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Predictive Approaches And Therapeutic Optimization In Odontogenic Inflammatory Diseases With Systemic Complications

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Abstract: Odontogenic inflammatory diseases (OIDs) represent a major cause of emergency admissions and are often complicated by deep fascial infections and systemic involvement. Progression to systemic inflammatory response syndrome (SIRS), sepsis, and multiple organ dysfunction (MOD) poses significant threats to patient outcomes. This study synthesizes prognostic indicators, biomarkers, and optimized therapeutic strategies based on an analysis of 91 clinical cases and the development of a predictive digital algorithm. Emphasis is placed on cytokine predictors, systemic infection markers, microbiological dynamics, and differentiated therapy including G-CSF Filgrastim. The findings demonstrate substantial improvements in early detection, prevention of MOD, and overall treatment outcomes.

Keywords: Odontogenic inflammatory disease, sepsis, filgrastim.

Introduction: Odontogenic infections continue to be a global clinical challenge, particularly in cases where delayed treatment or self-medication leads to the spread of infection beyond the primary dental structures. Severe forms of OIDs are characterized by rapid involvement of multiple fascial spaces, airway compromise, and a measurable increase in systemic inflammatory markers [1]. In high-risk groups such as patients with diabetes, immunosuppression, or chronic systemic diseases the likelihood of generalized infection and organ dysfunction is significantly elevated.

Recent advances in surgical techniques, antimicrobial

therapy, and biomarker-based diagnostics have improved prognosis, yet mortality remains notable due to the unpredictable clinical progression of odontogenic sepsis. This necessitates the development of precise predictive models and individualized therapeutic strategies to prevent the development of MOD. The present work integrates clinical, laboratory, microbiological, and immunological parameters to formulate a comprehensive prognostic and therapeutic approach [2,3].

METHODS

A total of 91 patients diagnosed with odontogenic inflammatory diseases complicated by generalized infection were examined and treated at the Tashkent State Dental Institute between 2021 and 2024. Patients were divided into two groups: a control group (n=44) managed with standard diagnostic and treatment protocols, and a study group (n=47) treated using the newly developed prognostic methods.

Inclusion criteria: confirmed odontogenic infection with systemic inflammatory manifestations, age ≥ 18, and written consent. Exclusion criteria included pregnancy, non-odontogenic infections, and refusal to participate.

Diagnostic assessments included clinical evaluation, hematological and biochemical tests, measurement of inflammatory biomarkers (CRP, PCT, LFR), cytokine profiling (IL-1β, IL-6, IL-8, TNF-α), microbiological wound analysis, ultrasonography, and multislice computed tomography (MSCT). A novel computer-assisted predictive model ("AIDOS") was applied in the study group to calculate the risk of distant organ damage based on combined cytokine and biomarker analysis. Therapeutic intervention in selected patients included administration of granulocyte colony-stimulating factor (G-CSF) Filgrastim following objective immunological criteria.

RESULTS AND DISCUSSION

The analysis revealed that elevated levels of TNF-α and IL-8 were the most reliable predictors of progression toward multiple organ dysfunction. CRP and PCT levels showed a strong correlation with the severity of systemic infection. (figure-1). Microbiological evaluation demonstrated a predominance of coccal flora in severe cases, accompanied by reduced lymphocyte and granulocyte counts in wound cytology.

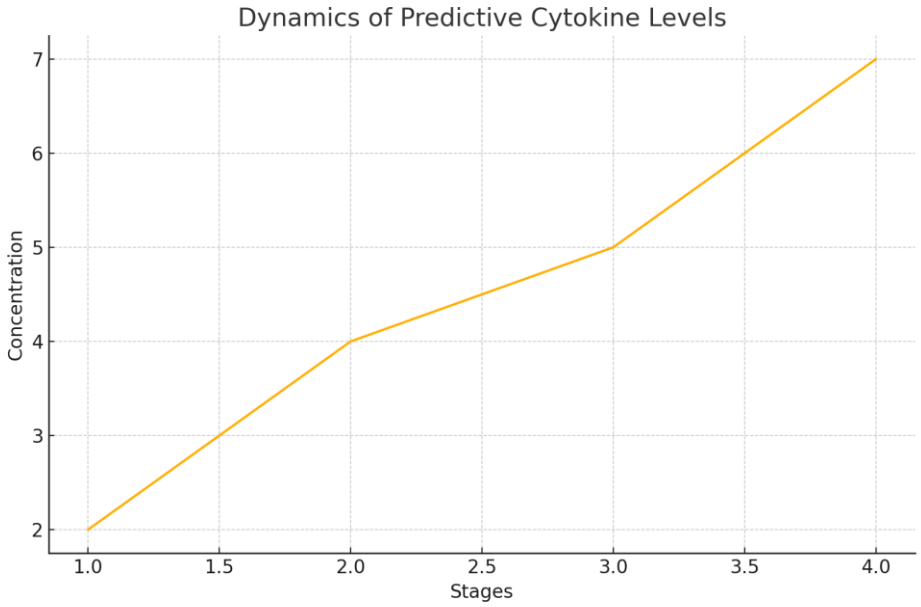

Figure 1. Dynamics of Predictive Cytokine Levels Across Clinical Stages.

The involvement of four or more fascial spaces significantly increased the risk of airway obstruction, deep neck infections, and early MOD. The AIDOS system demonstrated high diagnostic value, enabling timely identification of patients at high risk for systemic deterioration. (figure-2).

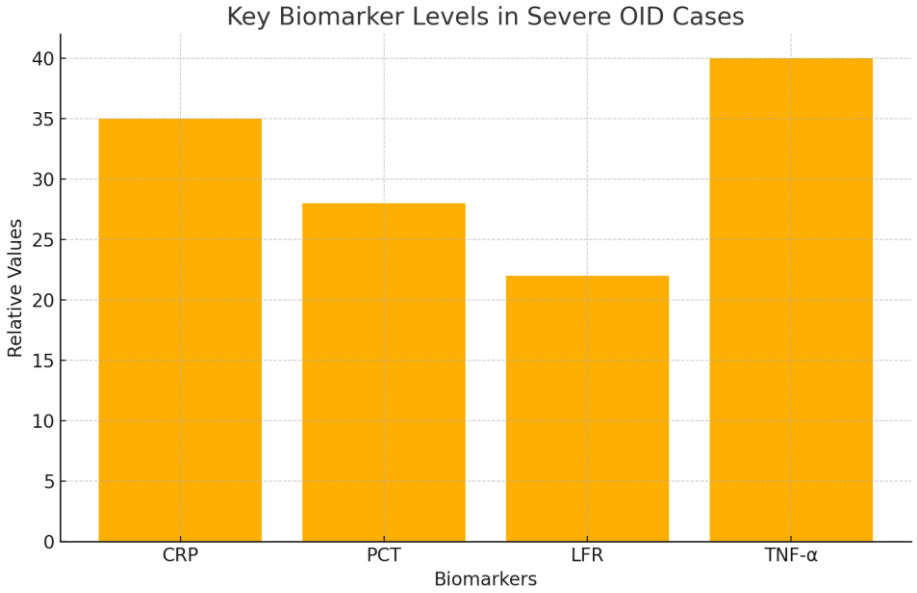

Figure 2. Comparative Levels of Key Biomarkers (CRP, PCT, LFR, TNF-α) in Severe Odontogenic Infections.

Application of G-CSF Filgrastim led to enhanced neutrophil response, accelerated wound healing, reduced systemic inflammation, and a measurable decrease in septic complications. Patients receiving biomarker-guided therapy required fewer surgical revisions and had shorter hospitalization periods compared with the control group.

The integration of digital predictive tools with cytokine analysis represents an important advancement in the early detection and management of life-threatening odontogenic infections.

CONCLUSION

Severe odontogenic infections require comprehensive risk assessment, timely prediction of complications, and targeted therapeutic measures. This study confirms the value of cytokine profiling, systemic inflammation markers, and topographic analysis in predicting generalized infection and organ dysfunction. The proposed treatment algorithm—including the use of Filgrastim and the AIDOS predictive model—demonstrated increased effectiveness and reduced complication rates. These approaches may serve as a foundation for future clinical protocols aimed at improving outcomes in odontogenic sepsis.

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