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PREDICTING THE RISK OF SEPSIS IN PATIENTS WITH DIABETIC FOOT SYNDROME BASED ON A COMPREHENSIVE ASSESSMENT OF MICROCIRCULATORY AND IMMUNOLOGICAL PARAMETERS

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Abstract

Diabetic foot syndrome (DFS) remains one of the most severe complications of diabetes mellitus, characterized by a high risk of infectious complications and sepsis. Early identification of patients with an increased likelihood of infection generalization is important for selecting treatment strategies and reducing mortality. The aim of the study was to assess the prognostic significance of microcirculatory and immune status parameters in patients with DFS for the early prediction of sepsis risk.

The study included patients with purulent-necrotic forms of diabetic foot syndrome. A comprehensive assessment of microcirculatory status was performed using modern non-invasive methods, along with analysis of key cellular and humoral immunity parameters. The obtained data were compared with the clinical course of the disease and the development of septic complications.

Pronounced microcirculatory disturbances combined with signs of immune dysfunction were found to be associated with an increased risk of sepsis. Comprehensive assessment of the studied parameters allows identification of a high-risk patient group and timely adjustment of therapeutic interventions.

The results indicate the potential usefulness of microcirculatory and immunological parameters as prognostic markers of sepsis in diabetic foot syndrome and may contribute to improving diagnostic and treatment algorithms for this category of patients.

Keywords

diabetic foot syndrome, sepsis, risk prediction, microcirculation, immune status, immunological parameters, diabetes mellitus, infectious complications, purulent-necrotic processes, early diagnosis.

INTRODUCTION

Diabetic foot syndrome (DFS) is one of the most severe and socially significant complications of diabetes mellitus, associated with a high risk of purulent-necrotic

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processes, amputations, and mortality. One of the key factors contributing to an unfavorable course is the development of systemic infection and sepsis.

The pathogenesis of sepsis in DFS is multifactorial and includes pronounced microcirculatory disturbances, tissue hypoxia, and dysregulation of the immune response. Microcirculatory disorders impair the delivery of oxygen and antibacterial agents to the inflammatory focus, while immune dysfunction contributes to the progression of infection.

Despite advances in modern medicine, early prediction of sepsis in patients with DFS remains a relevant challenge. In this regard, comprehensive assessment of microcirculatory and immunological parameters is of particular interest as a potential predictor of septic complications.

Objective: to develop an approach for predicting the risk of sepsis in patients with diabetic foot syndrome based on assessment of microcirculation and immune status.

MATERIALS AND METHODS

The study included 92 patients with diabetic foot syndrome treated in departments of purulent surgery and intensive care. Patients ranged in age from 45 to 78 years. Type 2 diabetes mellitus was confirmed in all participants.

Patients were divided into two groups:

1. Group I (n=52): patients without sepsis.
2. Group II (n=40): patients who developed sepsis.

Microcirculation was assessed using laser Doppler flowmetry. Immune status was evaluated using the following parameters:

1. Leukocyte count
2. Absolute lymphocyte count
3. CD4/CD8 ratio
4. IgG and IgM levels

Statistical analysis was performed using Student's t-test and correlation analysis. Differences were considered statistically significant at $p < 0.05$.

RESULTS

Patients in Group II (with sepsis) demonstrated marked microcirculatory impairment characterized by reduced tissue perfusion and diminished capillary blood flow.

Table 1. Microcirculation Parameters in the Study Groups

Parameter	Group I (without sepsis)	Group II (with sepsis)
Perfusion (PU, arbitrary units)	18.6 ± 2.3	9.4 ± 1.8*

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Microcirculation index	1.42 ± 0.21	0.71 ± 0.15*
Capillary blood flow	72.5 ± 6.8	48.3 ± 5.9*

* $p < 0.05$

Immunological analysis revealed pronounced immunodepression in patients with sepsis.

Table 2. Immunological Parameters in Patients

Parameter	Group I	Group II
Leukocytes (×10⁹/L)	9.8 ± 1.2	14.6 ± 2.1*
Lymphocytes (%)	28.4 ± 3.6	17.2 ± 2.9*
CD4/CD8 ratio	1.6 ± 0.3	0.9 ± 0.2*
IgG (g/L)	12.4 ± 1.8	8.1 ± 1.4*

* $p < 0.05$

Correlation analysis demonstrated strong associations between the severity of microcirculatory disturbances, immune dysfunction, and the development of sepsis.

Table 3. Correlation of Parameters with Sepsis Development

Parameter	Correlation coefficient (r)	Significance level
Reduced perfusion	-0.68	$p < 0.01$
CD4/CD8 ratio	-0.72	$p < 0.01$
Lymphopenia	-0.61	$p < 0.01$

Thus, the combination of pronounced microcirculatory impairment and immune dysfunction is a reliable predictor of sepsis development in patients with diabetic foot syndrome.

DISCUSSION

The findings confirm the key role of microcirculatory disturbances and immune dysfunction in the pathogenesis of sepsis in patients with diabetic foot syndrome. The marked reduction in tissue perfusion observed in septic patients indicates critically impaired delivery of oxygen and antibacterial agents to the inflammatory focus, promoting infection generalization.

The immunological changes identified in the study were characterized by a decreased CD4/CD8 ratio, lymphopenia, and reduced IgG levels, reflecting the development of secondary immunodeficiency. These alterations create conditions for uncontrolled progression of infection and the formation of a systemic inflammatory response.

The observed correlations suggest that the combined disturbance of microcirculation and immune response is the most significant risk factor for sepsis

development. This is consistent with contemporary studies indicating the multifactorial nature of septic complications in DFS.

Therefore, comprehensive assessment of these parameters may be considered a promising tool for early prediction of sepsis.

CONCLUSIONS

1. In patients with diabetic foot syndrome, sepsis development is accompanied by pronounced microcirculatory disturbances characterized by reduced tissue perfusion and capillary blood flow.
2. Sepsis formation is associated with signs of immune dysfunction, including a reduced CD4/CD8 ratio, lymphopenia, and decreased IgG levels.
3. Significant correlations were identified between microcirculatory parameters, immune status indicators, and the development of sepsis.
4. Comprehensive assessment of microcirculatory and immunological parameters allows identification of high-risk patients and may be used for early prediction of sepsis in diabetic foot syndrome.

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