Assessment of salivary elements (Zinc, Copper and Magnesium) among groups of patients with rheumatoid arthritis and chronic periodontitis and its correlation to periodontal health status

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ABSTRACT

Background: Periodontal diseases are common in the society and some researchers suggestedan association between rheumatoid arthritis (RA) and periodontal diseases. The aims of study were to determine the periodontal health status in patient with RA and chronic periodontitis and compare it with those having chronic periodontitis without RA anddetermine the level of salivary elements Copper(Cu),Zinc(Zn) and Magnesium(Mg) in patients with rheumatoid arthritis and patients have no rheumatoid arthritis (RA) and compare with the control group.And correlate between these salivary elements with the periodontal parameters Plaque index (PLI), gingival index (GI), bleeding on probing (BOP), probing pocketdepth (PPD) and clinical attachment level (CAL).

Materials and Methods: In this study, the samples were recruited from patientsreferred todepartment of Rheumatology at Baghdad hospital. Seventy five female patients participated in this study, twenty five of them rheumatoid arthritis patient andhad chronic periodontitis; twenty five were with chronicperiodontitis and have no arthritis; Twenty five patients wereperiodontally and systemically healthy (control group). Patients were with age range 40-50 yearswith no other systemic diseases. The smokers and patients taking medication affecting periodontium status were excluded from the study.Also the patients had normal weight and length. Periodontal parameters were measuredin all groups at four surfaces.Salivary elements (Zn, Cu and Mg) also measured in this study.

Results: Patients with RA had higher prevalence of sites presenting dental plaque, a higher rate of gingival inflammation and bleeding on probing,greater probing depth, and greater attachment loss compared with control and high level of Copper and low level of Zinc and Magnesium.

Conclusion: The results suggest higher potentiality for moderate to severe periodontitis involvement among RA patients, with higher levels of Copper (Cu), and low level of Zinc (Zn) and Magnesium (Mg).

Keywords: chronic periodontitis, rheumatoid arthritis, salivary elements. (J Bagh Coll Dentistry 2012;24(3):87-92).

INTRODUCTION

Periodontitis (PD), the most common oral disease, is a destructive infl ammatory disease of the supporting tissues of the teeth and is caused by group of specific microorganisms; Porphyromonas gingivalis, Prevotellaintermedia, Tannerella forsythia, and Aggregatibacteractinomycetem-comitans [1]. The periodontal diseases range from the relatively benign form of gingivitis to aggressive periodontitis. Many of these conditions are not only a threat to the dentition, but may also be a threat to general health. Periodontitis ischaracterized by both connective tissue and alveolar bone destruction due to a chronic inflammation.[2]

Rheumatoid arthritis (RA) is also a chronic destructive inflammatory disease characterized by the accumulation and persistence of an inflammatory infiltrate in the synovial membrane that leads to synovitis and the destruction of the joint architecture resulting in impaired function. Rheumatoid arthritis, a chronic multisystem disease, is also associated with joint connective tissue and bone destruction.[3]

The relationship between rheumatoid arthritis and the progression of inflammatory conditions elsewhere in the body, such as periodontitis, is controversial[4].Both periodontitis and RA represent an imbalance between pro-inflammatory cytokinesand anti-inflammatory cytokines, which are deemed responsible for tissue damage. [5] Recently, there has been growing evidence suggesting an association between periodontitis and rheumatoid arthritis, as both these conditions are associated with the destruction of bones [6]. Still, there is possibility of a common genetic trait predisposing to both these conditions. [5]

There is also a considerable amount of evidence indicating that Zn, Cu and Mg may

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contribute in the etiopathogenesis of the rheumatoid arthritis: Zinc (Zn) is a crucial element in a series of cellular functions as normal growth, protein metabolism, membrane stability, and metalloenzyme functions.[7]. Zinc, has several other effects on immune response, complement System, lysozomal enzyme release, and macrophage functions. Zn is also indispensible in many steps of the inflammatory reactions. Among these are prostaglandin biosynthesis, stimulation of lymphocytes and immune response. Zn is likewise an important element in collagen tissue formation and bone metabolism. [8].

Copper (Cu) is incorporated into the structure of many enzymes and proteins.RA, as a chronic inflammatory disorder, can cause substantial elemental alterations in the body .Inflammation induces consumption of Zn and Cu. [9]

Magnesium (Mg) is one of the most abundant cations present in living cells. It **is** an essential mineral that is needed for a broad variety of physiological functions. Imbalances in magnesium metabolism are common and are associated with different pathological conditions [10]. Many studies suggest that periodontitis may be a risk factor for many systemic diseases which have also been associated with Mg deficiencies [11,12].

MATERIALS AND METHODS

The study population included seventy five female patients, which are dividedinto three groups

1- Group PR (chronic periodontitis/ rheumatoid arthritis):-

Twenty five diagnosed to have chronic periodontitis disease, and have rheumatoid arthritis. The patients in the RA group were diagnosed according to the Revised Criteria for the classification of Rheumatoid Arthritis of the American College ofRheumatology [13] and also according to the laboratoryinvestigation (ESR, Latex test). A specific exclusion criterion in this group was a female patient never taken any drug used as treatmentto rheumatoid arthritis to prevent any effects of these drugs on periodontal health status. All patients werewith age range (40-50) years old& had normal weight & length according to BMI(Body Mass Index) which its normal value is 18.5-25 and didn't smoke and had no medical condition that would affect their participation in the study.

2- Group P (chronic periodontitis / non-rheumatoid arthritis):-Twenty five patients diagnosed to have chronic periodontitis and didn't haverheumatoidarthritis.chronic periodontitis in patients was defined as the presence of at least four sites with probing pocket depth ≥4mm with clinical attachment level ≥1-2mm, this made according to the international classification system for periodontal disease [14].

3- Group H (healthy periodontium / systemically healthy):- Twenty five patients with healthy periodontium. This group represents a base line data.

Clinical examination:

Oral examination was performed by the same examiner to three groups by periodontal probe on all teeth except third molar and on four surfaces. The collected data include: Plaque index (PLI),Gingival index(GI), Bleeding on probing (BOP), Probing pocket depth (PPD) and Clinical attachment level (CAL).

Biochemical Analyses

The collection of unstimulated salivary samples was performed to three groups under standard condition following the instructions cited by Tenovuo and Lagerlöf [15].Then salivary samples were taken to the laboratory. Samples were centrifuged at 4000 rpm for 15 minutes. The clear supernatant was separated by micropipette and divided into three portions to be stored at (-20 ^{o}C) in a deep freeze till being assessed.Frozen saliva were allowed to thaw and come to room temperature before their analysis [16].Thereafter, they were subjected to biochemical analysis. They were determined by Flame Atomic Absorption Spectrophotometer using standardized procedure by air – acetylene. The concentration level of each constituent was expressed as (mmol/L) unit.

RESULTS

Clinical Analysis:

The mean values of PL.I, GI, PPD and CAL in groups PR and P are shown in Table (1). There was a highly significant difference between these two groups.

The number and percentage of bleeding sites in Group PR and Group P.The BOP score 1 was significantly higher in the Group PR than Group P.

Salivary elements analysis:

Magnesium:

Magnesium inGroup PRand Group Pwas lower than GroupH (Table3). Highly significant differences were found between (PR and H Group) and (P and H Group) and no significant differenceswere found between (PR and PGroup) as shown in Table (4). Also

comparison between the three groups was found highly significant (Table5).

Copper:

Cu in Group PR and Group P was higher than Group H (Table6). Highly significant differences were found between (PR and H Group) and (P and H Group) and no significant differenceswere found between (PR and PGroup) as shown in Table (7). Also comparison between the three groups was found highly significant (Table 8).

Zinc :

Zinc in Group PR and Group P was lower than Group H (Table9). Highly significant differences were found between (PR and H Group) and (P and H Group) and no significant differenceswere found between (PR and P Group) as shown in Table (10). Also comparison between the three groups was found highly significant (Table11).

Intra- Group Correlation between clinical periodontal parameters and biochemical parameters:-

There was weak correlation between clinical periodontal parameters (PL.I, GI,BOP, PPD and CAL) and biochemical parameters (Zinc,Copper and Magnesium) as shown in Table (12)

DISCUSSION

Chronic periodontal disease can be considered a potential focus of infection, which worsens the metabolic control of patients with RA.[17]. The pathobiology of periodontal disease (PD) and rheumatoid arthritis (RA) is similar, both are inflammatory chronic diseases, with activation of complement, production of cytokines and release of other inflammatory cell products [18,19].

The relationship between rheumatoid arthritis (RA) and the progression of inflammatory conditions elsewhere in the body, such as periodontitis, is controversial. [4].

Results of this study showed thatthe mean valueof Pl.I of groupPR was significantly higher than that of the group P . This result could be related to thestiffness of hands muscles to achieve good oral hygiene among RA patients. The changes occurring in the life style of RA patients, as hands muscle function reduces and leads to improper oral hygiene mechanism, have been considered as areason for association between RA and periodontitis. This result is in conformity with the work of Kässer et al.[20].

There is asignificant increase in the mean values of GI. This elevation of GI reflects a higher inflammation in the Group PR than the group P and could be related to the increase in the plaque as the plaque is the causative factor of gingival inflammation. This result is agreed with the previous study [20].

The percentage of sites with BOP was significantly higher in group PR than group P. The potential altered abilities of RA patients to perform effective oral hygiene could result in an increased BOP that exacerbates the risk for enhanced tissue destruction in periodontitis. Moreover, interesting observations regarding the complexity of the oral and systemic challenge provide unique mechanisms by which dysregulation of host responses could occur [21].

The mean value of PPD in RA group was significantly higher compared to chronic periodontitis group. This elevation in the PPD could be related to local and systemic factors. the local factor is the dental plaque which was significantly higher in the RA group and this have influenced PPD in this group. The systemic factor in the RA patients is the defect in the immune system which could result in inflammatory-mediated destruction predisposingto periodontitis due to an unbalanced cytokine expression profile [22].

Clinical attachment level refers to the distance from the cementoenameljunction (CEJ) to the location of the inserted probe tip. Thus, loss of fibers attachment expressed at the clinical level the cumulative effect of destructive pathological processes in periodontal together with the protective and destructive effect of the immunological processes.The mean value of CAL were significantly higher in PR group.the local factor and the systemic factor had influenced CAL also in this group.This result is agree with other studies [5,20].

Zinc level was decrease in group PR and group P than group H with a highly significant difference between group PR and group H.

Inflammation within tissues induces a series of anti-inflammatory responses in which a number of proteinsand enzymes carrying Zn and Cu elements areinvolved. Most notable among these are; metallothioneins [23,24].In this study, we observed decrease in Zn levels in patients with RA. There is considerable evidence from previousstudies that, Zn distribution among the bodycompartments is reorganized by inflammatory process. Zn concentration is determinedby many factors; nutritional status and history ofprevious infections of the patient . Also the previous studies demonstrated decreased Zn levels in RA patients compared with normal subjects,lend support for the idea that reduction of the Znelement is essential in the genesis of the disease [23,24] .

This study showed that patients with RA have markedly elevated Cu levels compared withnormal subjects; there are a highly significant difference between group PR and group H andgroup P and group H. This result agree with AL-Hadad study in 2005[25].

The Mg level was decreased in group PR and group P than the group H.

Magnesium is one of the most abundant cations present in living cells. Itis an essential mineral that is needed for a broad variety of physiologicalfunctions.It may act as an important regulator of cell functions. Its concentration is remarkably constant in healthy subjects. High normal Mg concentrations are protective against various diseases. Imbalances in magnesium metabolism are common and areassociated with different pathological conditions [26].

Interactions between and among different steps in thepathogenesis of periodontitis may explain the relationshipbetween periodontal status and the Mg. The line of evidence for biologicallyplausible explanations: In periodontal inflammation, the activation of neutrophilsis an important factor in tissue injury. Neutrophilsinvading periodontal tissues maintain the inflammatoryprocess and participate in tissue destruction manifested byloss of attachment and also by systemic reactions. Magnesium status has a strong relationship withthe immune system, acting as a modulator of the immune response. Activation of neutrophilsis an early effect of hypomagnesaemia, and high Mgconcentrations inhibit free-radical generation . Thus, reduced Mg concentrations areassociated with enhanced inflammatory response tobacterial challenge [27].

There was aweak correlation between salivary elements and clinical periodontal parameters. This result may be due to small number of samples.

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Table 1: Mean & SD of Pl.I, GI, PPD & CAL and comparison between PR&P groups

GROUPS	Group PR mean SD	Group P Mean SD	t-test	PVALUE	SIGN
PL.I	1.837 0.255	1.149 0.113	7.981	<0.001	HS
GI	1.319 0.076	1.140 0.069	8.641	<0.001	HS
PPD	6.065 0.547	4.296 0.479	12.146	<0.001	HS
CAL	4.472 0.408	3.684 0.569	5.618	<0.001	HS

Table 2: Number & percentage of bleeding &non bleeding sites among PR &P groups

Score of BOP	Group PR		Group P				
	No.	%	No.	%	Chi-square	p-value	Sig
0 (no bleeding)	582	30%	824	44.017%	79.81	<0.001	HS
1 (bleeding sites)	1358	70%	1048	55.982%			

Table 3: Mean and standard deviation of Mg ion concentration among three groups

GROUPS	Mg mean	SD
PR Group	0.2212	0.0773
P Group	0.2724	0.1242
H Group	0.6652	0.0357

Table 4: Inter groups comparison of Mg ion concentration

Groups	t-test PVALUE	SIG
Group PR and Group P	1.749 0.087	NS
Group PR and Group H	26.066 <0.001	HS
Group P and Group H	15.193 <0.001	HS

Table 5: Comparison of Mg ion concentration among three groups

Groups	P VALUE Anova	SIG
Group PR , P and H	<0.001 1.475	HS

Table 6: Mean and standard deviation of Cu ion concentration among three groups

Groups	Cu mean	SD
Group PR	4.076	0.830
Group P	3.804	0.787
Group H	2.568	0.249

Table 7: Inter group comparison of Cu ion concentration

Groups	t-test	P VALUE	SIG
Group PR and Group P	1.189	0.240	NS
Group PR and Group H	8 .697	<0.001	HS
Group P and Group H	7.484	<0.001	HS

Table 8: Comparison of Cu ion concentration among three groups by Anova .

Groups	P VALUE Anova	SIG
Group PR, P and H	<0.001 16.14	HS

Table 9: Mean and slandered deviation of Znion concentration among three groups

GROUPS	Zn mean	SD
Group PR	2.528	0.795
Group P	2.752	0.727
Group H	4.532	0.247

Table 10: Inter group comparison of Zn ion concentration

Groups	t-test	P VALUE	SIG
Group PR and Group P	1.039	0.304	NS
Group PR and Group H	2.027	<0.001	HS
Group P and Group H	1.594	<0.001	HS

Table 11: Comparison of Zn ion concentration among three groups by Anova

Groups	P VALUE Anova	SIG
Group PR, P and H	<0.001 30.157	HS

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Table 12: Correlation coefficient(r) between clinical periodontal parameters and biochemical parameters

PL.I			GI		BOP	PPD CAL	
GPR	Zn	r	- 0.172	- 0.031	-0.175	-0.154	-0.371
		p	0.409	0.880	0.414	0.4614	0.067
	Cu	r	-0.3135	-0.077	0.360	0.276	0.059
		p	0.127	0.714	0.084	0.180	0.778
	Mg	r	-0.013	0.352	0.079	0.357	-0.050
		p	0.950	0.083	0.712	0.079	0.811
GP	Zn	r	0.220	0.036	-0.112	0.191	0.213
		p	0.288	0.862	0.603	0.358	0.306
	Cu	r	0.190	0.094	0.019	-0.245	-0.125
		p	0.360	0.654	0.931	0.236	0.550
	Mg	r	0.052	-0.087	-0.112	0.102	0.209
		p	0.804	0.678	0.601	0.625	0.314