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Serum Total Anti-oxidants, Super Oxide Dismutase (SOD), Myeloperoxidase and Vitamin C levels in periapical inflammation- A Original Study

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ABSTRACT

Periapical inflammation is the most common sequalae of dental caries; it is usually either an acute or a chronic inflammatory lesion around the apex of the tooth caused by bacterial infection of the pulp canal system. Multiple factors are considered to be responsible for the progress of the disease. The study was designed as a case-control study comprising of 20 patients (15 males & 5 females) with periapical inflammation and 20 age-matched healthy subjects as controls. Total antioxidants, Superoxide dismutase (SOD), myeloperoxidase and vitamin C levels of the serum were evaluated. A highly significant decrease in serum SOD, total antioxidant and myeloperoxidase levels were observed. Serum vitamin C level was increased in periapical inflammation patients. The study results support the role of antioxidants in periapical inflammation.

Keywords: Periapical inflammation, antioxidants, inflammation, oxidative stress

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INTRODUCTION

Biochemical reactions are the main driving force that helps to sustain human life that takes place within the organelles and the cells of the body [1] .The numerous animal cell culture and epidemiological studies have suggested the involvement of free radical formation and the subsequent lipid peroxidation process in the development of disease status [2]. Inflammatory process is often associated with free radical damage and oxidative stress [3].

Periapical inflammation is the most common sequalae of dental caries; it is usually either an acute or a chronic inflammatory lesion around the apex of the tooth caused by bacterial infection of the pulp canal system [4]. The present study was planned to evaluate the serum antioxidant level (i.e., Superoxide Dismutase, Myeloperoxidase, Vitamin C and total antioxidant) in patients with periapical inflammation.

MATERIALS AND METHODS

The study was designed as a case-control study comprising 20 patients (15 males & 5 females) with periapical inflammation and 20 age-matched healthy subjects as controls. The total antioxidant capacity was determined by the phosphomolybdenum method as described by Prieto et al (1999).The estimation of Superoxide Dismutase (SOD) was carried out by Beuchamp and Fridovich method. Evaluation of Vitamin C was done by DNPH method. The data was entered in Microsoft excel for Windows. Statistical analysis was carried out using SPSS version 16.0 (Chicago, Inc). Unpaired t-test was used to describe any significant differences between the 2 groups.

RESULTS

The mean total antioxidant level was 163.040 ± 22.966 µg/mL for the control group and 97.795 ± 28.664 µg/mL for the periapical inflammation group. The mean SOD level was 4.161 ± 1.176 U/mg Hb for the control group and 1.780±0.669 U/mg Hb for the periapical inflammation group. The mean myeloperoxidase level was 112.38±10.99 pM/L for the control group and 101.5± 4.791 pM/L for the periapical inflammation group. There was a decrease in serum SOD, total antioxidant and myeloperoxidase levels in periapical inflammation patients when compared to healthy individuals ($p<0.001$, highly significant) whereas an increase in serum vitamin C level was observed in periapical inflammation when compared to healthy individuals. The mean vitamin C level was 0.276±0.149 µg/mL for the control group and 0.453±0.165 µg/mL for the periapical inflammation group. (Table 1 and 2)

DISCUSSION

Once the dental infection is established in the pulp, the spread of the disease is in only one direction i.e., to the periapical region. Here a number of different tissue reactions may occur or it may be resistant without any pathology depending upon a variety of circumstances.

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There is also possibility of subtle transformation from one type into another type of lesion and also certain type of reversibility may be possible in some lesions. [5]

Table 1: Descriptive statistics of the study variables in control and case group

	Control (No Periapical Inflammation)				Periapical Inflammation present			
	SOD	Myeloperoxidase	Vitamin C	Total antioxidant	SOD	Myeloperoxidase	Vitamin C	Total antioxidant
N	20	20	20	20	20	20	20	20
Mean	4.161	112.38	.276	163.040	1.780	101.5	.453	94.795
Std. Deviation	1.176	10.99	.149	22.966	.669	4.791	.165	28.664
Std. Error of Mean	.263	2.459	.033	5.135	.149	10.715	.037	6.409
95% Confidence Interval of Mean	3.610 - 4.711	107.239 - 117.531	.206 - .346	152.291 - 173.788	1.466 - 2.094	79.114 - 123.969	.376 - .531	81.379 - 108.210
Minimum	1.236	102.3	.1	110.3	.1168	25.68	.2	30.3
Maximum	6.560	137.4	.7	198.2	2.7324	225.60	.7	153.3

Table 2: Significance of study variables among the case and control group using the unpaired t test

Variable	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
SOD	7.863	38	.000*	2.380	.303	1.767	2.993
Myeloperoxidase	.986	38	.330	10.844	10.994	-11.411	33.099
Vitamin C	-3.555	38	.001*	-.177	.0498	-.278	-.0762
Total Antioxidant	8.309	38	.000*	68.245	8.213	51.618	84.872

(*p<0.01, highly significant)

Periapical inflammation is viewed as a dynamic encounter between microbial factor and host defenses which may result in local inflammation and resorption of periapical hard tissue. Pulpal inflammation first elicits an immune response to the bacteria in the periapical region following pulp necrosis. In this situation, complex immunologic mechanisms are activated at the periapical region and can also cause host tissue destruction and mediate periapical bone resorption. [6]

The exact pathobiology for the diversity in the periapical pathology is not clearly understood. Multiple factors are playing synergistically and in a combative way. Some of the known key factors include nature and quality of irritation, duration of the exposure, systemic factors, chemical mediators etc. Although nutrition plays a major role in dental and bone

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health, very little information is available about its involvement in periapical pathology and its progress. Healing of periapical lesions following root canal therapy is an essential process to recover normal anatomic structure as well as for the success of root canal therapy [6]. The present study indicated a significant correlation between inflammation and serum antioxidant level except in vitamin C (Fig 1, 2, 3, 4). Hence the serum antioxidant level may play a major role in preventing periapical disease progression.

Figure 1: shows the mean SOD levels in the periapical inflammation and the control group

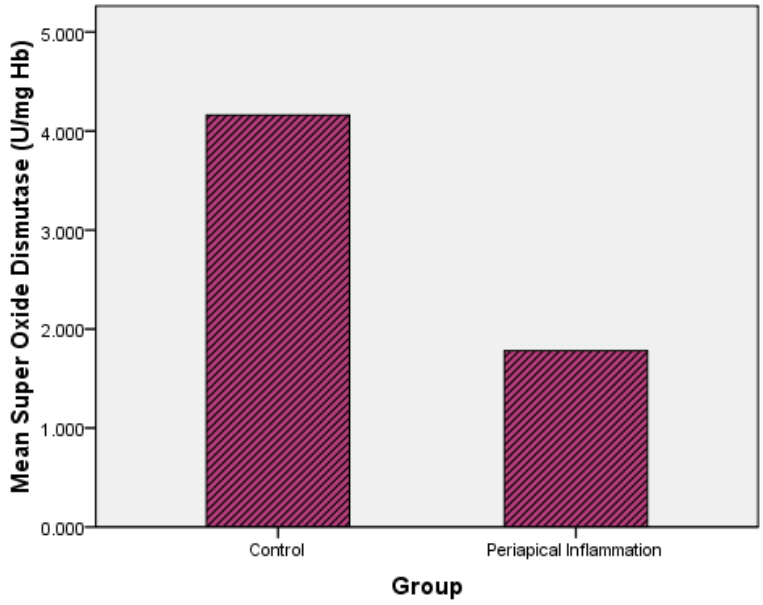

Figure 2: shows the mean myeloperoxidase levels in the periapical inflammation and the control group

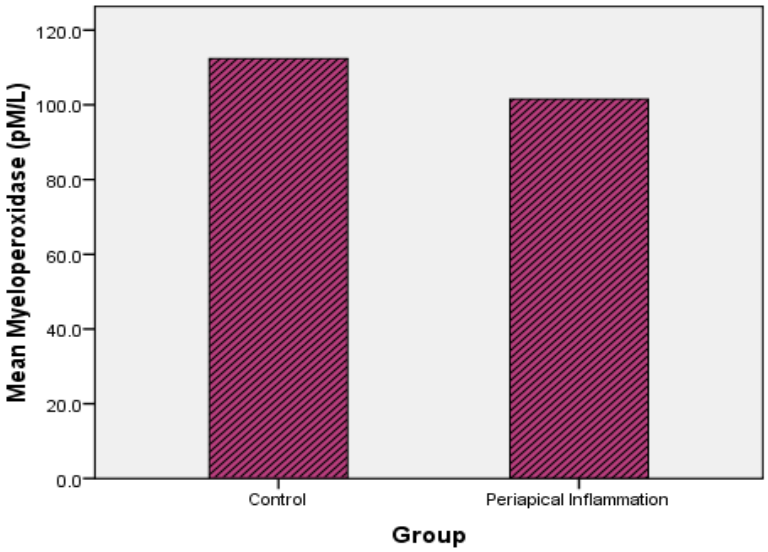

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Figure 3: shows the mean Vitamin C levels in the periapical inflammation and the control group

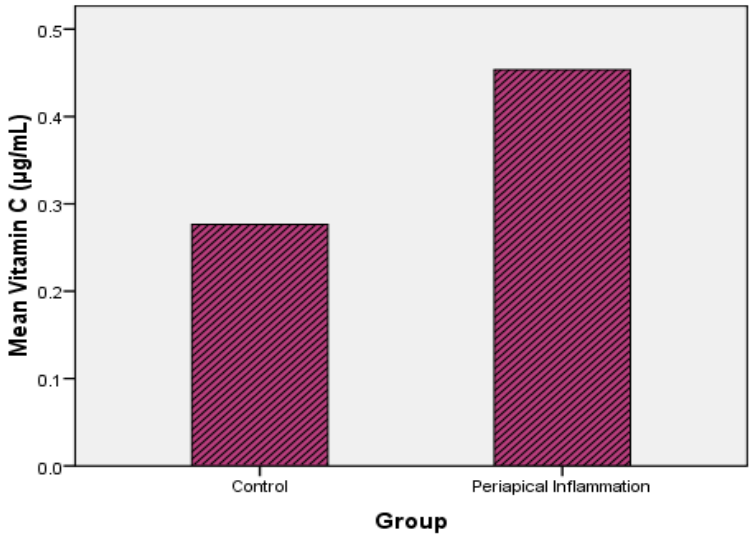
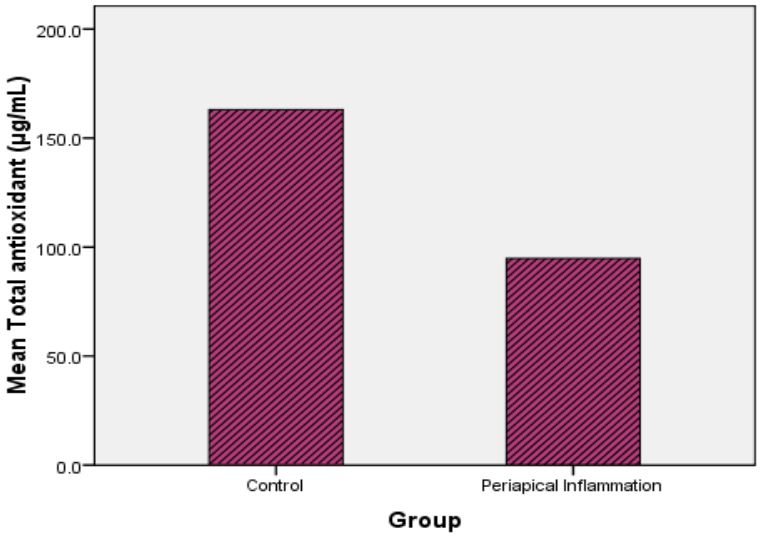


Figure 4: shows the mean total antioxidant levels in the periapical inflammation and the control group



Chronic inflammatory conditions are generally thought to be associated with increased oxidative stress with phagocytes (particularly neutrophils) being implicated with disease pathogenesis because of the generation of oxidative burst during phagocytosis and killing [7]. Originally ROS was thought to be directly microbicidal but recent evidence indicates that their role is to establish an environment in phagocytic vacuole suitable for killing and digestion by enzymes released into the vacuole from cytoplasmic granules [7].

The formation of reactive oxygen species could potentially affect healing or the response to bacteria induced periapical inflammation by direct effect on osteoblastic or

fibroblastic cells or indirectly through promoting inflammation and apoptosis of matrix producing cells. Thus enhancing the production of ROS may impair the healing response or progression of periapical inflammation [3]. Accelerated expression of antioxidant and proteolytic enzyme were directly associated with the degree of inflammation and reflects the extent of inflammation, thus suggesting that the host derived molecules can participate in the progression of inflammation. Antioxidants' acting as scavenger helps to prevent cells and tissue damage that could lead to cellular damage.

Excessive or inappropriate production of oxidants after infection is associated with inflammatory diseases. Impaired antioxidant defenses may contribute to disease progression after the infection in certain type of inflammatory tissue injury which is mediated by reactive oxygen metabolism [8]. Maintaining the adequate antioxidant status may provide a useful approach in attenuating the cellular injury and thus preventing the occurrence and progression of the inflammation. [9]. As the periapical inflammation is the known consequence of dental caries and the common reason for failure of root canal therapy, it may be possible to maintain a healthy periapical bone with maintaining adequate antioxidant levels.

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