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RESEARCH ARTICLE

Serum Levels of Cross-linked N-Telopeptide of Type I Collagen before and After Non-surgical Periodontal Therapy in Type 2 Diabetic Patients with Chronic Periodontitis

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Abstract

Background: Diabetes mellitus is a major risk factor for chronic periodontitis (CP) and hyperglycemia has an important role in the enhancement of the severity of the periodontitis. It has been reported that the progression of CP causes shifting of the balance between bone formation and resorption toward osteoclastic resorption, and this will lead to the release of collagenous bone breakdown products into the local tissues and the systemic circulation. Cross-linked N-telopeptide of type I collagen (NTx) is the amino-terminal peptides of type I collagen which is released during the process of bone resorption. This study was conducted to determine the effects of nonsurgical periodontal therapy on serum level of NTx in type 2 diabetic patients with chronic periodontitis (CP) and in systemically healthy patients with CP and to correlate NTx level with the clinical periodontal parameters in the studied groups. Materials and methods: The studied sample consisted of ninety subjects of both genders with an age range (35-55). They were divided into three groups, the first group consisted of 30 subjects with healthy periodontium and systemically healthy (control group), the second group consisted of 30 patients having chronic periodontitis and type 2 diabetes mellitus (CPDM) group, and the third group consisted of 30 patients with chronic periodontitis only and systemically healthy (CP) group. All the subjects enrolled in this study were with normal body mass index. The clinical periodontal parameters measured were plaque index (PLI), gingival index (GI), probing pocket depth (PPD), and relative attachment level (RAL). The blood samples were collected from all individuals and examined to measure the serum level of NTx using enzyme-linked immune sorbent assay (ELISA). Patients with chronic periodontitis were treated with scaling and root planning (SRP) and recalled for further measurements of the clinical periodontal parameters and collection of the blood sample to measure the serum level of NTx after eight weeks. Results: All the clinical periodontal parameters at the baseline were higher than that after treatment. PPD and RAL were highest in CPDM group followed by CP. Regarding the level of NTx at the baseline; it was highest in CPDM group followed by CP group then the control group. After treatment, results revealed a reduction in NTx level for both CPDM and CP groups. Regarding the correlation between the clinical periodontal parameters and NTx level, the results revealed almost a non-significant weak positive correlation. Conclusions: SRP is an impactful procedure and results in the improvement of all the clinical periodontal parameters and reduction in the serum level of cross-linked N-telopeptide of type I collagen which could be considered as a good bone resorption marker in the studied groups.

Keywords: *Periodontitis, Type 2 diabetes mellitus, Cross-linked N-telopeptide of type I collagen, Nonsurgical periodontal therapy.*

Introduction

Chronic periodontitis (CP) is a chronic bacterial infection result in permanent destruction of the periodontal tissue structures and characterized by persistent inflammation, connective tissue breakdown, and alveolar bone destruction [1, 2].Diabetes mellitus (DM) can be defined as a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors [3].DM is characterized by hyperglycemia which results from defects in insulin secretion, insulin action, or both. It has been stated that the status of chronic hyperglycemia of diabetes is accompanied by

long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels [4].Type 2 diabetic patients have a greater predisposition to have periodontitis [5, 6] and hyperglycemia plays a principal role in elevating the severity of the periodontal tissue destruction in diabetic patients [7].

During inflammation, the balance between bone formation and resorption is shifted toward osteoclastic resorption leading to the release of bone breakdown products into local tissues and the systemic circulation [8]. Cross-linked N-telopeptide of type I collagen (NTx) is known as the amino-terminal peptides of type I collagen which is released during the process of bone resorption [9]. It is released as a resolute end product of bone resorption and is not a part of soft tissues around the teeth [10].

Materials and Methods

Ninety subjects of both genders with an age range of (35-55) years were enrolled in this study. The subjects were patients attending the Diabetes and Endocrinology Center in Nasiriayah City/Iraq, as well as, patients from periodontics department and diagnosis department in the Specialized Dental Center in Nasiriyah City. All the subjects were informed about the purposes of the study and consented to its protocol. They were divided into three groups, the first group was the control group which consisted of thirty subjects with clinically healthy periodontium and systemically healthy.

The second group was the CPDM group which consisted of thirty patients diagnosed to have chronic periodontitis and type 2 diabetes mellitus. The patients in CPDM group were diagnosed according to the American Diabetes Association criteria in 2017 [11].The third group was the CP group which consisted of thirty patients diagnosed to have chronic periodontitis only. Chronic periodontitis was defined as the presence of four sites with probing pocket depth ≥4mm with clinical attachment loss ≥1-2mm, this made according to the international classification system for periodontal disease [12].

Inclusion criteria included T2DM patients on oral hypoglycemic medication, with normal body mass index level, ranges between 18.5 kg/m^2 - 24.9 kg/m^2 [13]. Exclusion Criteria included pregnant ladies, smoking and other systemic diseases and patients who have undergone periodontal treatment and course of anti-inflammatory or antimicrobial therapy 3 months prior to the study. Initial examination was carried out consisting of an evaluation of the periodontal condition of the teeth and after selecting the suitable patients for the study, blood samples were collected from each individual. After collection of the whole blood, it centrifuged at 3,000 rpm for 20 minutes and aspirated and transferred immediately into another tube and frozen at(-15 C^o) for subsequent analysis.

Haemolyzed samples were discarded. An alginate impression was taken and an occlusal stent was constructed for each patient in CPDM and CP groups. After completion of occlusal stent construction, the patients recalled for clinical periodontal parameters recording and they received thorough scaling and polishing with a good motivation and instructions in oral hygiene measures.

The patients in CPDM and CP groups were recalled one week after scaling and polishing and the sites with periodontal pockets were treated by root planning. The patients in CPDM group were advised to follow the instructions rendered by their physician regarding medication and food prior to the procedure. The treatment procedures were kept short and as atraumatic as possible.

After 8 weeks, patients in CPDM and CP groups were recalled for further collection of blood samples and recording of clinical periodontal parameters which included: Plaque Index (PLI) [14], Gingival Index (GI) [15], probing pocket depth (PPD) and relative attachment level (RAL).

Results

Clinical Periodontal Parameters

Table (1) showed the mean values of the clinical periodontal parameters PLI, GI of the control group, PLI, GI, PPD, RAL of CPDM and CP groups respectively at baseline and after treatment. At the baseline, the highest value of PLI was found in CP group (1.8543) followed by CPDM group (1.6041) and then control group (0.2920). Regarding GI, the highest value was found in CP group (1.9295) followed by CPDM group (1.9017) then the control group (0.3233).

The highest value of PPD was found in CPDM group (4.6973) followed by CP group (4.2901) and the highest value of RAL was found in CPDM group (7.4983) followed by CP group (7.1337).

Immunological Findings

At the baseline, the highest value of NTx level were found in CPDM group (25.8964) followed by CP group (22.8573) and then control group (15.4591) (Table 2) with highly significant differences between each pair of studied groups (Table 3). After treatment, the NTx level decrease significantly in both CPDM and CP group (Table 4).

Correlation between NTx Level and the Clinical Periodontal Parameters

There were almost non-significant weak positive correlations between all of the clinical periodontal parameters and the level of NTx among all the study groups (Table 5).

Table 1: Clinical periodontal parameters among the studied groups at the baseline and after treatment

Groups	Indices	Mean	SD	Minimum	Maximum
Control	PLI	0.2920	0.05555	0.21	0.39
	GI	0.3233	0.06233	0.21	0.42
CPDM	PLI1	1.6041	0.18693	1.21	2.01
	PLI2	0.9523	0.11032	0.63	1.10
	GI1	1.9017	0.21638	1.42	2.31
	GI2	1.0927	0.08313	0.97	1.24
	PPD1	4.6973	0.44124	3.94	5.71
	PPD2	3.5347	0.47972	2.79	4.61
	RAL1	7.4983	0.46224	6.75	8.61
	RAL2	6.2407	0.52339	5.36	7.32
CP	PLI1	1.8543	0.27827	1.33	2.19
	PLI2	0.9530	0.12388	0.68	1.20
	GI1	1.9259	0.29707	1.16	2.25
	GI2	1.0438	0.07668	0.77	1.20
	PPD1	4.2901	0.47699	3.53	5.20
	PPD2	3.4580	0.39408	2.88	4.20
	RAL1	7.1337	0.37299	6.61	8.36
	RAL2	5.8791	0.44804	5.32	7.11

Table 2: Mean values of NTx level among the studied groups at the baseline and after treatment

status		NTx1	NTx2
Control	Mean	15.4591	
	Standard deviation	3.5718	
	Minimum	7.02	
	Maximum	21.47	
CPDM	Mean	25..8964	20.0897
	Standard deviation	1.79079	1.80377
	Minimum	23.01	17.02
	Maximum	28.87	22.67
CP	Mean	22.8573	18.0407
	Standard deviation	1.38998	1.73225
	Minimum	19.66	15.21
	Maximum	26.71	22.85
	ANOVA	144.922	20.139
	P	0.0001	0.0001

Table 3: Intergroup comparisons for the mean of difference values of NTx level among the studied groups at the baseline

(I) status	(J) status	Mean of Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
CP	CPDM	-3.03910-*	0.63064	0.000	-4.2926-	-1.7856-
	Control	7.39827*	0.63064	0.000	6.1448	8.6517
CPDM	CP	3.03910*	0.63064	0.000	1.7856	4.2926
	Control	10.43737*	0.63064	0.000	9.1839	11.6908

Table 4: Intergroup comparisons for the mean and standard deviation values for NTx level between CPDM and CP groups after treatment

Groups	Mean	Std. Deviation	95% Confidence Interval for Mean		F-value	Sig
			Lower Bound	Upper Bound		
CP	18.0407	1.73225	17.3938	18.6875	20.139	0.000
CPDM	20.0897	1.80377	19.4161	20.7632		

Table 5: Correlations between the clinical periodontal parameters and NT x level

NTx	Groups	Statistical analysis	PLI	GI	PPD	RAL
	Control	r	0.210	0.173		
		P-value	0.265	0.361		
		sig	NS	NS		
	CPDM	r	0.188	0.482**	0.063	0.118
		P-value	0.321	0.007	0.739	0.534
		sig	NS	HS	NS	NS
	CP	r	0.047	0.304	0.021	0.111
		P-value	0.804	0.102	0.910	0.560
		sig	NS	NS	NS	NS
		Correlation is significant at 0.05 levels (2-tailed).				

Discussion

The results of the study showed a reduction in all the clinical periodontal parameters after treatment in both studied groups. Our possible explanation is that the SRP process leads to disturbance of the subgingival plaque biofilm, and this will cause shifting in the bacterial population to bacteria that commonly have more association with health.

The enormous shifting in the composition of subgingivally located bacterial flora and the removal of microbial endotoxins subgingivally result in the healing of the periodontal tissue and improvement of the clinical periodontal parameters can be obtained, as conducted by many studies [16-18].

This was in agreement with other studies which suggested that the process of SRP resulted in the disposal of the pathogenicity of bacterial plaque and other factors that contribute to periodontal diseases which in turn lead to terminating of progression of the periodontal disease and returning of the tissue to the health status [19-24].

Highly significant reduction in NTx level was found after treatment for both CPDM and CP groups. Our possible explanation is that the active phase of bone resorption in periodontitis leads to release of collagen breakdown fragments into the circulation including NTx, and the further reduction of resorptive phase after SRP lead to further reduction of NTx level and this confirmed by many studies [8, 25, 26]. The correlation between the clinical periodontal parameters and the level of NTx showed a non-significant week positive correlation. This was in agreement with other studies [25, 26].

Conclusions

Scaling and root planing is an effective process for improvement of clinical periodontal parameters and leads to significantly decreasing in the serum level of NTx in type 2 diabetic patients with CP and in systemically healthy patients with CP only. NTx may be considered as a good marker of bone resorption that is associated with chronic periodontitis.

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