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CONTENTS

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ORIGINAL ARTICLE

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EFFICIENCY OF LOW-INTENSITY LASER IRRADIATION IN THE MANAGEMENT OF PATIENTS WITH ORAL MUCOSAL DISEASES ASSOCIATED WITH RHEUMATOID ARTHRITIS BY RESULTS OF DOPPLER ULTRASOUND

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ABSTRACT

Aim: To evaluate the therapeutic effectiveness of low-intensity laser irradiation in the treatment of patients with oral mucosal diseases in association with rheumatoid arthritis, according to parameters of Doppler ultrasonography of blood flow of lingual arteries.

Materials and Methods: An examination of 25 patients with geographic tongue and concomitant rheumatoid arthritis and 12 practically healthy persons of the control group was carried out. In the main group (13 patients) the complex treatment of glossitis was carried out with non-contact laser irradiation of the affected tongue areas. Patients in the comparison group (12 persons) underwent standard treatment. Treatment effectiveness of patients in both groups was determined by the parameters of Doppler blood flow study of lingual arteries.

Results: In the main group of patients, after diode laser therapy, a significant decrease in linear blood flow parameters (Vmax by 19.7%, TAMAX by 19.6%), an identical increase in volume velocity (Q by 21%) and an improvement in vascular tone and peripheral resistance (Pourcelot index by 12.5%, Gosling index by 13.1%) were observed. At the same time, a slight increase in the linear and volume velocity characteristics of blood circulation in lingual arteries during treatment of patients in the comparison group was not statistically significant ($p>0.05$) and with a high degree of probability differed from the control group.

Conclusions: The use of low-intensity laser irradiation in the management of patients with oral mucosal diseases associated with rheumatoid arthritis contributes to the normalization of hemodynamics and the functional state in the vascular bed of the tongue.

KEY WORDS: oral mucosa, glossitis, rheumatoid arthritis, diode laser, Doppler ultrasound

INTRODUCTION

In recent years, many studies have been devoted to the search for effective methods of treatment of concomitant pathology. Due to the complexity and duration of treatment, oral mucosal diseases (OMD) in association with autoimmune illnesses are of great interest to doctors [1].

Despite the achievements of modern dentistry, the treatment of patients with glossitis in association with rheumatoid arthritis (RA) causes many difficulties. In view of concomitant autoimmune pathology and the use of strong pharmacotherapy for its containment, the treatment of OMD requires gentle and at the same time effective methods. One of the *problem-solving* approaches is the use of low-intensity laser radiation.

The diode laser is becoming increasingly popular in various fields of dentistry [2-4], because it is multifunctional, ergonomic and convenient for operations on soft tissues of the oral cavity. According to scientific research [5-7], low-intensity laser radiation stimulates biochemical processes in the body, promotes metabolic and reparative processes, activates microcirculation, normalizes vascular permeability, reduces the content of inflammatory mediators in the affected areas and blocks the inflammatory process. All the above listed encourages its use for the treatment of patients with combined OMD and RA.

In the basis of the development of OMD, a disturbance of the local functional state of the vascular system occupies a prominent place [8, 9]. In addition, many studies indicate endothelial dysfunction and hemodynamic changes of internal organs in RA [10, 11]. Considering the fact that an important role in improving the treatment of OMD is played by the use of methods of adequate control over the effectiveness of treatment measures, the study of the nature of local hemodynamics in the oral cavity is a priority direction, which will allow to establish pathogenic processes of the development of associated diseases and to develop ways of influencing them for correction purposes.

AIM

To evaluate the therapeutic effectiveness of low-intensity laser irradiation in the treatment of patients with oral mucosal diseases in association with rheumatoid arthritis, according to parameters of Doppler ultrasonography of blood flow of lingual arteries.

MATERIALS AND METHODS

To achieve the aim of the study, an examination of 25 patients with lesions of oral mucosa, among them benign migratory glossitis (K14.1 BMG, geographic tongue) and concomitant RA aged 32 to 65 years was carried out. 12 practically healthy persons of the same age made up the control group.

Echographic study of arteria profunda linguae in patients was performed in triplex scanning mode: a combination of the image in B-mode, the color-flow imaging and spectral analysis of the blood flow with the use of the ultrasound scanner "MyLab 50 Xvision" of the company Esaote Biomedica SpA (Italy), equipped with a 7.5 MHz linear array transducer.

When performing the spectral analysis, qualitative parameters were evaluated: the shape of the Doppler curve, the presence of a "spectral window", the glow intensity of different zones of the Doppler spectrum. Assessment of quantitative parameters of the Doppler frequency shift was performed according to the indices of maximum systolic blood flow velocity (Vmax) and time-averaged maximum blood flow velocity (TAMAX). Resistive index (RI, **Pourcelot index**), pulsatility index (PI, Gosling index), systolic-diastolic ratio (S/D) and volume velocity of blood flow (Q) were determined by standard methods.

To compare the treatment effectiveness of patients with the help a complex of prophylactic and therapeutic measures developed by us and the standard therapy, all patients with a concomitant lesion of OMD and RA were divided into two groups: the main (13 patients) and comparison (12 patients). Patients of both groups were treated with systemic therapy of the combined pathology with the use of disease-modifying antirheumatic drugs, glucocorticoids for oral use and nonsteroidal anti-inflammatory and antirheumatic drugs in accordance with the "Unified clinical protocol of primary, secondary (specialized), tertiary (highly specialized) medical care and medical rehabilitation" approved by the Ministry of Health of Ukraine" (Order No. 263 dated April 11, 2014).

In the stage of clinical-laboratory remission of autoimmune disorders of the joints, patients of the main group were treated with complex treatment of glossitis, developed by us [12] with non-contact constant laser irradiation of the affected tongue areas with the Picasso diode laser of the company "AMD Lasers" (USA) with a wavelength of 810 nm, a power range of 0.5 W/cm^2 when using non-activated 400 microns fiber and "Program 4" with the mode "Therapy". Exposure – 2 minutes per field, number – 5 procedures. Patients of the comparison group were treated with standard therapy, in accordance with the protocol adopted in Ukraine (Order of the Ministry of Health of Ukraine No. 566 dated November 23, 2004). The treatment effectiveness assessment of patients in the main and comparison groups was carried out on the basis of determining the quantitative and qualitative parameters of blood flow in one month after performed therapeutic complex.

The statistical analysis of the obtained data was performed with the use of parametric and non-parametric methods of variation statistics with the determination of Student's criteria in the computer programs "Statistica 5.5" (licensed number AXXR910A374605FA) and Microsoft® Excel 2003. Differences between research groups were considered statistically significant at $p < 0.05$. In the case of confirming the normal distribution law, when comparing quantitative indicators between groups, we used parametric methods – Student's t-test for independent variables, and to identify differences occurring in the dynamics of preventive and therapeutic measures, Student's t-test for dependent variables.

The study complies with the requirements of the Declaration of Helsinki, the research protocol was approved by the Biomedical Ethics Committee of National Pirogov Memorial Medical University, Vinnytsya; voluntary informed consent of the patients was received.

RESULTS

Clinical examination of patients with BMG in association with RA revealed that the majority of patients (22 from 25 patients – 88.0±6.5%) complained of appearance the changes and lesions of oral mucosa. At the same time, the main complaints were dryness of oral mucosa, pain in the tongue, burning, bad breath and taste disorder. Lingual examination of patients showed prints of the teeth on the lateral borders of the tongue, on the dorsum and the lateral borders of the tongue – clearly island-shaped red smooth areas of desquamation and atrophy of the filiform papillae, surrounded by well-demarcated scalloped white borders of non-desquamated zone of hyperkeratosis, slightly raised above lingual mucosa (Fig. 1).

The obtained preliminary results [13] encouraged to study the possibility of using quantitative and qualitative parameters of blood flow for assessment of treatment effectiveness of patients with OMD associated with RA.

The effect of complex therapy in patients with tongue diseases in association with RA, there was a noticeable positive dynamic of the clinical condition and echographic indices of hemodynamics of the tongue.

Thus, after the third diode laser procedure, all patients of the main group noted the absence of dryness in the oral cavity, pain and burning sensation in the tongue. A follow-up patients' examination of this group 1 month later did not reveal further dynamics of clinical manifestations of the disease: the tongue was clear, without slough, patches or lesions, and the swelling of the tongue was reduced significantly (Fig. 2).

Despite the performed therapy, positive dynamics in patients of the comparison group was revealed only in 8 from 12 patients (66.7±13.6%). At the same time, 2 patients of this group had taste disorder, and 4 patients (33.3±13.6%) had swelling of the tongue and lesions, concentrated at the tip and lateral borders of the tongue (erythematous areas due to atrophy of the filiform papillae, partially surrounded by zone of hyperkeratosis).

The parameters of Doppler ultrasonography of regional blood flow in patients with BMG and RA of the main and comparison groups after treatment are shown in Table 1. According to the given table data, average statistical results of all parameters of hemodynamics arteria profunda linguae before treatment of patients of the main and comparison groups were identical with an unreliable difference in their

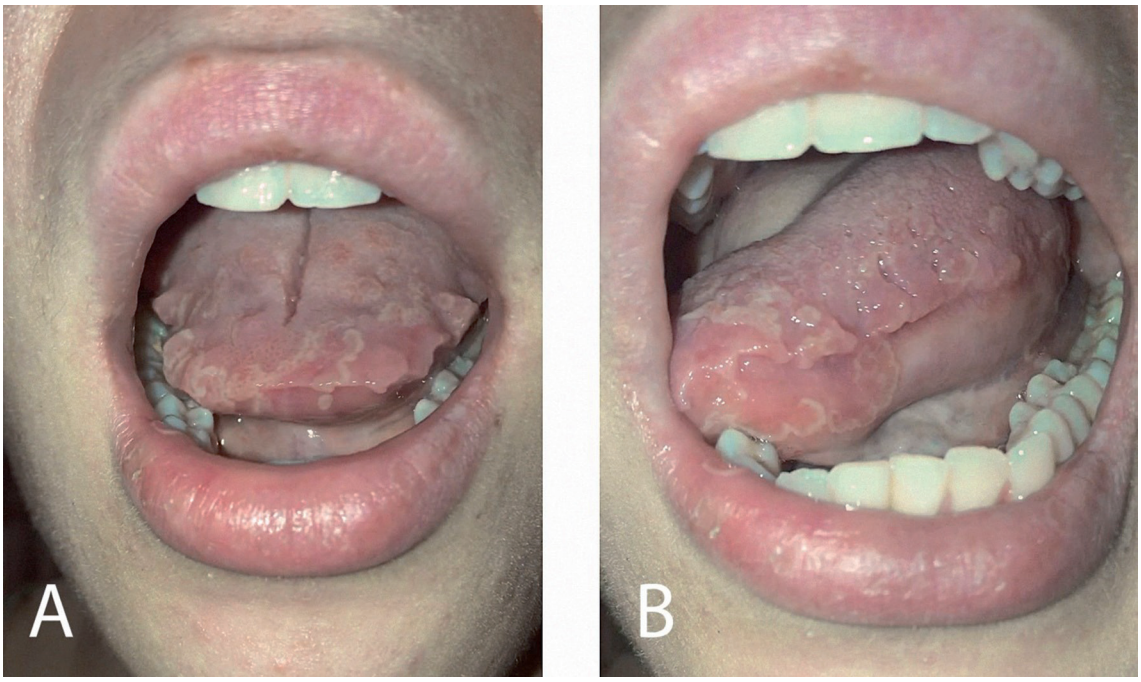

Fig. 1. Patient K. Diagnosis: benign migratory glossitis in association with rheumatoid arthritis. Dorsal aspect of the tongue (A) and lateral aspect (B) before treatment

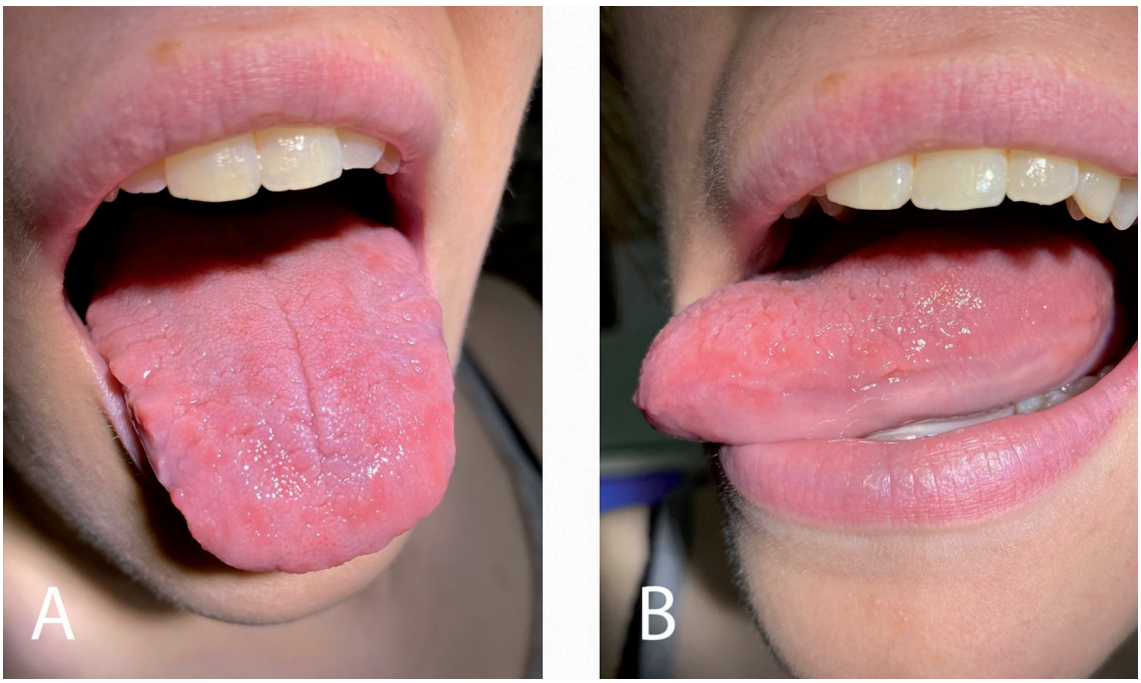

Fig. 2. Patient K. Diagnosis: benign migratory glossitis associated with rheumatoid arthritis. Dorsal aspect of the tongue (A) and lateral aspect (B) after treatment

values. However, after the complex treatment of the main group of patients with the use of laser irradiation of the affected areas of the tongue, a probable improvement of most of the quantitative parameters of the echographic study of the deep lingual artery was determined. At the same time, a significant ($p < 0.01$) decrease in linear velocity indices (V_{max} by 19.7%, TAMAX by 19.6% compared to the initial level) indicated the normalization of local blood flow, that correlated with the elimination of inflammatory process in the tongue tissues.

As a result of the treatment of this group of patients, a significant improvement in the tone and peripheral resistance of blood vessels and their elastic properties was observed (according to the Pourcelot's index and

Table 1. Parameters of the Doppler ultrasonography of lingual arteries in patients with benign migratory glossitis in association with rheumatoid arthritis during treatment

Parameters of ultrasound diagnostics of lingual artery	Control group (n=12)	Main group (n=13)		Comparison group (n=12)	
		Before treatment	After treatment	Before treatment	After treatment
V max, m/c	0.41 ± 0.05	0.62 ± 0.04	0.48 ± 0.02	0.64 ± 0.04	0.54 ± 0.03
		$p>0.05; p_1<0.01; p_2<0.05; p_3>0.05; p_4<0.05$			
RI	0.73 ± 0.02	0.89 ± 0.03	0.78 ± 0.02	0.87 ± 0.04	0.82 ± 0.04
		$p>0.05; p_1<0.01; p_2>0.05; p_3>0.05; p_4<0.05$			
PI	1.82 ± 0.03	2.25 ± 0.13	1.92 ± 0.06	2.09 ± 0.14	1.96 ± 0.09
		$p>0.05; p_1<0.05; p_2>0.05; p_3>0.05; p_4>0.05$			
TAMAX, m/c	0.32 ± 0.02	0.46 ± 0.03	0.37 ± 0.01	0.43 ± 0.04	0.39 ± 0.02
		$p>0.05; p_1<0.01; p_2>0.05; p_3<0.05; p_4<0.05$			
S/D	3.49 ± 0.12	3.1 ± 0.12	3.3 ± 0.05	3.07 ± 0.15	3.15 ± 0.12
		$p>0.05; p_1>0.05; p_2>0.05; p_3>0.05; p_4<0.05$			
Q, ml/min	23.1 ± 1.6	20.2 ± 1.7	24.3 ± 1.2	17.9 ± 2.2	18.2 ± 1.5
		$p>0.05; p_1<0.05; p_2>0.05; p_3>0.05; p_4<0.05$			

Note: p – the significance of the difference between the indices values of the main and comparison groups before treatment; p_1 – the significance of the difference in the parameters of the main group before and after treatment; p_2 – the significance of the difference in the parameters of the comparison group before and after treatment; p_3 – the significance of the difference in the parameters of the main group after treatment with the control group; p_4 – the significance of the difference in the parameters of the comparison group after treatment with the control group.

Gosling's index). A significant ($p < 0.05$) increase in the volume velocity of blood flow by 21% and its approach to the normative parameters of the control group is of particular importance. This indicates a significant improvement of microcirculation in arteria profunda lingua system. At the same time, a slight increase in the linear and volume velocity characteristics of the blood circulation in arteria profunda lingua system during treatment of patients in the comparison group was not *statistically significant* ($p > 0.05$) and with a high degree of probability (95-99.9%) differed from the control group. Despite a significant decrease in the linear velocity of blood flow after treatment of this group of patients ($p_2 < 0.05$), the average statistical values were higher than the normative parameters and differed from them with 95% significance. Therefore, the obtained results of the treatment of the comparison group can be considered low effective.

DISCUSSION

Literature data on the pathogenesis of RA indicate changes in the functional state of the vascular system [10]. In addition, long-term use of nonsteroidal anti-inflammatory drugs and glucocorticoids in RA leads to structural changes in blood vessels (reduced elasticity and increased resiliency) [14]. Atrophic processes in the lamina propria of tongue mucosa in glossitis and sclerotic processes in peripheral vessels in autoimmune lesions [11] contribute to the deepening of local blood circulation disorders in the tongue tissues during development of BMG.

From the point of view on the role of peripheral blood circulation in the pathogenesis of BMG [9, 13], the Doppler blood flow study of lingual arteries in patients with associated pathology was carried out, which allows monitoring the effectiveness of therapeutic measures.

The normalization of the main parameters of the state of blood circulation (Vmax, TAMAX, Q) was facilitated by complex treatment using means and methods of pathogenic action on the local hemodynamics of tongue arteries. A significant improvement in regional blood flow is also associated with the normalization of tone and peripheral vascular resistance under the influence of the diode laser.

Non-contact laser irradiation of the affected areas of the tongue contributed to the expansion of blood vessels and increasing blood flow. A significant decrease in the resistive index of tongue vessels can be explained by the improvement of blood transport due to the normalization of venous outflow when using low-intensity irradiation, as indicated by the authors [6].

CONCLUSIONS

Doppler ultrasonography of regional blood flow is an informative method of treatment effectiveness assessment in patients with tongue diseases in association with RA.

The analysis of indices of the functional study of regional blood flow in the early term of follow-up examination shows that the complex therapy of patients with glossitis associated with RA, using low-intensity laser radiation, significantly increases the treatment effectiveness in comparison with standard method, which determines the recommendations on the expediency of its wide implementation in practice.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest.

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A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article