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Research Article

COMPARATIVE EVALUATION OF SALIVARY ADVANCED OXIDATIVE PROTEIN PRODUCTS (AOPP) LEVELS IN CHRONIC PERIODONTITIS IN ASSOCIATION WITH METABOLIC DISORDER (TYPE II DIABETES MELLITUS)

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A B S T R A C T

Introduction: Advanced Oxidative Protein Products (AOPP) are a family of oxidized, dityrosine containing protein products formed as a result of oxidative stress, considered as a novel markers of oxidant-mediated protein damage. An emerging body of evidence suggests oxidative stress to play an important role in pathogenesis of periodontal tissue destruction and type 2 diabetes mellitus (T2DM).

Aim and Objectives: To quantify AOPP levels in periodontal health and disease, with and without T2DM and compare it with clinical parameters.

Methodology: Total of 100 subjects, Group I:25 periodontally healthy subjects; Group II:25 subjects with chronic periodontitis (CP); Group III:25 periodontally healthy subjects with T2DM; Group IV:25 subjects of CP with T2DM. Unstimulated whole saliva samples were collected after obtaining duly signed informed consent. AOPP were determined using UV spectrophotometry at 340nm.

Results: AOPP levels for group-II and group-IV were significantly higher than the group-I & group- III.

Conclusion: The well-established relation between AOPP response and inflammation suggests that it is the best marker for monitoring oxidative stress mediated protein damage in chronic inflammatory conditions. AOPP accumulation can be a therapeutic target for the prevention and delaying the progression of micro and macrovascular complications.

INTRODUCTION

Stress, a persistent term in the scientific study of disease and illness. It was being redefined and considered as a significant, well established etiological and maintenance feature in periodontal disease and systemic disorders such as metabolic syndrome or diabetes mellitus, cardiovascular diseases.[1] , [2] Diabetes mellitus, being a chronic disease, reflected epidemical by World Health Organization (WHO). It was previously documented as a risk factor for periodontal disease and stated as the 6th complication of diabetes mellitus.[3]

Oxidative stress is well-known to be involved in various human pathological processes. By products such as Reactive oxygen species (ROS) or free oxygen radicals which are the result of normal cellular metabolism and oxidative processes. Many biochemical pathways such as glucose autooxidation, polyol pathway, prostanoid synthesis, and protein glycation can increase ROS production which were strictly associated with hyperglycemia.

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Moreover, endothelial cell exposed to higher levels of glucose can lead to ROS production.[4] Thus that can be one of the motives which suggest that alterations of periodontal tissues happen in type 2 diabetes mellitus subjects (T2DM). Even though, main etiologic factors of periodontal disease such as dental plaque and calculus were missing.[3]

Several studies proposed that there is amplified modification of proteins related with chronic periodontitis and diabetes mellitus. Advanced oxidation protein products (AOPP), are the dityrosine containing cross linked protein products [5, 6] which were first designated by Witko-Sarasat *et al* in 1996. They were established from a family of oxidized protein compounds as a novel class of inflammatory mediators along with the formation and accumulation of advanced glycation end products (AGEs),[7] AOPP resemble AGE proteins structurally and biologically, AOPP may also exert same biologic property as intiating pro-inflammatory cytokines and adhesive molecules like AGE's.[5,6] AOPP are documented as markers of oxidative damage to proteins, reflecting the intensity of Inflammation and oxidative stress. [8] Albumin is the specific Protein damaged by oxidative stress [9], but for

some extent fibrinogen is also liable for blood plasma AOPP levels.[10]

Since molecular products from oxidative stress are generally more stable than oxidants themselves.[11] In relationship of oral and dental diseases specifically periodontitis, oxidative stress markers changes were reported in saliva.[12] Even though, abundant methods existing for the assessment of oxidative stress, mostly were not yet easily applicable in routine experimental laboratory as of their complicated procedures and/or shortage of automation. The simplification and automation of procedures characterize a crucial concern from a laboratory point of view at present in research hooked on human oxidative stress.[13]

The well-established relation between AOPP response and inflammation suggests that it is the best marker for monitoring T2DM mediated oxidative stress damage on periodontal structure and vice versa. To date, there are no studies relating to AOPP in T2DM and chronic periodontitis. Therefore, the main objective of this research was to investigate the effect of T2DM on pathogenesis of periodontal disease by quantification of AOPP levels.

MATERIALS & METHODS

The present cross-sectional study was conducted on 100 individuals of age between 18-65 years, who reported to the outpatient department of Periodontics, P.M.N.M Dental College& hospital, private diabetic clinic, Bagalkot. The research protocol was reviewed and approved by the Institutional Ethical Committee, P.M.N.M Dental College and Hospital. A written informed consent was obtained from all the selected patients prior to commencement of the study.

The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2013 consisting of 25 subjects with chronic periodontitis, 25 periodontally healthy subjects with type 2 DM, 25 subjects of chronic periodontitis with type 2 DM and 25 healthy individuals (controls). Inclusion criteria for the study are subjects with minimum complement of 20 natural teeth, periodontally healthy controls with a GI score ≤ 1 and absence of loss of attachment, Subjects having minimum of six teeth with periodontal pockets of PD≥5mm & Clinical attachment loss CAL ≥3mm & GI>1 were included in the CP group.[14] The diagnosis of patients with T2DM was based on the criteria of the World Health Organization.[15] The glycemic status of patients previously diagnosed with T2DM was confirmed by their glycosylated hemoglobin (HbA1c >7%) a preprandial glycemia of >130 mg/dl and postprandial >180 mg/dl [15] and were on insulin supplementation, diet regimen, or hypoglycemic agents.

Subjects with history of any systemic diseases or conditions (except type 2 diabetes mellitus) and with any apparent oral infections (i.e. herpes or candida), any injuries or bleeding in the oral cavity unrelated to gingivitis or periodontitis, intake of antibiotics or anti- inflammatory drugs within six months prior to the study, pregnant or lactating women, subjects with history of smoking or any form of tobacco and alcohol consumption and individuals who had received any periodontal treatment in the past six months prior to the study were excluded from the study.[16]

Method of saliva collection

Subjects were instructed not to eat or drink one hour before the time of saliva collection. They were explained about the study and required appointment was given for saliva sample collection. 1ml of unstimulated whole saliva was collected between 10 am and 12 Noon to avoid diurnal variation.[17] Patients were seated on dental chair and were instructed to rinse with water to avoid the previously collected saliva. The patients were asked to allow saliva to accumulate in the floor of the mouth for a minute and to spit into the eppendorf tube without stimulation.[18] Prior to analysis, saliva samples were centrifuged at 3000 rpm for 10 min at 4^0 c to devoid debris and bacteria. The supernatant fraction was then aliquotted into storage vials and kept at -20^0C until required for biochemical analysis.[19]

Biochemical Analysis

Salivary AOPP levels were determined using a spectrophotometric method given by Witko-Sarsat *et al*. Briefly 200 μL of saliva was incubated with 20 μL of glacial acetic acid. The absorbance was read immediately at 340 nm. AOPP concentration was expressed in μmol/L on the basis of the calibration curve of chloramine-T with potassium iodide.[19]

Statistical Analysis

Statistical analysis were performed using a statistical software package. Data were expressed as mean ± standard deviation (X ± SD). Independent t- test was done for intergroup comparison, Analysis of variance (ANOVA) test was done for multiple group comparisons, followed by post-hoc Tukey's test for group wise comparison. The statistical significance of correlations among variables was determined using the Pearsons correlation coefficient. All analysis were performed using a software program (SPSS 21.0). A $P < 0.05$ was considered to be statistically significant.

RESULTS

The mean age group of the study population was (38.93±6.31) out of which upper limit (44.16+8.48) and lower limit (28.32+4.19) respectively described in Table 1 and the descriptive statistics along with the mean SD of GI, PPD and CAL of all groups as described in Table 2,3,4.

Table 1 Comparison of age between the study groups

Groups	N	Mean	Std. Deviation	Minimum	Maximum	ANOVA	
						F	p-value
1	25	28.32	4.19	22	36	30.52	<0.001*
2	25	44.16	8.48	28	60		
3	25	41.72	6.48	29	53		
4	25	41.52	6.1	30	53		

*p<0.05 statistically significant,
p>0.05 Non Significant, NS

Table 2 Comparison of gingival score between the study groups

Groups	N	Mean	Std. Deviation	Minimum	Maximum	ANOVA	
						F	p-value
Healthy	25	0.49	0.2	.2	.9	232.27	<0.001*
CP	25	2.17	0.39	1.5	2.8		
Diabetes	25	0.61	0.14	.3	.9		
Diabetes with CP	25	2.26	0.44	1.3	2.9		

*p<0.05 statistically significant, p>0.05 Non Significant, NS

Table 3 Comparison of Pocket probing depth between the study groups

Groups	N	Mean	Std. Deviation	Minimum	Maximum	ANOVA	
						F	p-value
CP	25	6.6	1.04	5	8	197.33	<0.001*
Diabetes	25	2.44	0.51	2	3		
Diabetes with CP	25	6.76	0.97	5	9		

*p<0.05 statistically significant, p>0.05 Non Significant, NS

Table 4 Comparison of Clinical attachment loss between the study groups

Groups	N	Mean	SD	Mean Difference (95% CI)	t	df	p-value
CP	25	5.76	0.97	-0.64(-1.20, -0.08)	-2.30	48	0.03*
Diabetes with CP	25	6.4	1				

Independent sample t test
*p<0.05 statistically significant,
p>0.05 Non Significant, NS

All the samples in each group, tested positive for AOPP and the study showed an increased concentration of salivary AOPP in T2DM and chronic periodontitis patients compared to healthy and T2DM individuals which were statistically significant with p<0.05 as shown in Table 5.

Table 5 Comparison of AOPP level between the study groups

Groups	N	Mean	Std. Deviation	Minimum	Maximum	ANOVA	
						F	p-value
Healthy	25	8.52	3.93	2.43	20.76	66.78	<0.001*
CP	25	21.74	5.53	8.60	32.37		
Diabetes	25	12.72	3.93	5.86	20.76		
Diabetes with CP	25	49.17	20.94	10.67	98.02		

*p<0.05 statistically significant,
p>0.05 Non Significant, NS

When AOPP levels are correlated with clinical parameters a significant positive correlation was found between levels of AOPP with GI, PPD, CAL as shown in Table 6.

Table 6 Correlation of AOPP level with other variables in study groups

		AOPP LEVEL µmol/l			
		Group 1	Group 2	Group 3	Group 4
Age	Pearson Correlation	-0.15	0.02	-0.22	-0.04
	p-value	0.47(NS)	0.93(NS)	0.29(NS)	0.84(NS)
Gingival index	Pearson Correlation	0.03	0.72	0.77	0.82
	p-value	0.88(NS)	<0.001*	<0.001*	<0.001*
Pocket probing depth	Pearson Correlation	-	0.76	-0.19	0.88
	p-value	-	<0.001*	0.36(NS)	<0.001*
Clinical attachment loss	Pearson Correlation	-	0.89	-	0.94
	p-value	-	<0.001*	-	<0.001*

Pearson's Correlation test
*p<0.05 statistically significant,
p>0.05 Non Significant, NS

DISCUSSION

A complex set of enzymatic and non-enzymatic antioxidant systems of human body are persistently endangered against excessive oxidative stress. The enzymatic antioxidants superoxide dismutase (SOD) and glutathione peroxidase (GPx) are intricated in the metabolism of superoxide and hydrogen peroxide respectively.[20] Nevertheless, oxidative stress is outcome of overproduction and/or inadequate removal of ROS, which is regarded as an imbalance between the establishment of active oxygen metabolites and the proportionate at which they are scavenged antioxidants.[21] The role of ROS is common to both bacterial and host mediated pathways of tissue damage.[22] The demonstration that oxidative modified forms of proteins accumulate during oxidative stress and in some pathological conditions has focused attention on physiological and non-physiological mechanisms for generation of ROS.[23]

In contrast to lipid oxidation, the importance of protein oxidation in periodontitis has not been studied exclusively. The current study emphases on proteins, which are highly abundant and major targets for free radicals and other oxidants since they are responsible for most functional processes in the cell. Furthermore, proteins can retain the fingerprint of the initial oxidative insult that mediates damage. This distincts with lipid peroxidation, where propagation reactions involving the initial lipid oxidation products result in loss of the information about the initial oxidative insult. Protein oxidation products are superior to lipid oxidation products in terms of stability during sample storage and are considered as most sensitive markers for oxidative damage in mammalian cells.[24]

Previous studies have shown that AOPP plays a dynamic role in complex patho-physiology of oxidative stress and inflammation. But the mechanisms by which AOPP accelerate inflammation remain to be investigated.[25] Subsequently periodontitis & T2DM being one of the chronic inflammatory disorders most commonly affecting the general population globally.[26,3] The present research was focused on this aspect wherein we assessed AOPP levels in subjects with chronic periodontitis and chronic periodontitis with T2DM.

Present study revealed significantly higher levels of salivary AOPP in subjects with chronic periodontitis and chronic periodontitis with T2DM as compared to healthy controls and T2DM without chronic periodontitis as described in Table 5,6. AOPP are generated by different oxidation patterns, which might lead to production of reactive oxygen species such as hydrogen peroxide. These ROS secondarily leads to increased inflammatory reaction by signalling activation of NF-Kβ which stimulates pro-inflammatory cytokines release through depletion of intracellular thiol compounds. This could possibly explain higher levels of AOPP found in diseased groups as compared to healthy individuals.[27, 28]

An increase in AOPP level in T2DM without chronic periodontitis than healthy subjects as shown in table 4 is due to decreased antioxidants in diabetes patients which is accordance with Baskol *et al* [29]. An increase in AOPP levels was observed in periodontitis patients with T2DM compared to the chronic periodontitis patients as shown in Table 4, due to vicious circle mechanism among glycation and oxidation ('glyco-oxidation') demonstrating a disturbance of oxidative-antioxidative balance, and generates molecular damage.[30,31] The findings in our study keep in tract that AOPP is induced by intensified glyco-oxidation process, oxidant antioxidant imbalance and coexisting inflammation which was found by Piwowar A,[32] Pan *et al,* [33] and Fathy *et al,* [34] Gil delvaly, [35] and Sharada HM *et al* [36] by the correlation between AOPP and HbA1C. The elevated levels of AOPP not only reflect oxidative stress but also of disease-deprived protein dysfunction and oxidative damage contributing additive effect of T2DM to the patho-physiology of the periodontal disease.[37]

The well-established relationship between AOPP response and induced damage makes this simple, fast and inexpensive technique applicable in daily routine practice for measuring

oxidative stress mediated damage in chronic inflammatory conditions.

The results of this research lay emphasis on the need for studies with large sample size to authenticate the impact of periodontal disease with T2DM on AOPP Levels. Gender distribution was not possible as patients were randomly selected from the outpatient department. These could be the possible limitations of the study.

CONCLUSION

Advanced oxidation protein product (AOPP) recognised as a prognostic marker of protein damage recommends total oxidant status (TOS) reflecting the severity of oxidative stress and inflammation has been advocated as the gold standard for measurement of whole body oxidative stress.

AOPP accumulation may be a therapeutic target of the physicians to challenge the chronic complications of chronic periodontitis and diabetes. Moreover, in view of the socio-economical status of Asian developing countries, measurement of AOPP is beneficial as it is simple and cost effective.

Antioxidants such as N-acetylcysteine, vitamin C and α-lipoic acid are effective in reducing oxidative related complications, indicating that it may be beneficial either ingestion of natural antioxidants or through dietary supplementation. Future trails of antioxidants with better identification of potential candidates for antioxidant treatment as an adjunct to scaling and root planing should be encouraged for the prevention of grave consequences of oxidative stress in chronic inflammatory conditions like chronic periodontitis.

References

1. The role of stress in inflammatory disease, including periodontal disease: review of concepts and current findings. *Periodontology 2000, Vol. 30, 2002, 91-103*
2. X. Li, Kolltveit K M, Tronstad L, and Olsen I. "Systemic diseases caused by oral infection," *Clinical Microbiology Reviews*, vol. 13, no. 4, pp. 547-558, 2000.
3. Monea A, Mezei T, Popsor S and Monea M. Oxidative Stress: A Link between Diabetes Mellitus and Periodontal Disease, *International Journal of Endocrinology* 2014,1-4
4. Yamamoto Y, Hirose H, Saito I, Nishikai K, and Saruta T. "Adiponectin, an adipocyte derived protein, predicts future insulin resistance: two-year follow-up study in Japanese population," *The Journal of Clinical Endocrinology and Metabolism*, vol. 89, no. 1, pp. 87-90, 2004.
5. Wei XF, Zhou QG, Hou FF, Bei L, Liang M. Advanced oxidation protein products mesangial cell perturbation through PKC dependent activation of NADPH oxidase. *American J of Physiol*., 2009; 296(2): 427-437.
6. Shi XY, Hou FF, Niu HX, Wang GB, Xie D, Guo ZJ *et al*. Advanced oxidation protein products promote inflammation in diabetic kidney through activation of renal nicotinamide adenine dinucleotide phosphate oxidase. Endocrinology, 2008; 149 (4): 1829-1839.
7. Witko-Sarsat V, Friedlander M, Capeillere-Blandin C; Advanced oxidation protein products as a novel marker of oxidative stress in uraemia.Kidney Int., 1996; 49(5): 1304-1313.
8. Piwowar A. Advanced oxidation protein products.Part 1.Mechanism of formation, characteristics and property. Pol Merkur Lekarski, 2010; 28(164): 166-169.
9. Tan AL, Forbes JM, Cooper ME. AGE, RAGE, and ROS in diabetic nephropathy. Semin Nephrol., 2007; 27(2): 130-143.
10. Selmeci L, Szekely M, Soos P, Seres L, Klinga N, Geiger A *et al*. Human blood plasma advanced oxidation protein products (AOPP) correlates with fibrinogen levels. Free Radic Res., 2006; 40(9): 952-958.
11. Sharma A, Sharma S. ROS and anti-oxidants in periodontics: A review. Int*ernational journal of dental clinics* 2011; 3(2):44-47.
12. Kamodyovaa N, Tothovaa LU and Celec P. Salivary markers of oxidative stress and antioxidant status: Influence of external factors. Disease Markers 34 (2013) 313-321
13. Selmeci1 L, Seres L, Antal M, Lukacs J, Regoly-Merei A and Acsady G**.** Advanced oxidation protein products (AOPP) for monitoring oxidative stress in critically ill patients: a simple, fast and inexpensive automated technique. Clin Chem Lab Med 2005; 43(3):294-297.
14. American Academy of Periodontology Task Force Report on the update to the 1999 Classification of Periodontal Diseases and Conditions*.J Periodontol 2015; 86(7): 835-838.
15. World Health Organization. *Use of Glycated Hemoglobin in the Diagnosis of Diabetes mellitus. Abbreviated report of a WHO consultation*. WHO/NMH/CHP/CPM/11.1 Geneva, World Health Organization,2011.
16. Kejriwal S, Bhandary R, Thomas B, Kumari S. Estimation of Levels of Salivary Mucin, Amylase and Total Protein in Gingivitis and Chronic Periodontitis Patients. *Journal of Clinical and Diagnostic Research*. 2014; 8(10):ZC56-ZC60.
17. Kaufman E and Lamster. I.B.Analysis of saliva for periodontal diagnosis. *J Clin Periodontol* 2000; 27:453-465.
18. Navazesh M. Method for collecting saliva. Ann.NY.Acad. 1994; 694:72-77.
19. Tothovaa L, Celecovab V and Celeca P. Salivary markers of oxidative stress and their relation to periodontal and dental status in children. Disease Markers 34 (2013) 9-15.
20. Mates JM, Perez-Gomez C, Nunez de Castro I; Antioxidant enzymes and human diseases. Clin Biochem., 1999; 32(8): 595-603.
21. Saygili EI, Aksoy SN, Gurler B, Aksoy A, Erel O, Ozaslan N. Oxidant/Antioxidant status of patients with diabetic and senile cataract. Biotechnol & Biotechnol Eq., 2010; 24(1):1648-1652.
22. Chappleilc. Reactive oxygen species and antioxidants in inflammatory diseases. *J clin periodontol* 1997;24:287-296
23. Swallow AJ. Radiation chemistry of organic compounds pergamon press. Newyork 1960 (swallow AJ ed. 211-224)

24. Donne ID, Scaloni A, Giustarini D, Cavarra E, Tell G, Lungarella G *et al*. Proteins as biomarkers of oxidative/nitrosative stress in diseases: the contribution of redox proteomics mass spectrometry reviews, 2005:24; 55-99.
25. Liu *et al*. Advanced oxidation protein products accelerate atherosclerosis through promoting oxidative stress and inflammation. Arterio sclera thromb vasc biol. 2006; 26: 1156-1162.
26. Marcenes W, Kassebaum NJ, Bernabe E, Flaxman A, Naghavi M, Lopez A *et al*. Global burden of oral conditions in 1990-2010: a systematic analysis. *J.Dent.Res.* 2013; 92:592-597.
27. Chaudhary S, Gowda TM, Mehta DS, Kumar T. Comparative evaluation of plasma ROM levels in chronic periodontitis patients before and after non-surgical and surgical periodontal therapy: A clinical trial. *Journal of Indian Society of Periodontology* 2014; 18(2):140-144.
28. Servettaz A, Guilpain P, Goulvestre C, Chereau C, Hercend C, Nicco C *et al*. Radical oxygen species production induced by advanced oxidation protein products predicts clinical evolution and response to treatment in systemic sclerosis. *Ann Rheum Dis* 2007; 66: 1202-1209.
29. Baskol G, Gunus K, Onera A, Arda H, Karakucuk S. The role of advanced oxidation protein products and total thiols in diabetic retinopathy. *European Jour of Ophthal* 2008; 18(5): 792-798.
30. Kalousova M, Zima T, Tesar V, Dusilova-Sulkova S, Skrha J. Advanced glycooxidation end products in chronic diseases-clinical chemistry background. Mutat Res., 2005; 579(1-2): 37-46.
31. Kostolanska J, Jakus V, Barak L; HbA1C and serum levels of advanced glycation and oxidation protein products in poorly and well controlled children and adolescents with type 1 diabetes mellitus. *J Pediatr Endocrinol Metab*., 2009; 22(5):433-442.
32. Piwowar A. Advanced oxidation protein products. Part II. The significance of oxidation protein products in the pathomechanism of diabetes and its complications. Pol merkur Lekarski, 2010; 28(165): 227-230.
33. Pan HZ, Zhang L, Guo MY, Sui H, Li H, Wu WH *et al*. The oxidative stress status in diabetes mellitus and diabetic nephropathy. Acta Diabetologica, 2010; 47(Suppl1): 71-76.
34. Fathy SA, El-Habashy SA, Rasheed WI, Helmy AS, Gamila SM *et al*. Diagnostic potential of oxidative stress indicators in Egyptian type 1 diabetic children and adolescents. *J of Appl Sc Res* 2009; 5(12): 2524-2534.
35. Gil-Del Valle L, De la Milian CL, Toledo A, Vilaro N, Tapanes R, Otero MA. Altered redox status in patients with diabetes mellitus type l. Pharmacological Res., 2005; 51: 375-380.
36. Sharada HM, Abdalla MS, Amin AI, El Knouly SA, El Sherif HA. Plasma levels of oxidation products in type 2 diabetic patients with nephropathy. *Australian J of Basic an Applied Sc*., 2012; 6(7): 537-544.
37. Pradeep AR, Ramachandraprasad MV, Bajaj P, Rao NS, Agarwal E. Protein Carbonyl: An Oxidative stress marker in gingival crevicular fluid in healthy, gingivitis and chronic periodontitis subjects. Contemp clin dent 2013; 4(1):27-31.

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