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Clinical and Laboratory Parameters of The Wound Process Complicated by the Systemic Inflammatory Response Syndrome in Patients with Diabetes Mellitus

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Abstract

The relentless increase in the incidence of surgical soft tissue infections requires more and more attention from medical societies to pay attention to this problem. Special cases are considered when a surgical soft tissue infection is complicated by a systemic inflammatory response syndrome. As you know, such cases are a priority among patients with diabetes mellitus. In this article, we present the results of our own analytical studies on the assessment of the clinical picture and clinical and laboratory signs of the course of purulent-inflammatory diseases of soft tissues complicated by the systemic inflammatory response syndrome in patients with diabetes mellitus. We found that the frequency of occurrence of certain clinical and laboratory signs of the systemic inflammatory response syndrome was ambiguous. The dynamics of changes has a certain regularity. At the same time, the analysis of the microbiological picture of a wound infection complicated by a systemic inflammatory response syndrome in patients with diabetes mellitus showed a staging of changes in both the quantitative and qualitative nature of pathogens in the dynamics of the treatment.

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INTRODUCTION

The problem of treating purulent diseases, remaining relevant throughout the history of mankind, under conditions of a high incidence of diabetes mellitus, is becoming increasingly important both clinically and socially [1-3].

Scientists have long studied the pathogenetic factors that affect the course of the wound process in diabetic patients [4-8]. It has been proven that diabetes mellitus creates favorable conditions for the development of a wound infection process. At the same time, the infectious process itself negatively affects the course of diabetes mellitus, by suppressing insulin deficiency and, accordingly, provoking the development of metabolic acidosis. Thus, a close relationship is formed, which enhances the aggressive aspects of the disease [9].

Along with this, the course of the purulent-inflammatory process under conditions of progressive metabolic acidosis is often complicated by the accelerated generalization of the infection. A systemic inflammatory response syndrome develops, which “randomly” activates the body’s immune system [10-12].

And today, the study of pathogenetic factors

in the development of the wound process, complicated by the syndrome of systemic inflammatory response in patients with diabetes mellitus, becomes paramount, determining the high relevance of this problem [13].

The protracted course of regenerative processes of wound infection in patients with diabetes mellitus is the starting foundation for the development of systemic inflammatory response syndrome and sepsis, which often does not allow to reduce the duration of the inpatient treatment period [14]. It requires constant monitoring of both the course of the wound process and the general manifestations of a possible generalization of the infection. This, in turn, leads to an increase in bed days and a high risk of hospital infection [14]. The solution to this problem is possible by optimizing the methods of local wound treatment, based on objective methods for assessing the phases of the inflammatory process.

In connection with the above, the purpose of our study was to investigate the features of changes in the clinical and laboratory parameters of the course of the wound process, complicated by the systemic inflammatory response syndrome in patients with diabetes mellitus.

MATERIAL AND METHODS

The results of a comprehensive examination and treatment of 59 patients with a wound infection complicated by a systemic inflammatory response syndrome against the background of diabetes mellitus, who were in the Regional Multidisciplinary Clinic of the Bukhara Region (Bukhara, Republic of Uzbekistan) from 2011 to 2016, are analyzed.

The main manifestations of wound infection in patients with diabetes mellitus were purulent diseases of the skin and subcutaneous fat (furuncle, carbuncle, erysipelas, etc.), as well as acute nonspecific infection of soft tissues of various localization (mastitis, paraproctitis, hidradenitis, etc.).

Also, this statistic considers patients with purulent-inflammatory diseases of soft tissues after various invasive interventions (injections, catheterization, surgery, etc.).

Meanwhile, summing up these pathological manifestations of wound infection, it should be noted the main form of the formation of the disease in the form of phlegmon or abscess. In this regard, the most objective, when assessing the depth of tissue damage of a surgical infection, is the assessment according to the classification of D.H. Ahrenholz. At the same time, according to these criteria, categories I-II refer to superficial lesions of soft tissues, and III-IV - to deep or severe forms of purulent-inflammatory diseases of soft tissues.

The analysis showed that most patients had level IV soft tissue lesions (40.7%). Only 8.5% was inferior in number to soft tissue lesions of level III (32.2%). Superficial forms of wound infection were ascertained by us in 27.1% of patients.

Most of all, surgical infection of soft tissues was in the extremities (45.8%). The maximum frequency was noted among such patients with level III soft tissue lesions (18.6%). Only 3.3% less were patients with level IV lesions in this area of the body.

Isolated cases of surgical infection of soft tissues were found in the head and neck at the II level of depth, in the torso at the I level of depth and in the perineum at the I and II levels of depth. This once again confirms that patients with wound infection complicated by the systemic inflammatory response syndrome against the background of diabetes mellitus are characterized by damage at the level III and IV of the depth of the lesion.

An analysis of the distribution of patients by zones of damage to parts of the body showed that among patients with the head and neck region, soft tissue lesions with a degree III prevailed (66.7%). Depths of levels III and IV prevailed in the extremities (40.7% and 33.3%, respectively). In the trunk area, almost half of the patients were patients with level IV soft tissue lesions (41.2%). In the perineal region, more than half of the patients had a level IV soft tissue lesion (66.7%).

In proportion to the depth of the lesion among patients, when analyzing various parts of the body, it was found that in patients with level I of the depth of soft tissue damage, limb zones prevailed (66.7%). Level II of the depth of soft tissue damage by surgical infection in 50% of cases was noted among patients with damage to the trunk area. In grade III and IV soft tissue lesions, patients with limb lesions prevailed (57.9% and 37.5%, respectively).

It should be noted that high rates of the number of patients with level IV soft tissue lesions due to surgical infection were also in the perineal area (33.3%). This, apparently, is due to the high virulence of microbial contamination in this area and the presence of complex fascial anatomical structures that contribute to the development of deep purulent-inflammatory processes and the severe course of the disease.

The area affected by purulent-inflammatory disease of soft tissues was very diverse but had a certain relationship. In particular, the affected area had a definite relationship with the extent of the lesion.

The revealed relationship, apparently, is also due to the volume of surgical treatment of the purulent focus. Thus, among patients with III and IV degrees of soft tissue damage, patients

with more than 1000 cm^2 of the affected area prevailed (23.8% and 33.9%, respectively). In general, patients with large areas of soft tissue lesions prevailed (69.5%), which, apparently, determined the presence of sepsis.

The clinical and laboratory picture of the course of a wound infection complicated by a systemic inflammatory response syndrome in patients with diabetes mellitus was evaluated according to several parameters, the most accessible of which are the criteria for a systemic inflammatory response syndrome (hyperthermia/hypothermia, leukocytosis/leukopenia, tachycardia, tachypnea).

RESULTS

For the entire period of dynamic monitoring of the condition of patients, 566 clinical and laboratory signs of the systemic inflammatory response syndrome were registered. Most of them accounted for changes in body temperature (38.9%). Almost in the same proportion were tachycardia (25.8%) and leukocytosis/ leukopenia (24.0%). The least reported cases of patients with dyspnea frequency above 20 times per minute (11.3%).

The dynamics of the curve was characterized by the same pattern: a sharp decrease in the frequency of occurrence of symptoms of the systemic inflammatory response syndrome after surgical treatment of a purulent focus, followed by a gradual decrease in pathological signs of a complication of the disease.

At the same time, in the dynamics of 7-10 days of treatment, no special changes in the number of signs were noted. As in the overall picture, hyperthermia/hypothermia was the leader in daily control, which closely correlated with such a sign as tachycardia during the first day. On the 3rd–5th day, the number of cases of registration of a violation of cardiac activity decreases, relative to the change in body temperature, in fact, by 2 times, however, in some cases, on the 7th day of treatment, it again manifests itself in a more pronounced form.

In general, 343 cases of the course of the disease with signs of systemic inflammatory response syndrome were registered in patients. Most of all were patients with one sign of systemic inflammatory response syndrome, which is quite natural given the ongoing adequate correction of the generalization of surgical infection.

In the dynamics of the study during treatment, out of 59 admitted patients, most of all were patients with three and four signs of systemic inflammatory response syndrome (47.5% and 30.5%, respectively). The remaining patients (22.0%) had two signs of systemic inflammatory response syndrome.

Naturally, patients with one symptom of the systemic inflammatory response syndrome were not initially included in our studies since they do not meet the criterion for the development of a generalization of a surgical infection. However, because of the treatment, we counted them too. On the 1st day after the operation, already in 13.6% of patients, the presence of one sign of the systemic inflammatory response syndrome was noted. Meanwhile, the number of patients with two signs of systemic inflammatory response syndrome increased (by 12.2% compared with the preoperative period). The number of patients with three and four signs of systemic inflammatory response syndrome decreased (by 15.3% and 8.5%, respectively).

On the 3rd day of traditional therapeutic measures, 2 (3.4%) patients died. The dynamics of the decrease in patients with two, three and four signs of systemic inflammatory response syndrome also continued, and an increase in patients with one sign of systemic inflammatory response syndrome was noted. Attention is drawn to the sharp (more than 2-fold) decrease in the number of patients with category two signs of systemic inflammatory response syndrome, which at first glance may seem like a continuation of positive dynamics. However, in a detailed analysis of clinical cases, this indicator was, unfortunately, due to the return of patients to the category with many signs of systemic inflammatory response syndrome.

During 5–7 days, 4 more patients died. Meanwhile, against the background of a decrease in the number of patients with three and four signs of systemic inflammatory response syndrome, on the 7th day of traditional therapy there was an increase in the number of patients with two signs of systemic inflammatory response syndrome (by 11.8% compared with 5 days and on 13.5% compared to 3 days of traditional treatment).

By the 10-day follow-up, 61% of patients achieved the presence of one sign of the systemic inflammatory response syndrome and completely avoided cases with the development of four signs of the systemic inflammatory response syndrome. And despite the progressive decrease in patients with three signs of systemic inflammatory response syndrome (by 13.97 times compared with the preoperative period), nevertheless, there were still an impressive number of patients with two signs of systemic inflammatory response syndrome (25.4%). This, in turn, serves as an alarming signal about the persistence of the inflammatory response in the body despite the elimination of the purulent-inflammatory focus.

The microbial contamination of the wound was represented by a wide variety of representatives of both aerobic and anaerobic habitats. It should be noted the prevalence of facultative

anaerobes, such as Escherichia coli (average $6.8x10^6$±1.1 CFU/ml) or Proteus mirabilis (average $9.2x10^7$±2.5 CFU/ml). The proportion between gram-positive and gram-negative was the same.

The average content of microorganisms in the wound during the entire period of treatment was $26.2x10^7$±4.3 CFU/ml due to facultative anaerobes (54.8%) and in dynamics it was distributed as follows.

On the day of the operation (primary inoculation), I found the prevalence of obligate anaerobes over facultative ones. Among the obligate anaerobes, B. Fragilis ($32x10^6$±3.2 CFU/ml) and S. Intermedius ($11x10^8$±3.2 CFU/ml) prevailed. Among the facultative anaerobes, Proteus mirabilis was prevalent ($19x10^7$±2.1 CFU/ml).

On the 3rd day after surgical treatment of the purulent focus, the microbial contamination of the wound significantly decreases by a total of 1.65 times (from $54.5x10^8$±13.1 CFU/ml to $33x10^7$±5.1 CFU/ml, respectively). At the same time, obligate anaerobes decreased by 2 times (from $58x10^7$±11.4 CFU/ml to $29x10^6$±9.3 CFU/ml, respectively), and facultative anaerobes decreased by 1.4 times (from $51x10^7$±2.9 CFU/ml to $37x10^6$±3.1 CFU/ml, respectively).

B. Fragilis ($16x10^6$±2.8 CFU/ml) still prevailed among the obligate anaerobes, although its number decreased by exactly 2 times compared to the previous period. A slight decrease in the number of microorganisms was noted in relation to Fusobacterium spp. (from $7.0x10^7$±1.1 CFU/ml to $5.0x10^6$±1.2 CFU/ml, respectively). Among the facultative anaerobes, Proteus mirabilis was also in the lead, accounting for 37.8% of the total number of this group of pathogens ($14x10^6$±2.2 CFU/ml).

7 days of treatment showed changes in the microbial contamination of the wound, both in relation to obligate anaerobes and facultative ones. In particular, the number of S. intermedius increased against the background of a sharp decrease in the number of B. fragilis ($p<0.05$). Among facultative anaerobes, there was an increase in the number of Escherichia coli ($p<0.05$) and a more than 2-fold decrease in the number of Staphylococcus aureus ($p<0.05$).

Starting from the 10th day of treatment, the balance between obligate and facultative anaerobes changes radically. Facultative anaerobes begin to prevail for this period by 1.5 times ($p<0.05$), by 14 days - 1.9 times ($p<0.05$). In these long-term periods of treatment, no leaders were found among obligate anaerobes. All bacteria of this group were in the same amount. The same pattern was noted among facultative anaerobes and aerobes, apart from Escherichia coli, the number of which slightly exceeded the rest of the microorganisms.

Thus, the frequency of occurrence of certain clinical and laboratory signs of the systemic inflammatory response syndrome was not unambiguous. The dynamics of changes has a certain regularity. At the same time, the analysis of the microbiological picture of a wound infection complicated by a systemic inflammatory response syndrome in patients with diabetes mellitus showed a staging of changes in both the quantitative and qualitative nature of pathogens in the dynamics of the treatment. The quantitative characterization between gram-negative and gram-positive bacteria was almost identical. The early stages of the course of wound infection were characterized by the prevalence of obligate anaerobic pathogens, which, in dynamics, losing their positions, gave way to facultative anaerobes and aerobes. Although the surgical treatment of the purulent focus and the dressing of the wound with a water-soluble ointment Levomekol significantly reduced the concentration of microorganisms in the wound, nevertheless, there was a change in the proportional balance in the structure of their quantitative redistribution, among facultative anaerobes. This, in turn, indicates the persistence of the aggressive properties of microorganisms even 2 weeks after the surgical treatment of the purulent focus.

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