patients, possibly due to the atypical presentation seen in diabetics, who had a longer duration of symptoms and fewer systemic signs of toxicity. Similarly, and probably for the same reason, diabetic patients had a longer hospital stay and were more likely to undergo surgery at a later time of admission than non-diabetic patients. This delay in time to surgery is significant, since a delay in surgery of this duration has been shown to correlate with increased mortality [36-39-].

Conclusion

Thus, despite advances in medicine, surgical soft tissue infection in diabetes mellitus is one of the severe surgical diseases leading to generalization. The key to a favorable outcome in the treatment of patients with necrotic soft tissue infections in diabetes mellitus is early diagnosis, especially at the primary level, surgical intervention and subsequent intensive conservative treatment. Only in this way can mortality, morbidity and length of stay of patients in hospital be reduced.

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