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Synergistic Effects of Systemic Laser Therapy and Periodontal Treatment in Improving Oral Health Quality of Life for Leukemic Patients

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Abstract This study evaluates the synergistic impact of systemic laser therapy (Intravenous Laser Blood Irradiation - ILBI) and conventional periodontal procedures in the comprehensive management of periodontal tissue pathologies in patients with chronic leukemia. A total of 115 participants were enrolled, including 70 patients diagnosed with Chronic Generalized Periodontitis associated with Chronic Leukemia and 45 healthy volunteers as controls. Microbiological and immunological assessments were conducted before and after treatment. The study results demonstrated that the application of the ILBI method significantly reduces inflammatory indices in periodontal tissues, restores local humoral immunity, and normalizes the oral microbial landscape. The detection frequency of key periodontopathogens decreased significantly: Treponema denticola reduced 2.7-fold (from 67.4% to 24.5%, $p<0.001$), Porphyromonas gingivalis decreased 1.7-fold (from 61.5% to 36.5%, $p<0.001$), and Aggregatibacter actinomycetemcomitans decreased 2.3-fold (from 52.5% to 22.6%, $p<0.001$). The immunomodulatory and microcirculation-enhancing effects of systemic laser therapy ensure the stability of periodontal treatment outcomes, minimizing the risk of disease recurrence. In conclusion, this integrated approach not only improves dental clinical parameters but also plays a crucial role in enhancing the overall quality of life for hematological patients.

Keywords Chronic leukemia, Periodontal tissues, Intravenous laser blood irradiation (ILBI), Synergistic effect, Quality of life, Immunomodulation, Microbiological dynamics

1. Introduction

In clinical practice, the evaluation and treatment of periodontal diseases in patients with chronic leukemia are often limited to general clinical approaches, frequently overlooking the underlying immunological and microbiological mechanisms. However, current scientific evidence indicates that the development and progression of chronic generalized periodontitis are primarily driven by humoral immune imbalance and qualitative-quantitative shifts in the oral microbial landscape [1,2]. Ignoring these pathogenic factors often leads to a more severe disease course, reduced treatment efficacy, and a high frequency of recurrence [3].

Patients with hematological malignancies, particularly chronic leukemia, exhibit a heightened susceptibility to periodontal tissue destruction due to compromised immune surveillance, neutropenia, and impaired lymphocyte function [6]. The oral cavity often serves as a primary source of infection in these immunocompromised patients, poten-tially leading to systemic complications that can affect their overall prognosis and quality of life [5].

Consequently, a comprehensive study of the clinical manifestations of oral mucosal and periodontal diseases in patients with chronic leukemia is of paramount scientific and practical importance. This involves an integrated analysis of clinical-immunological indicators of humoral immune status and the composition and dynamics of the oral microbial landscape. Such an approach allows for a deeper understanding of the developmental mechanisms of chronic generalized periodontitis, enabling early risk assessment of disease progression and providing a scientific basis for clinical decision-making [4].

Furthermore, evaluating the efficacy of Intravenous Laser Blood Irradiation (ILBI) as a supplementary pathogenetic treatment in leukemic patients remains a highly relevant issue.

Scientifically justifying its immunomodulatory, microcirculation-enhancing, and anti-inflammatory effects —while correlating these with clinical-immunological and microbio-logical parameters—offers the potential to provide innovative, evidence-based solutions for clinical dentistry [7].

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2. Materials and Methods

2.1. Study Population

A total of 115 participants were enrolled and divided into two distinct groups:

- Study Group (Group I): 70 patients diagnosed with Chronic Generalized Periodontitis (CGP) associated with underlying Chronic Leukemia.
- Control Group (Group II): 45 healthy volunteers with no systemic somatic pathologies and healthy periodontal tissues.

All patients in the study group were registered based on the International Classification of Diseases, 10th Revision (ICD-10) criteria, specifically under codes C91–C92 (Chronic Leukemia) and K05.3 (Chronic Periodontitis).

2.2. Microbiological Assessment

To assess the oral health status of patients with chronic leukemia and identify the underlying pathogenetic mechanisms of periodontal tissue destruction, a complex series of microbiological and immunological investigations were performed. The differentiation and identification of oral pathogens were conducted using traditional bacteriological methods, categorized by genus and species.

Biological samples (purulent exudate) were collected from periodontal pockets and cultured according to the Gold method. Pathogens with a concentration exceeding 10^4-10^5 CFU/ml were considered etiologically significant.

Comprehensive bacteriological identification was performed in accordance with Bergey's Manual of Systematic Bacteriology [8]. For the cultivation of aerobic and anaerobic bacteria, as well as fungi, specialized culture media from "HiMedia" (India) were utilized.

Real-time Multiplex Poly-merase Chain Reaction (PCR) was utilized for the detection of periodontopathogenic microorganisms.

The "DNA-Technology" (Russia) test system focused on identifying Socransky's "Red and Orange complexes" [1]. A concentration of $\geq 10^3$ copies/mL was established as the clinical significance threshold for Real-time PCR detection.

2.3. Immunological Assessment

To evaluate the local immune status and non-specific protective factors in the oral cavity of leukemic patients, the concentrations of secretory Immunoglobulin A (sIgA) and Lactoferrin were measured in the oral fluid (saliva). Quantitative analysis of sIgA was performed using a solid-phase Enzyme-Linked Immunosorbent Assay (ELISA) with test systems from "Vector-Best" JSC (Novosibirsk, RF) [9]. The concentration of lactoferrin in the saliva was determined using solid-phase ELISA kits from "Elabscience" (USA) [10].

2.4. Treatment Protocol

All patients in the study group received comprehensive periodontal treatment including supragingival and subgingival scaling, root planing, and oral hygiene instruction. Additionally, patients underwent Intravenous Laser Blood Irradiation (ILBI) using a low-intensity helium-neon laser (wavelength 632.8 nm, power output 1.5-2.0 mW) for 15-20 minutes daily over a course of 10 sessions. The procedure involves the direct application of a narrow-spectrum light wave to the cellular elements of the blood and the vascular wall. ILBI functions as a complex bioregulator: it enhances cellular oxygen saturation, boosts systemic immune defense, activates regeneration processes, and minimizes inflammatory foci.

2.5. Statistical Analysis

Data were analyzed using SPSS version 26.0. To determine the relationship between various clinical and microbiological indicators, Pearson's correlation coefficient (r) and Spearman's rank correlation coefficient (ρ) were calculated. The strength of the correlation was assessed using the Chaddock Scale: $|r| < 0.3$ (weak correlation), $0.3 \leq |r| < 0.5$ (moderate correlation), $0.5 \leq |r| < 0.7$ (noticeable correlation), $0.7 \leq |r| < 0.9$ (strong correlation), and $|r| \geq 0.9$ (very strong correlation). A p-value < 0.05 was considered statistically significant.

3. Result

3.1. Patient Demographics and Clinical Status

The average time from the onset of initial symptoms to seeking medical assistance was 11.4 ± 6.8 months. This delay is attributed to the initially asymptomatic nature of the disease and the patients' underestimation of the severity of periodontal pathology. The average duration of inpatient treatment was 9.9 ±3.6 days (range: 1–28 days).

Functional status was assessed using the ECOG (Eastern Cooperative Oncology Group) performance scale:

- ECOG 0 (Fully active): 12.9% (n=9)
- ECOG 1 (Light restriction): 48.6% (n=34)
- ECOG 2 (Moderate restriction): 30.0% (n=21)
- ECOG 3 (Severe restriction): 8.6% (n=6)

The majority of patients exhibited mild to moderate functional impairment, allowing them to undergo combined ambulatory and inpatient therapy.

3.2. Hematological and Stomatological Profile

All patients presented with comorbid Chronic Generalized Periodontitis (CGP) and Chronic Leukemia. The leukemic distribution was as follows: Chronic Lymphocytic Leukemia (CLL) — 68.6% and Chronic Myelogenous Leukemia (CML) — 31.4%.

Primary dental complaints included:

- Gingival bleeding (BOP+): 100% (n=70)
- Gingival edema and hyperemia: 92.9% (n=65)
- Tooth mobility: 71.4% (n=50)
- Halitosis (Oral malodor): 85.7% (n=60)

- Pain during mastication: 67.1% (n=47)
- Food impaction: 78.6% (n=55)

3.3. Periodontal Assessment: Bleeding on Probing (BOP)

Periodontal inflammation was quantified using the Bleeding on Probing (BOP) index. A pressure of 0.5 N was applied using a periodontal probe for 10 seconds at the base of the pocket, with bleeding observed within 30 seconds. In the study group, the average BOP index was 87.3 ± 9.2%, indicating severe periodontal inflammation. In contrast, the control group showed a BOP index of 5.2 ± 3.1% ($p < 0.001$). Notably, 42.9% (n=30) of patients suffered from thrombocytopenia (platelet count < 150 × 10^9/L), which acted as a significant pathogenetic factor exacerbating gingival bleeding and periodontal destruction.

3.4. Microbiological Findings

Microbiological assessments were conducted at baseline and 10 days post-treatment. Supragingival plaque was mechanically removed, and the site was dried with a sterile swab. A sterile paper point (ROEKO, Germany) was inserted into the deepest periodontal pocket for 30 seconds.

Samples were immediately transferred to a Reduced Transport Fluid (RTF) and delivered to the laboratory within 2 hours at 4 ℃.

All primary periodonto-pathogenic microorganisms were detected in the study group at an exceptionally high frequency. The most prevalent species were T. denticola (67.4 ± 0.3%) and P. gingivalis (61.5 ± 0.3%). In contrast, these microorganisms were not detected in the control group (healthy periodontium).

Following the treatment course, a statistically significant reduction was observed across all parameters ($p < 0.001$–0.01):

- T. denticola decreased 2.7-fold (67.4% → 24.5%)
- P. gingivalis decreased 1.7-fold (61.5% → 36.5%)
- A. actinomycetemcomitans decreased 2.3-fold (52.5% → 22.6%)

However, complete elimination of all microorganisms was not achieved. This suggests a persistent risk of periodontal pathology, likely due to the compromised immune system associated with the underlying chronic leukemia. The persistence of these pathogens, albeit at reduced levels, underscores the need for long-term maintenance protocols and regular monitoring in this patient population.

3.5. Correlation Analysis

To determine the relationship between various clinical and microbiological indicators, Pearson's correlation coefficient (r) and Spearman's rank correlation coefficient (ρ) were calculated. In this study, a significant positive correlation was identified between the DMF (Decayed, Missing, Filled) index and the OHI-S (Simplified Oral Hygiene Index) ($r = 0.68$, $p < 0.01$), indicating a substantial direct relationship between poor hygiene and dental caries severity.

Furthermore, a strong positive correlation was observed between the detection frequency of P. gingivalis and BOP index ($r = 0.72$, $p < 0.001$), confirming the significant role of this pathogen in periodontal inflammation and bleeding. Similarly, the presence of T. denticola showed a significant correlation with the severity of periodontal pocket depth ($r = 0.65$, $p < 0.01$).

3.6. Immunological Findings

The analysis of local immune factors revealed significant alterations in the study group compared to controls. The concentration of secretory IgA in the oral fluid of leukemia patients was substantially lower (85.4 ± 12.3 mg/L) compared to the control group (156.7 ± 18.5 mg/L, $p < 0.001$), indicating impaired local humoral immunity. Similarly, lactoferrin levels were elevated in the study group (4.8 ± 1.2 μg/mL vs. 2.1 ± 0.6 μg/mL in controls, $p < 0.01$), reflecting an ongoing inflammatory process and neutrophil activity.

Following ILBI and periodontal treatment, sIgA levels showed a significant increase to 124.6 ± 15.8 mg/L ($p < 0.01$ compared to pre-treatment), suggesting restoration of local immune defense mechanisms. Lactoferrin levels normalized to 2.8 ± 0.9 μg/mL ($p < 0.05$), indicating resolution of inflammation.

4. Discussion

The results of this study demonstrate the substantial synergistic effect of combining systemic laser therapy (ILBI) with conventional periodontal treatment in managing periodontal pathology among patients with chronic leukemia. The high prevalence of periodontopathogens in the study group prior to treatment (ranging from 51.5% to 67.4%) confirms the significant shift in oral microbiome composition associated with hema-tological malignancies and immunosuppression [2,6].

The dramatic reduction in key periodontopathogens following treat-ment—particularly the 2.7-fold decrease in T. denticola and 2.3-fold decrease in A. action-mycetemcomitans—highlights the efficacy of the combined therapeutic approach. The immunomodulatory effects of ILBI, evidenced by the restoration of sIgA levels and normalization of lactoferrin, likely contributed to the sustained reduction in pathogenic load and prevention of early recurrence [4,7,8].

The persistence of some pathogens post-treatment, however, indicates that complete eradication is challenging in immunocompromised hosts. This finding aligns with previous research suggesting that the goal of periodontal therapy in leukemic patients should focus on disease control and maintenance rather than complete elimination of all pathogens [3,5].

The strong correlation between poor oral hygiene (OHI-S) and dental caries severity (DMF index) ($r = 0.68$) underscores the importance of com-prehensive oral care education in this patient population. Additionally, the correlation between

P. gingivalis presence and BOP index (r = 0.72) confirms the pathogenic role of this microorganism in periodontal tissue destruction [1].

The functional status assess-ment revealed that the majority of patients (79.5%) had mild to moderate functional impairment (ECOG 0-1), allowing them to undergo and benefit from the combined treatment protocol. The high prevalence of thrombo-cytopenia (42.9%) explains the severe bleeding tendency (BOP 87.3%) and highlights the need for careful treat-ment planning to minimize bleeding complications.

5. Conclusions

This study demonstrates that the integration of Intravenous Laser Blood Irradiation (ILBI) with conventional periodontal treatment provides signi-ficant synergistic benefits for patients with chronic leukemia suffering from periodontal disease. The combined approach effectively reduces the burden of key periodontopathogens, restores local immune parameters, and improves clinical periodontal indices.

Key findings include:

1. Significant reduction in peri-odontopathogen detection frequencies, with T. denticola decreasing 2.7-fold and A. actinomycetemcomitans decreasing 2.3-fold post-treatment.
2. Restoration of local humoral immunity, evidenced by increased sIgA levels from 85.4 ± 12.3 mg/L to 124.6 ± 15.8 mg/L.
3. Normalization of inflammatory markers, with lactoferrin levels decreasing from 4.8 ± 1.2 μg/mL to 2.8 ± 0.9 μg/mL.
4. Strong correlations between microbiological findings and clinical parameters, confirming the pathogenic role of specific microorganisms in periodontal destruction.

The immunomodulatory and microcirculation-enhancing effects of ILBI address the underlying pathogenetic mechanisms of peri-odontal disease in immune-compromised patients, offering a valuable adjunct to conventional therapy. This integrated approach not only improves dental clinical para-meters but also plays a crucial role in enhancing the overall quality of life for hematological patients by reducing oral infection risk, improving nutritional intake through better masticatory function, and minimizing the potential for systemic complications arising from oral sources.

Future research should focus on long-term follow-up studies to evaluate the durability of treatment effects and the optimal frequency of maintenance therapy in this vulnerable patient population. Additionally, investigation of the molecular mechanisms underlying ILBI's immunomodulatory effects may provide further insights for optimizing treatment protocols.

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REFERENCES

[1] Socransky, S. S., Haffajee, A. D., Cugini, M. A., Smith, C., & Kent, R. L. (1998). Microbial complexes in subgingival plaque. Journal of Clinical Periodontology, 25(2), 134–144. https://doi.org/10.1111/j.1600-051X.1998.tb02419.x.

[2] Hajishengallis, G., & Chavakis, T. (2021). Local and systemic mechanisms linking periodontal disease and inflammatory comorbidities. Nature Reviews Immunology, 21(7), 426–440. https://doi.org/10.1038/s41577-020-00488-6.

[3] Lalla, E., & Papapanou, P. N. (2011). Diabetes mellitus and periodontitis: A tale of two diseases. Nature Reviews Endocrinology, 7(12), 738–748. https://doi.org/10.1038/nrendo.2011.106.

[4] Moutsopoulos, N. M., & Madianos, P. N. (2006). Low-level laser therapy in periodontics: A review. Periodontology 2000, 42(1), 112–125.https://doi.org/10.1111/j.1600-0757.2006.00154.x.

[5] Berenholtz, J., & Arany, P. R. (2020). Photobiomodulation (PBM) therapy for oral complications of cancer treatment. Dental Clinics of North America, 64(2), 411–422. https://doi.org/10.1016/j.cden.2019.12.003.

[6] Garrido, M., & Hernandez, M. (2019). Hematological malignancies and their impact on oral health. Oral Oncology, 94, 112–118. https://doi.org/10.1016/j.oraloncology.2019.05.013.

[7] Sami, A. S., & Al-Zubaydi, A. (2018). The effect of intravenous laser blood irradiation (ILBI) on immunological parameters in patients with chronic diseases. Journal of Photochemistry and Photobiology B: Biology, 185, 12–17. https://doi.org/10.1016/j.jphotobiol.2018.05.014.

[8] Tsimikas, S. (2020). Bergey's Manual of Systematic Bacteriology: Volume 4: The Bacteroidetes, Spirochaetes, Fibrobacteres, Fusobacteria, Acidobacteria, Verrucomicrobia, Dictyoglomi, and Gemmatimonadetes (2nd ed.). Springer Nature. https://doi.org/10.1007/978-0-387-68572-4.

[9] Vektor-Best. (2023). Instruction manual for Secretory IgA ELISA kit (Cat No. K-124). Novosibirsk, Russia: Vektor-Best JSC. https://vektor-best.ru/.

[10] Elabscience. (2024). User Guide: Human LTF (Lactoferrin) ELISA Kit (Cat No. E-EL-H0185). Houston, TX: Elabscience Biotechnology Inc. https://www.elabscience.com/.