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STUDY OF CHOLESTEROL CONTENT IN THE ORAL FLUID OF PATIENTS WITH PERI-IMPLANTITIS AGAINST THE BACKGROUND OF THE TREATMENT AND PREVENTION COMPLEX

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The study was devoted to researching of the effect of the treatment and prevention complex on the cholesterol content in the oral fluid of patients with peri-implantitis. The study involved 40 patients with peri-implantitis aged 25 to 55 years. Indicators of oral lipid metabolism – cholesterol – were determined in the patients' oral fluid. In patients receiving the treatment and prevention complex, the level of cholesterol in the oral fluid decreased by 25 % after one month of therapy compared to the baseline. After three months, it decreased by another 2.1 times, approaching the level observed in healthy individuals. In patients in the comparison group, who received only the standard treatment protocol, the level of cholesterol in the oral fluid remained persistently elevated throughout the study period, which emphasizes the need for additional interventions to achieve a significant normalization of lipid metabolism in peri-implantitis.

Key words: oral fluid, health of the oral cavity, implants, treatment and prevention complex, adult patients.

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ДОСЛІДЖЕННЯ ВМІСТУ ХОЛЕСТЕРИНУ У РОТОВІЙ РІДИНІ ПАЦІЄНТІВ З ПЕРИІМПЛАНТИТАМИ НА ТЛІ ЛІКУВАЛЬНО-ПРОФІЛАКТИЧНОГО КОМПЛЕКСУ

Дослідження було присвячено вивченню впливу лікувально-профілактичного комплексу на вміст холестерину в ротовій рідині пацієнтів з перимплантитом. У дослідженні взяли участь 40 пацієнтів з перимплантитом у віці від 25 до 55 років. У ротовій рідині пацієнтів визначали показники ліпідного обміну порожнини рота – холестерину. У пацієнтів, які отримували лікувально-профілактичний комплекс, рівень холестерину в ротовій рідині через місяць терапії знизився на 25 % порівняно з вихідними показниками. Через три місяці він знизився ще в 2,1 раз, наблизившись до рівня, що спостерігався у здорових осіб. У пацієнтів групи порівняння, які отримували лише стандартний протокол лікування, рівень холестерину в ротовій рідині залишався стійко підвищеним протягом усього періоду дослідження, що підкреслює необхідність додаткових втручань для досягнення значущої нормалізації ліпідного обміну при перимплантиті.

Ключові слова: ротова рідина, здоров'я порожнини рота, імплантати, лікувально-профілактичний комплекс, дорослі пацієнти.

The work is a fragment of the research project “Improving the prediction of the occurrence and course of dental caries and periodontal disease, schemes for their prevention and treatment”, state registration No. 0121U114672.

Peri-implantitis is a multifactorial pathological condition characterized by inflammation of the tissues surrounding a dental implant, accompanied by the loss of supporting alveolar bone. The prevalence of peri-implantitis has been observed to range widely, with reported figures up to 47 % for implant sites over long-term follow-up periods, underscoring the significant clinical challenge it presents to dentistry and implantology [10]. Numerous risk factors contribute to the onset and progression of peri-implantitis, including inadequate plaque control, biomechanical overload, genetic predisposition, smoking, and concomitant systemic diseases particularly conditions associated with a dysregulation of lipid metabolism, such as atherosclerosis [3, 6]. In parallel, the relationship between local oral health and systemic health is increasingly recognized, with periodontal and peri-implant inflammatory processes potentially influencing systemic disorders, and vice versa [6, 7].

Recent studies highlight the importance of identifying and quantifying biomarkers in oral fluids as a means of evaluating peri-implant inflammatory states and predicting treatment outcomes [9]. Crevicular fluid analysis, for instance, has emerged as a promising approach to assess the molecular and

biochemical changes associated with peri-implantitis [8]. However, while there is growing evidence on the role of specific proteins, cytokines, and bacterial profiles in the development of peri-implantitis [4, 5, 11], the interplay between lipid metabolism and peri-implant inflammatory diseases remains relatively underexplored. Cholesterol, a key component in cellular membranes and an indicator of systemic metabolic status, can also be detected in the oral fluid, thereby offering a potential biomarker for both local inflammatory processes and broader systemic conditions. Given that hypercholesterolemia and related dyslipidemias are strongly linked to atherosclerosis and other systemic pathologies, investigating cholesterol levels in the oral cavity of peri-implantitis patients with concomitant periodontitis and atherosclerosis may reveal valuable diagnostic and prognostic insights.

The present study addresses this gap by exploring whether a specially designed treatment and preventive complex can favorably modulate the cholesterol content in the oral fluid of peri-implantitis patients, thereby contributing to a more comprehensive therapeutic strategy. This approach extends beyond standard protocols by incorporating agents with antioxidant, anti-inflammatory, microbiome-restorative, microcirculation-enhancing, and osteotropic effects. The potential to simultaneously manage peri-implant inflammation and support systemic lipid regulation aligns with current calls for more holistic interventions targeting both local and systemic risk factors [7]. Thus, the aim of this investigation is to evaluate the efficacy of this combined regimen in restoring healthier lipid profiles within the oral cavity, which may ultimately contribute to improved peri-implant and systemic outcomes.

The purpose of the study was to evaluate the effect of the treatment and preventive complex on cholesterol content in the oral fluid of patients with peri-implantitis.

Materials and methods. Biochemical studies of oral fluid were performed in 40 patients with peri-implantitis aged between 25 and 55 years. Biochemical studies were carried out in the laboratory of biochemistry and vivarium of the SE “The Institute of stomatology and maxilla-facial surgery National academy of medical sciences of Ukraine” (SE “ISMFS NAMS”).

Patients were divided into 3 groups:

- 1st group – normal (somatically healthy patients), n=10;
- 2nd group – comparison (patients with peri-implantitis who received basic therapy according to the protocol, n=15);
- 3rd group – main group (patients with peri-implantitis who received a treatment and prevention complex in addition to the basic therapy, n=15).

Patients of groups 2 and 3 had peri-implantitis with a history of concomitant pathology – periodontitis and atherosclerosis.

Patients in the comparison group received basic therapy according to the protocol, while patients in the 3rd (main) group, in addition to basic therapy, received a treatment and prophylactic complex that included drugs with antioxidant, anti-inflammatory effects, agents to restore microbiocenosis and microcirculation, as well as drugs with an osteotropic mechanism of action. The use of this complex was repeated 6 months after the start of treatment.

Cholesterol content was determined in the oral fluid of patients [1].

The results were processed by variational statistical methods of analysis using the Microsoft Office Excel 2016 software. Statistical processing of the experimental study results was carried out by the methods of variation analysis using the Student's test. The difference was considered statistically significant at $p < 0.01$ [2].

Results of the study and their discussion. To investigate the state of lipid metabolism in the oral fluid of patients with peri-implantitis and concomitant periodontal disease and atherosclerosis, the cholesterol content was measured. The results of the analysis are presented in Table 1.

Table 1

Cholesterol content in the oral fluid of patients at different stages of treatment, $M \pm m$

Groups	Terms	Terms of the study				
	Initial state	After 1 month	After 3 months	After 6 months	After 1 year	
Normal, n=10		0.12±0.01				
Comparison, n=15	0.27±0.02 $p < 0.001$	0.24±0.02 $p < 0.001$ $p_1 > 0.25$	0.22±0.02 $p < 0.001$ $p_1 > 0.25$	0.25±0.02 $p < 0.001$ $p_1 > 0.5$	0.30±0.02 $p < 0.001$ $p_1 > 0.3$	
Main, n=15	0.24±0.02 $p < 0.001$ $p_2 > 0.3$	0.18±0.01 $p > 0.1$ $p_1 < 0.01$ $p_2 < 0.01$	0.11±0.01 $p > 0.1$ $p_1 < 0.001$ $p_2 < 0.001$	0.15±0.01 $p > 0.2$ $p_1 < 0.001$ $p_2 < 0.001$	0.17±0.01 $p < 0.02$ $p_1 < 0.001$ $p_2 < 0.001$	

Note. p – significance of differences from the norm; p_1 – significance of differences from the initial level. p_2 – significance of differences from the indices in groups.

Before treatment, the cholesterol level in the oral fluid of patients with peri-implantitis in both the comparison and main groups was markedly higher relative to systemically healthy individuals. Specifically, in the comparison group, the baseline value exceeded the norm by a factor of 2.25 ($p < 0.001$), while in the main group it was 2.0 times higher ($p < 0.001$) compared to the healthy control level of 0.12 ± 0.01 mmol/L. This initial elevation underscores a pronounced disturbance in lipid metabolism in patients presenting with peri-implantitis, compounded by concomitant periodontal disease and atherosclerosis.

When examining the longitudinal data at 1, 3, 6, and 12 months, the comparison group displayed persistently elevated oral fluid cholesterol levels. According to the table, their values decreased only slightly from 0.27 ± 0.02 mmol/L at baseline to 0.24 ± 0.02 mmol/L after one month, and then gradually to 0.22 ± 0.02 , 0.25 ± 0.02 , and 0.30 ± 0.02 mmol/L at 3, 6, and 12 months, respectively. However, none of these changes reached statistical significance when compared with the group's own baseline ($p_1 > 0.25$, $p_1 > 0.25$, $p_1 > 0.5$, $p_1 > 0.3$ for each subsequent measurement). Moreover, each of these values remained significantly higher than those of the healthy control group ($p < 0.001$ at every time point), indicating that basic treatment alone was insufficient to restore normal lipid metabolism in the oral cavity.

By contrast, the main group, which received an additional therapeutic and prophylactic regimen alongside basic treatment, demonstrated a substantially different trend. Their baseline cholesterol level of 0.24 ± 0.02 mmol/L was also elevated ($p < 0.001$). Yet, after only one month of the combined therapeutic approach, the group exhibited a notable 25 % reduction in oral fluid cholesterol levels (0.18 ± 0.01 mmol/L, $p_1 < 0.001$ compared to baseline). This reduction not only highlighted the effectiveness of the supplementary regimen early on but also set the stage for more profound changes at later assessments.

After three months, the main group's cholesterol dropped further to 0.11 ± 0.01 mmol/L, representing a 2.1-fold decrease relative to the initial state ($p_1 < 0.001$), which brought it well within the range of the healthy control group (0.12 ± 0.01 mmol/L). This shift was statistically significant both in relation to baseline and in comparison to the other groups ($p_2 < 0.001$). Importantly, although the cholesterol level rose slightly at the six-month (0.15 ± 0.01 mmol/L) and one-year (0.17 ± 0.01 mmol/L) marks, these values remained 37.5 % and 29.1 % below the group's baseline, respectively. In each instance, the post-treatment cholesterol measurements remained close to the normal range and were significantly lower than those noted for the comparison group.

Overall, these findings indicate a clear divergence in the treatment outcomes between the two patient cohorts. While patients in the comparison group maintained high cholesterol levels over the year, the main group experienced a marked normalization of cholesterol in the oral fluid by three months, which persisted albeit with minor fluctuations through one year of follow-up. Thus, the additional therapeutic and prophylactic regimen appears to be instrumental in achieving and maintaining a more favorable lipid profile in the oral cavity. These data suggest that targeted interventions addressing lipid metabolism can substantially improve oral health outcomes in individuals with peri-implantitis, especially when periodontitis and atherosclerosis are also present.

The outcomes of our study, indicating a significant decrease in cholesterol levels in the oral fluid of peri-implantitis patients under a combined therapeutic and prophylactic regimen, align with the growing recognition that inflammation and metabolic disturbances are intricately linked in periodontal and peri-implant diseases [7]. Several researchers have reported that local biomarkers in the oral cavity especially those related to bone turnover, oxidative stress, and inflammatory mediators reflect not only the status of peri-implant tissues but may also echo systemic pathologies such as atherosclerosis [8, 9]. In our findings, the persistently elevated cholesterol levels observed in the comparison group mirror observations in other studies highlighting that basic treatment alone often fails to correct the underlying metabolic dysregulation associated with peri-implantitis [10]. The positive effect seen in the main group suggests that incorporating adjuncts with antioxidant, anti-inflammatory, and osteotropic properties into standard protocols could be instrumental in mitigating both local tissue damage and systemic lipid imbalances, which is consistent with the premise that systemic diseases, including periodontitis and atherosclerosis, exacerbate peri-implantitis severity [6]. This multidimensional approach corroborates evidence pointing to the importance of microbiome balance and targeted anti-inflammatory therapy in controlling pathological changes around implants [4, 5, 11]. Furthermore, our results may encourage broader research into the interplay between systemic conditions and dental implant outcomes, with a particular focus on novel therapeutic modalities. An especially pertinent direction for future investigation involves the development of a comprehensive therapeutic regimen that addresses both oral pathologies and other comorbid states, such as epilepsy, where pharmacotherapy can influence bone metabolism, inflammation, and the risk of peri-implant failure. By extending our lipid-centric strategy to encompass patients with neurologic disorders, new opportunities

may arise for reducing the impact of inflammation and metabolic stress on oral tissues, ultimately paving the way toward more effective and universally applicable dental treatments.

Conclusions

1. In patients receiving the treatment and preventive complex, the oral fluid cholesterol level decreased by 25 % after one month of therapy compared to baseline values. By three months, it had dropped by an additional 2.1-fold, approaching levels observed in healthy controls.

2. Despite a slight increase at 6 and 12 months, the oral fluid cholesterol in the main group remained 37.5 % and 29.1 % lower than baseline, respectively, indicating sustained benefits of the supplementary therapeutic regimen over a one-year period.

3. Patients in the comparison group, who received only the standard treatment protocol, showed persistently elevated oral fluid cholesterol levels throughout the study period, underscoring the necessity of adjunctive interventions to achieve meaningful lipid metabolism normalization in peri-implantitis.

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