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Research Article

Lipid Peroxidation Status and Total Antioxidant Capacity in Serum and Saliva of Periodontitis Patients

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Key Words
Oral infection, oxidative stress, chronic gingivitis

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Received: 15th October 2024
Accepted: 11th November 2024
Published: 31st December 2024

Citation: Ali Mohammed Khaleel Al-Balki, 2024. Lipid Peroxidation Status and Total Antioxidant Capacity in Serum and Saliva of Periodontitis Patients. J. Res. Stud. Biosci., 4: 18-21, doi: 10.36478/ acejrsb.2024.18.21

Abstract
Periodontitis is a chronic inflammatory disease of the oral cavity that develops as a consequence of microbial infection. In advanced cases, it can lead to the destruction of supporting tooth structures and eventual tooth loss. Beyond its local effects, periodontitis has been associated with systemic inflammation, contributing to broader health complications. One key mechanism implicated in this process is oxidative stress, which arises from an imbalance between pro-oxidants and the antioxidant defense system. This study aimed to investigate the involvement of oxidative stress in both local and systemic manifestations of periodontitis by measuring malondialdehyde (MDA) and total antioxidant capacity (TAC) in saliva and serum samples. The findings indicate that periodontitis is associated with increased oxidative stress, both locally and systemically. The elevated MDA levels and decreased TAC suggest a disrupted redox balance, which may contribute to the progression of tissue damage and potentially influence systemic health outcomes. Measuring oxidative stress biomarkers, particularly in saliva, could serve as a useful, non-invasive tool in the diagnosis and prognosis of periodontitis. These results underscore the importance of oxidative stress in the pathophysiology of periodontal disease and support its consideration in clinical assessments.

INTRODUCTION

Periodontitis is a chronic disease of the gingival tissue resulted from microbial infection[1]. Upon infection, a characteristic and serious feature of periodontitis in chronic condition appears, in which osteoclasts are activated and start a continuous destructive process on the alveolar bone which ultimately results in teeth loss[2]. Hence, it is important to study the pathophysiology of the disease. Periodontitis is generally more prevalent in developing countries[3], although disease may not necessarily be extensive or severe in indigenous populations[4]. Chronic periodontitis triggers a series of inflammatory events mediated by an overexpression of pro-inflammatory cytokines such as interleukin 6, which translocate the influence from the local oral site to a systemic influences that can affect distal tissues[5].

Free radicals and reactive oxygen species (ROS) are highly reacted substances involved in many inflammatory conditions[6]. The term of ROS involves various radical and non-radical reactive substances that contains oxygen such as superoxide, hydrogen peroxide, hydroxyl radical etc.[7]. The high levels of ROS has linked to cell apoptosis through affecting the main constituents of cells including the unsaturated fatty acids in membrane[8], protein oxidation[9] and even it affects the DNA[10,11]. When ROS affects the lipids on the cell membrane by a process called lipid peroxidation, malondialdehyde (MDA) forms as one of the final products[12]. MDA is extensively used as an indicator of lipid peroxidation[13].

MATERIALS AND METHODS

Subjects and Samples: The study has included 22 patients with periodontitis disease from Iraq, and controlled with 22 healthy people volunteered for the study. At first, the subjects were informed to fasting for 12 hours prior the sample collection to reduce any interfere with the examination. Saliva and blood samples (serum was isolated) were collected from each sample and stored at -20°C until analysis time.

Estimation of MDA and TAC: Spectrophotometric methods were used for the determination of MDA and TAC in serum and saliva. MDA level was determined in µmol/L by using the method of Benge and Aust[14]. TAC on the other hand was determined in reference to vitamin C (Vit C. Eq. /L) according to Erel's method[15].

Statistical Analysis: Data were analyzed using Statistical Process for Social Sciences (SPSS) version 26 application statistical analysis system and Excel 2016. The results are expressed by mean and standard deviation (SD) and means compared by using independent sample t-test between the two groups. Receiver operating characteristic (ROC) test was used for testing the sensitivity of MDA and TAC as diagnostic markers by taking the area under the curve (AUC) and cut-off values.

RESULTS AND DISCUSSIONS

Table 1 contains the obtained results of MDA and TAC. Periodontitis patients were in comparable ($P>0.05$) ages with control (range 18-42 year). Serum levels of MDA were significantly ($P<0.05$) higher in periodontitis patients (2.69±0.74 µmol/L) compared to healthy control (0.79±0.15 µmol/L). Likewise, saliva levels of MDA were also elevated in periodontitis patients (0.80±0.12 µmol/L) compared to healthy control (0.36±0.12 µmol/L). Moreover, periodontitis patients have shown significant ($P<0.05$) lower levels of TAC in serum (1.03±0.12 Vit C. Eq. /L) and saliva (0.83±0.09 Vit C. Eq. /L) compared to control.

The ROC analysis indicate the usefulness of MDA as sensitive marker for the diagnostic of periodontitis in serum (AUC=1.0, $P<0.001$) and saliva (AUC=0.989, $P<0.001$), as shown in Figure 1. The cut-off value of serum MDA was calculated as 1.45 µmol/L with sensitivity= 100% and specificity= 100% while the cut-off value in saliva was 0.57 µmol/L with sensitivity= 95.5% and specificity= 95.5%.

The ROC analysis indicate the usefulness of TAC as sensitive marker for the diagnostic of periodontitis in saliva (AUC=1.0, $P<0.001$), but fairly sensitive in serum (AUC=0.680, $P<0.041$), as shown in Figure 2. The cut-off value of salivary TAC was calculated as 1.2 Vit C. Eq. /L with sensitivity= 100% and specificity= 100% while the cut-off value in serum was 1.05 Vit C. Eq. /L with sensitivity= 59.1% and specificity= 50%.

The literatures have reported systemic influence of periodontitis which associated with other complications, especially metabolic diseases[16-18]. Periodontitis has shown to triggers inflammatory events mediate by activation of pro-inflammatory cytokines[19]. The overproduction of ROS stimulated by the these cytokines which develops oxidative stress[20].

In periodontal pathogenesis, the balance between ROS and antioxidant mechanisms is believed to be significant, and imbalance might be induced by (1) increased ROS and inhibited antioxidant mechanisms, and/or (2) lower antioxidant capacity in sick patients. Recent medical and dental research in this field has focused on identifying factors that promote free radical–mediated tissue harm in periodontitis patients, as well as preventing it with the use of particular nutritional antioxidants[21,22]. We have observed that MDA and TAC are affected in serum and saliva of periodontitis patients. Hence, oxidative damage does not consider as exclusive oral problem in periodontitis, but it may affect any part

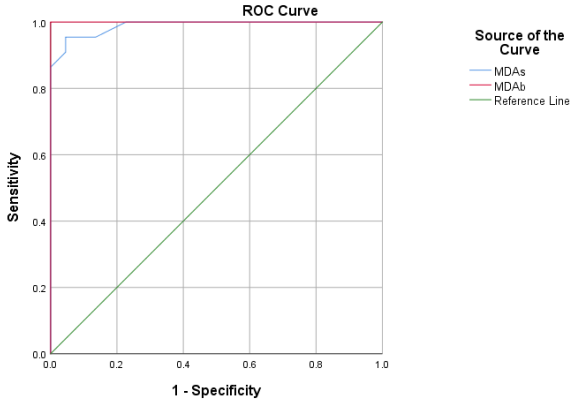

Fig. 1: ROC curve of MDA in serum and saliva of periodontitis patients

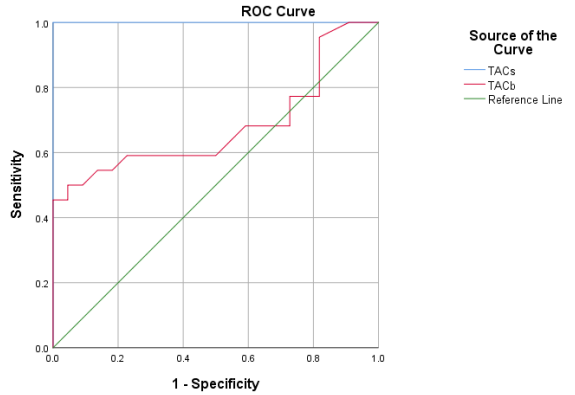

Fig. 2: ROC curve of TAC in serum and saliva of periodontitis patients

Table 1: The levels of MDA and TAC in periodontitis patients

Parameters	Serum			Saliva		
	Control, N=22	Periodontitis patients, N=22	p-value	Control, N=22	Periodontitis patients, N=22	p-value
MDA (µmol/L)	0.79±0.15	2.69±0.74	0.0001	0.36±0.12	0.80±0.12	0.0001
TAC (Vit C. Eq. /L)	1.19±0.25	1.03±0.12	0.007	1.51±0.07	0.83±0.09	0.0001

of the body system since the pro-oxidant are elevated in the circulation.

The ROC analysis indicate that salivary MDA and TAC are excellent sensitive markers in the prognosis of periodontitis. This can be used to prevent future complications arisen from periodontitis.

CONCLUSION

Even though the case number was small in their study, oxidative stress was found to be significantly higher in periodontitis patients. MDA as a biomarker of lipid peroxidation show that the increase in oxidative damage is produced both in the local (saliva) and general level (serum), as it is matched with the decrease in the TAC levels. According to these findings, the periodic evaluation of oxidative stress in patients with periodontitis is indicated for the avoidance of possible later outcomes.

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