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EFIKASNOST OZONIZOVANE VODE I 0,2% HLORHEKSIDIN GLUKONATA U LEČENJU HRONIČNOG PARODONTITISA

EFFCACY OF OZONISED WATER AND 0,2% CHLORHEXIDINE GLUCONATE IN THE MANAGEMENT OF CHRONIC PERIODONTITIS

Emilija Stefanovska[1], Kiro Ivanovski[1], Silvana Georgieva[1], Stevica Ristoska[1], Efka Zabokova Bilbilova[2], Marina Eftimoska[3]

[3]UNIVERZITET „SV. KIRIL I METODIJ", KATEDRA ZA ORALNU MEDICINU I PARODONTOLOGIJU, STOMATOLOŠKI FAKULTET, SKOPLJE, SEVERNA MAKEDONIJA
[3]UNIVERZITET „SV. KIRIL I METODIJ", KATEDRA ZA DEČJU I PREVENTIVNU STOMATOLOGIJU, STOMATOLOŠKI FAKULTET, SKOPLJE, SEVERNA MAKEDONIJA
[3]UNIVERZITET „SV. KIRIL I METODIJ", KATEDRA ZA KONZERVATIVU STOMATOLOGIJU I ENDODNCIJU, STOMATOLOŠKI FAKULTET, SKOPLJE, SEVERNA MAKEDONIJA

[1]UNIVERSITY 'SS CYRIL AND METHODIUS" SKOPJE, FACULTY OF DENTISTRY, DEPARTMENT OF PERIODONTOLOGY AND ORAL MEDICINE, SKOPJE, REPUBLIC OF NORTH MACEDONIA
[2]UNIVERSITY 'SS CYRIL AND METHODIUS" SKOPJE, FACULTY OF DENTISTRY, DEPARTMENT OF PEDIATRIC AND PREVENTIVE DENTISTRY, SKOPJE, REPUBLIC OF NORTH MACEDONIA
[3]UNIVERSITY 'SS CYRIL AND METHODIUS" SKOPJE, FACULTY OF DENTISTRY, DEPARTMENT OF RESTORATIVE DENTISTRY AND ENDODONTICS, SKOPJE, REPUBLIC OF NORTH MACEDONIA

Sažetak

Cilj: *Proceniti efikasnost irigacije parodontalnih džepova korišćenjem ozonizovane vode i 0,2% hlorheksidin glukonata (CHKS) u lečenju hroničnog parodontitisa.*
Materijal i metod: *U studiju je uključeno 40 pacijenata sa hroničnim parodontitisom podeljenih u dve grupe od po 20 pacijenata. Indeks zubnog plaka, indeks upale gingive, dubina parodontnog dzepa i klinički gubitak epitelnog pripoja bili su mereni na početnom pregledu i nakon iperioda od 4 nedelje. Tokom i nakon tretmana čišćenja i poliranja korenske površine, prva grupa je irigirana ozonizovanom vodom, a druga grupa sa 0,2% hlorheksidin glukonatom tokom dva minuta. Prikupljeni podaci su podvrgnuti statističkoj analizi.*
Rezultati: *Ova studija je pokazala značajne rezultate u pogledu poboljšanja kliničkih parametara u obe grupe. Poređenjem između grupa, ozoniyovana voda je pokazala nešto bolje poboljšanje u odnosu na grupu sa hlorheksidinom. statistički značajna razlika je uočena za Indeks upale gingive (IGI).*
Zaključak: *Subgingivalna irigacija ozonizovanom vodom se pokazala kao novi metod lečenja koji pacijentima nudi značajne prednosti. Ozonizirana voda ograničava stvaranje zubnog plaka i smanjuje broj subgingivnih patogena. Njena jaka antimikrobna moć, sposobnost da stimuliše cirkulacijski sistem i modulira imunološki odgovor je čini lekom izbor kao sredstvo za irigaciju u kombinaciji sa terapijom prve faze u lečenju parodontitisa.*

Ključne reči: *ozonirana voda, irigacija, hlorheksidin glukonat, hronični parodontitis*

Corresponding author:
Prof. d-r sci Emilija Stefanovska
e- mail: estefanovska@stomfak.ukim.edu.mk

Abstract

Aim: *To evaluate the efficacy of irrigation of periodontal pockets by using ozonated water and 0.2% chlorhexidine (CHX) gluconate in the management of chronic periodontitis.*
Materials and methods: *40 patients suffering from chronic periodontitis were involved in the study. They were divided into two groups with 20 patients. Dental Plaque Index, Gingival Inflammation Index, Periodontal Pocket depth and Clinical Attachment Level were recorded for both groups at the baseline visit and after 4 weeks interval, when they were subsequently recalled . During and after treatment of scaling and root planning, the first group was irrigated with ozonated water and the other group was irrigated with 0.2% chlorhexidine gluconate for two minutes. Collected data was compiled to statistical analysis.*
Results: *The present study showed significant results regards to the improvement in the clinical parameters in the both groups. When the parameters were compare between the groups, ozonated water showed slightly better improvement than the chlorhexidine group. However, a statistically significant difference was seen for Index of gingival inflammation (IGI).*
Conclusion: *Subgingival irrigation with ozonized water is proving to be a new useful treatment modality which offers great benefits to the patients. Ozonated water restricts the formation of dental plaque and reduces the number of subgingival pathogens. The strong antimicrobial power of ozone, its ability to stimulate the circulatory system and modulate the immune response, makes it a remedial agent of choice as an irrigant in conjugation with first phase therapy in the treatment of periodontitis.*

Key words: *ozonated water, irrigation, chlorhexidine gluconate, chronic periodontitis*

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Introduction

Periodontal diseases are among the most common conditions, affecting more than 90% of the global population[1]. Today, it is well known that in the etiology and pathogenesis of these diseases, alongside other local and general factors, the accumulation and maturation of dental biofilm, or the presence of certain specific microorganisms within it, play a dominant role[2]. Therefore, the elimination of periodontal pathogens is the primary goal of periodontal therapy.

Conservative treatment in periodontology (ultrasonic instrumentation and root surface treatment) is considered the gold standard, but it does not always achieve the desired effect. Factors such as variations in the depth of periodontal pockets, as well as the ability of some specific bacteria to invade tissues, suggest the need for additional antimicrobial agents, either systemically or locally, to complement conservative treatment.

Systemically administered antimicrobial agents achieve low concentrations in periodontal pockets and, on the other hand, have several unwanted side effects. Therefore, locally applied antimicrobial agents are preferred, as they provide a longer-lasting concentration of the medication in the affected area, reducing the potential for the development of resistant bacterial strains[3].

Chlorhexidine gluconate (CHX) is considered the gold standard in the fight against bacterial agents, with a broad antimicrobial spectrum, used for supra- and subgingival irrigation[4]. The molecules of chlorhexidine, due to their cationic nature, can bind to the molecules of the oral mucosa, enamel, the biofilm on teeth, proteins in saliva, and bacterial cell walls, thus exerting a negative effect on bacterial development and activity dynamics[5]. These molecules are released gradually but retain their potency. It is effective against gram-positive and gram-negative bacteria, as well as fungi and some viruses. In lower concentrations, it destabilizes and destroys the microbial cell membrane (bacteria), acting bacteriostatic, while in higher concentrations, it affects the cytoplasm of the organism (bacteria), thus having a bactericidal effect[6].

Recently, as a possible alternative antiseptic to this common treatment, the benefits of ozone, in its three available forms—ozonated water, ozone gas, and ozonated olive oil are increasingly being mentioned[7]. Ozonated water and ozonated olive oil provide an ideal system for delivering ozone to tissues, as they can trap and then release oxygen molecules, thereby altering the subgingival environment, which is highly anaerobic, and exert their antibacterial effect against the present periodontal pathogens[8].

The powerful antimicrobial action of ozone, without the development of drug resistance and without side effects, together with its capacity to stimulate the circulatory system and modulate the immune response, makes it a therapeutic agent of choice[9,10,11]

The aim of this study was to compare the effectiveness of subgingival irrigation of periodontal pockets with ozonated water and 0.2% chlorhexidine (CHX) as an adjunct to conservative periodontal treatment.

Materials and Methods

The study was performed at the Faculty of Dentistry in Skopje, Clinic for Periodontology and Oral Medicine, University "Ss Cyril and Methodius" – Skopje.

The study involved 40 patients aged 30-60 years, diagnosed with chronic periodontal disease. The patients were divided into 2 groups of 20 participants each. During the first examination, clinical periodontal indices (DPI, IGI, PPD, and CAL) were recorded for each patient. During and after the conservative treatment, selected periodontal pockets with the deepest depths were irrigated. In the first group, irrigation was done with ozonated water, using a direct irrigation method with a syringe for 2 minutes. In the second group, irrigation was done with 0.2% chlorhexidine gluconate, using a properly sized needle for 2 minutes. Patients were simultaneously trained and motivated for proper and regular oral hygiene using the modified Bass technique. One week after the initial treatment, the patients were recalled for control and re-motivation for proper oral hygiene, and irrigation was repeated in the selected periodontal pockets with either ozonated water or 0.2% chlorhexidine gluconate. After one month, the periodontal index parameters were recorded.

The results were analyzed using descriptive statistical analysis with the SPSS statistics program. Differences in means were analyzed as statistically significant using the Student's t-test. The difference between treatment modalities was assessed using the Wilcoxon Signed-Ranks test.

Resluts

The first group of patients, treated with conservative therapy and irrigation of the periodontal pockets with ozonated water,

consisted of 20 patients, 8 women and 12 men, with an average age of 48 years. (Table 1).

The second group, treated with conservative therapy and irrigation with 0.2% chlorhexidine, consisted of 7 women and 13 men, with an average age of 52 years. (Table 2)

DPI in the first group, treated conservatively and supplemented with ozonated water irrigation, showed a statistically significant reduction from an initial value of 2.05 to 0.25 after one month. $p < 0.00001$. (Table 3)

Similarly, IGI in this group showed a significant decrease from 2.05 to 0.2. $p < 0.00001$. (Table 4)

For PPD, there was a reduction in the depth of periodontal pockets from an initial value of 3.3 to 2.6, but this was not statistically significant. (Table 5)

For CAL, there was a reduction from 3.45 to 3.05, but this difference was also not statistically significant. (Table 6)

In the second group treated with 0.2% chlorhexidine, DPI showed a statistically significant reduction from 2.3 to 0.75 after one month of treatment. $p < 0.00001$ (Table 7)

IGI also showed a significant decrease from 2.15 to 0.7. $p < 0.00001$ (Table 8)

For PPD, there was a reduction in depth from 3.95 to 3.75, but this was not statistically significant. (Table 9)

Similarly, for CAL, the values were identical to those of PPD, showing a reduction from 3.95 to 3.75, but this difference was also not statistically significant (Table 10)

The Wilcoxon Signed-Ranks test for the difference between treatment modalities (ozonated water vs. 0.2% chlorhexidine) showed statistically significantly better results only for IGI in the group treated with ozonated water. ($p = 0.011$). For the other parameters (DPI, PPD, and CAL), no statistical significance was found. (Table 11)

Table 1. Average age of I group (Irrigation with ozonated water)

Average age	Mean	Median	Mode
8 Female	48	48,5	58
12 Male			

Table 2. Average age of II group (Irrigation with 0,2% chlorhexidine gluconate)

Average age	Mean	Median	Mode
7 Female	51,95	54	54
13 Male			

Table 3. DPI - I group - Irrigation with ozonated water (before and after treatment)

	DPI - I group (irrigation with ozonated water, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	41	5	46			
Mean	2.05	0.25	1.15			
$\sum X^2$	89	5	94			

Std.Dev.	0.5104	0.4443	1.0266			
Source	***SS***	***df***		***MS***		
Between-treatments	32.4	1		32.4	$F = 141.51724$ $p < 0$ .00001	
Within-treatments	8.7	38		0.2289		
Total	41.1	39				

Table 4. IGI - I group- Irrigation with ozonated water (before and after treatment)

	IGI - I group (irrigation with ozonated water, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	41	4	45			
Mean	2.05	0.2	1.125			
$\sum X^2$	91	4	95			
Std.Dev.	0.6048	0.4104	1.0667			
Result Details						
Source	***SS***	***df***		***MS***		

Between-treatments	34.225	1	34.225	$F = 128.13301$ $p < 0\ .00001$
Within-treatments	10.15	38	0.2671	
Total	44.375	39		

Table 5. PPD - I group - Irrigation with ozonated water (before and after treatment)

	PPD - I group (irrigation with ozonated water, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	66	52	118			
Mean	3.3	2.6	2.95			
$\sum X^2$	230	154	384			
Std.Dev.	0.8013	0.9947	0.9594			
Result Details						
Source	***SS***	***df***	***MS***			
Between-treatments	4.9	1	4.9	$F = 6.00645$ $p < 0.018967$		
Within-treatments	31	38	0.8158			
Total	35.9	39				

Table 6. CAL - I group - Irrigation with ozonated water (before and after treatment)

	CAL - I group (irrigation with ozonated water, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	69	61	130			
Mean	3.45	3.05	3.25			
$\sum X^2$	269	223	492			
Std.Dev.	1.2763	1.3945	1.3349			

Result Details

Source	***SS***	***df***	***MS***	
Between-treatments	1.6	1	1.6	*F* = 0.89543 *p* < 0.349988
Within-treatments	67.9	38	1.7868	
Total	69.5	39		

Table 7. DPI - II group - Irrigation with 0,2% chlorhexidine gluconate (before and after treatment)

	DPI - II group (irrigation with chlorhexidine, before and after treatment					
	1	2	Total			
N	20	20	40			
∑X	46	15	61			
Mean	2.3	0.75	1.525			
$\sum X^2$	110	21	131			
Std.Dev.	0.4702	0.7164	0.9868			

Result Details

Source	***SS***	***df***	***MS***	
Between-treatments	24.025	1	24.025	$F = 65.44444$ $p < 0\ .00001$
Within-treatments	13.95	38	0.3671	
Total	37.975	39		

Table 8. IGI - II group - Irrigation with 0,2% chlorhexidine gluconate (before and after treatment)

	IGI -II group (irrigation with 0,2% chlorhexidine, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	43	14	57			
Mean	2.15	0.7	1.425			
$\sum X^2$	97	18	115			
Std.Dev.	0.4894	0.6569	0.9306			
Result Details						
Source	***SS***	***df***	***MS***			
Between-treatments	21.025	1	21.025	$F = 62.66275$ $p < 0$ .00001		
Within-treatments	12.75	38	0.3355			
Total	33.775	39				

Table 9. PPD - II group - Irrigation with 0,2% chlorhexidine gluconate (before and after treatment)

	PPD - II group (irrigation with chlorhexidine, before and after treatment)					
	1	2	Total			
N	20	20	40			

∑X	79	75	154			
Mean	3.95	3.75	3.85			
$\sum X^2$	323	295	618			
Std.Dev.	0.7592	0.8507	0.8022			

Source	***SS***	***df***	***MS***	
Between-treatments	0.4	1	0.4	*F* = 0.61539 *p* < 0.437631
Within-treatments	24.7	38	0.65	
Total	25.1	39		

Table 10. CAL - II group - Irrigation with 0,2% chlorhexidine gluconate (before and after treatment)

	CAL II group (irrigation with chlorhexidine, before and after treatment)					
	1	2	Total			
N	20	20	40			
∑X	79	75	154			
Mean	3.95	3.75	3.85			
$\sum X^2$	323	295	618			
Std.Dev.	0.7592	0.8507	0.8022			

Source	*SS*	*df*	*MS*	
Between-treatments	0.4	1	0.4	$F = 0.61539$ $p < 0.437631$
Within-treatments	24.7	38	0.65	
Total	25.1	39		

Table 11. DPI, IGI, PPD, CAL differences between two treatments (irrigation with ozonated water and chlorhexidine gluconate) (Wilcoxon Signed-Ranks Test)

Among the groups	Positive sign count	Negative sign count	Total count	*Z - score*	*P - value*
DPI	3	10	13	1.94145	0.052
IGI	1	9	10	2.529	0.011
PPD	3	10	13	1.94145	0.052
CAL	5	11	16	1.5	0.133

Discussion

The onset and progression of periodontal disease is caused by various bacterial accumulations in the subgingival pockets. The elimination of pathogenic subgingival microflora can be achieved mechanically. However, the chronic course of the disease requires additional treatment, necessitating the use of various antimicrobial agents, either systemically or locally, to complement the conservative treatment, in order to maintain the results of the initial therapy for a longer period.[9]

Subgingival irrigation is the most common method of applying antimicrobial agents, whether performed by professionals or patients themselves. Antiseptics can deactivate bacteria in two ways: physical-chemical damage to the components of the cell surface, followed by damage to intracellular constituents and disruption of their function, or direct disruption of intracellular functions without damaging surface structures.

Both, chlorhexidine and ozone act on the same principle, disrupting the integrity of the microbial cell wall, thereby damaging cell components. Chlorhexidine gluconate is a cationic biguanide with a broad spectrum of already proven antibacterial effects against both gram-positive and gram-negative bacteria, as supported by numerous studies. However, its use is burdened with some side effects (brown staining of dental structures, taste sensitivity, allergic reactions, etc.).

On the other hand, the use of ozone is a new option for periodontal pocket irrigation with antimicrobial action, without the tendency to develop side effects, due to its ability to oxidize microbial cell components. Ozone becomes highly reactive and quickly decomposes when it contacts water, generating hydroxyl radicals, which are among the most active oxidizing species.

Water ozonates show high biocompatibility with fibroblasts, cementoblasts, and epithelial cells. Its biological effects include immune stimulation, immunomodulation, anti-inflammatory action, biosynthetic, bioenergetic, anti-hypoxic, analgesic, and hemostatic effects.

Various studies confirm the positive effects of irrigation with both chlorhexidine and ozone. Our study aimed to compare the effects of 0.2% chlorhexidine, as a well-established subgingival antibacterial irrigant, with the effects of subgingival

irrigation with ozonated water in the treatment of chronic periodontal disease.

Conclusion

Irrigation of gingival tissue with ozonated water leads to changes in plaque composition, resulting in reduced inflammationand faster regeneration of gingival tissue, confirming its antimicrobial and anti-inflammatory effects. The use of ozone as a subgingival irrigant is a simple and painless adjunct in non-surgical periodontal treatment. However, there is still a need for high-level evidence, such as well-designed double-blind randomized clinical studies, to justify its routine use. Therefore, clinical application of ozone has not yet achieved its effectiveness, and its cost-effectiveness remains to be proven.

Conflicts of Interest

The authors declare that they have no conflict of interest.

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