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DIFFERENTIAL EXPRESSION OF LIPID PEROXIDATION AND THEIR CONCEIVABLE ROLE IN DENTAL IMPLANT FAILURE

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ABSTRACT

The human inflammatory periodontal diseases are reported as amongst the most common of chronic diseases that affect adults. 69% of adults have early signs and only 5% are completely free from clinical signs of inflammation. The aim and objective of the present study was to evaluate the role of differential expression of lipid peroxidation and inflammatory markers in the failure of dental implant. Total 23 individuals were included in the study, among them 13 were diagnosed patients of dental implant failure and 10 were healthy controls having successful dental implant. Serum, saliva and urine samples were drawn from each individual. Various stress and inflammatory markers were performed through their respective protocols.Levels of stress profile including MDA, NO, 4-HNE and Isoprostanes were increased significantly in serum, saliva and urine of diseased patients as compared to healthy controls. Moreover levels of 8-OHdG, IL-6 and TNF-α were also raised significantly resulting in oxidative stress and inflammation that leads to failure of dental implant. Results of present study concluded that increased stress and inflammatory environment plays a key role in the failure of dental implant.

Keywords: 8-OHdG, MDA, Dental Implant, 4-HNE, TNF-α

INTRODUCTION:

In Denmark in the year late 1970s and 1980s various epidemiological and health sociological studies has been performed that observed the prevalence of oral disease in adult Danish population, and there are various differences have been observed in disease of caries and periodontal. Dental implant is the best treatment of the teeth failure that is generated by titanium because of having the best bonding capacity of titanium with the bone and has least chances of induction of inflammation and production of inflammatory cytokines. But due to unhygienic and uncleanliness of oral environment there is significant chances of induction of inflammation. Inflammation leads to oxidative stress by production of reactive oxygen species (ROS). The highly unstable molecules, Reactive oxygen Species (ROS), attack the polyunsaturated fatty acids (PUFA) in lipid bilayer membranes present in the cell membrane and other outer membrane of different cellular organelles, resulting in the disruption of bio-membranes and deposition of lipid peroxides namely lipid hydroperoxides (LHP) and Malondialdehyde (MDA) [1].

Presently, survival of dental implant has become very suitable because of having high knowledge in the field of oral dental implantation and oral implantology. Various clinicians having good experience of dentistry trying not only to deliver the function of freshly implanted dental implant but also artistic capable of representing the tissue that is missing. Moreover, from last few decades it has been observed that there is increase in the cases of dental implant failure and the reason of its increase ratio is might be the lack of understanding about the causative factors involved in its failure. Major factors that are involved are: occlusal overload, residual cement, hereditary factors, diabetes mellitus and smoking [2]. Osseointegration is defined as the direct structural and functional connection between the living bone and load bearing implant or alloplastic material [3]. Moreover, dental implant failure can be defined as the failure of dental implant that leads to induce failure of osseointegration and causes abrupt bone loss [4-5]. For the prevention of bone loss it is to be suggested that failed dental implants must be retrieved [6].

We can classify Dental implant failure in to two classes depending on the time of its failure, early or delayed failure, that are arisingearlier or afterward placement of the prosthesis, respectively. This dental implant failure can be classified in to two

classes i.e., early dental implant failure and late dental implant failure [7]. Early dental implant failure is due to the catastrophe of tissue to generate osseointegration and late dental implant failure was due to the failure of tissue to maintain the osseointegration inside the bone [8]. We can differentiate early and late dental implant failure through the prosthetic restoration is the dental implant failed before the prosthetic renovation it will be described as early dental implant failure whereas if the implant removed after prosthetic rehabilitation it will be classified as late dental implant failure [9].

The aim of the present study was to evaluate the role of oxidative and inflammatory biochemical markers and its differential expression in the failure of dental implant.

MATERIALS AND METHODS

Present study includes 10 healthy control individuals with successful dental implant and 13 diagnosed patients of dental implant failure. Study was carried out at the Institute of Molecular Biology and Biotechnology (IMBB), The University of Lahore. Blood, saliva and urine sample was drawn from each individual to perform various biochemical markers involved in the failure of dental implant. Levels of MDA were measured through spectrophotometer by using the protocol of Ohkawa [10]. Levels of NO were also measured through spectrophotometer through the protocol of Bredt and Snyder [11]. Whereas levels of isoprostanes, 8-OHdG, 4-HNE, IL-6 and TNF-α were measured through the ELISA kit assay.

RESULTS

Total 23 patients were included in the study with 13 diagnosed dental implant failure patients and 10 healthy controls with successful dental implant. Results presented in table 01 showed that levels of MDA were increased significantly (p=0.023) in serum, saliva and urine of subjects (1.93±0.031, 0.017±0.0061 and 0.34±0.014 nmol/ml)as compared to serum, saliva and urine of healthy controls (0.93±0.015, 0.010±0.0019 and 0.031±0.0012 nmol/ml) respectively. Levels of isoprostanes were increased prominently (p=0.000) in serum, saliva and urine of dental implant failure patients (2.11±1.24, 1.99±0.34 and 7.16±2.19pg/ml) as compared to healthy controls (1.53±0.027, 0.716±0.035 and 0.134±0.015pg/ml) respectively. According to table 01 level of 8-OHdG and 4-HNE were increased significantly (p=0.019 and 0.006) in subjects (1.43±0.27, 0.134±0.013 and 2.19±1.056 pg/ml) and (1.95±0.156, 0.43±0.012 and 2.53±0.31 µmol/ml) respectively in

comparison with the controls (0.51±0.025, 0.10±0.0026 and 0.016±0.009 pg/ml) and (0.72±0.011, 0.135±0.0742 and 0.024±0.0094µmol/ml) respectively. Moreover levels of IL-6, TNF-α and NO were increased significantly (p=0.031, 0.024 and 0.011) respectively in diseased patients (6.316±1.56, 0.000±0.000 and 0.000±0.000pg/ml), (29.65±2.16, 0.000±0.000 and 0.000±0.000pg/ml) and (29.36±3.16, 0.000±0.000 and 0.000±0.000 µmol/L) respectively as compared to healthy controls (2.19±0.62, 0.000±0.000 and 0.000±0.000pg/ml), (17.35±3.16, 0.000±0.000 and 0.000±0.000pg/ml) and (9.65±2.16, 0.000±0.000 and 0.000±0.000 µmol/L) respectively.

Table 1: Differential Expression of Lipid Peroxidation and Their Potential Role In Dental Implant Failure

VARIABLES	CONTROL (n=10)			SUBJECT(n=13)			P- VALUE
	Serum	Saliva	Urine	Serum	Saliva	Urine	
MDA (nmol/ml)	0.93±0.015	0.010±0.0019	0.031±0.0012	1.93±0.031	0.017±0.0061	0.34±0.014	0.023
Isoprostanes (pg/ml)	1.53±0.027	0.716±0.035	0.134±0.015	2.11±1.24	1.99±0.034	7.16±2.19	0.000
8-OHdG (pg/ml)	0.51 ±0.025	0.10±0.0026	0.016±0.009	1.43±0.27	0.134±0.013	2.19±1.056	0.019
4-HNE (µmol/ml)	0.72±0.011	0.135±0.074	0.024±0.0094	1.95±0.156	0.43±0.012	2.53±0.31	0.006
IL-6 (pg/ml)	2.19±0.62	0.000±0.000	0.000±0.000	6.316±1.56	0.000±0.000	0.000±0.000	0.031
TNF-α(pg/ml)	17.35±3.16	0.000±0.000	0.000±0.000	29.65±2.16	0.000±0.000	0.000±0.000	0.024
NO (µmol/L)	9.65±2.16	0.000±0.000	0.000±0.000	29.36±3.16	0.000±0.000	0.000±0.000	0.011

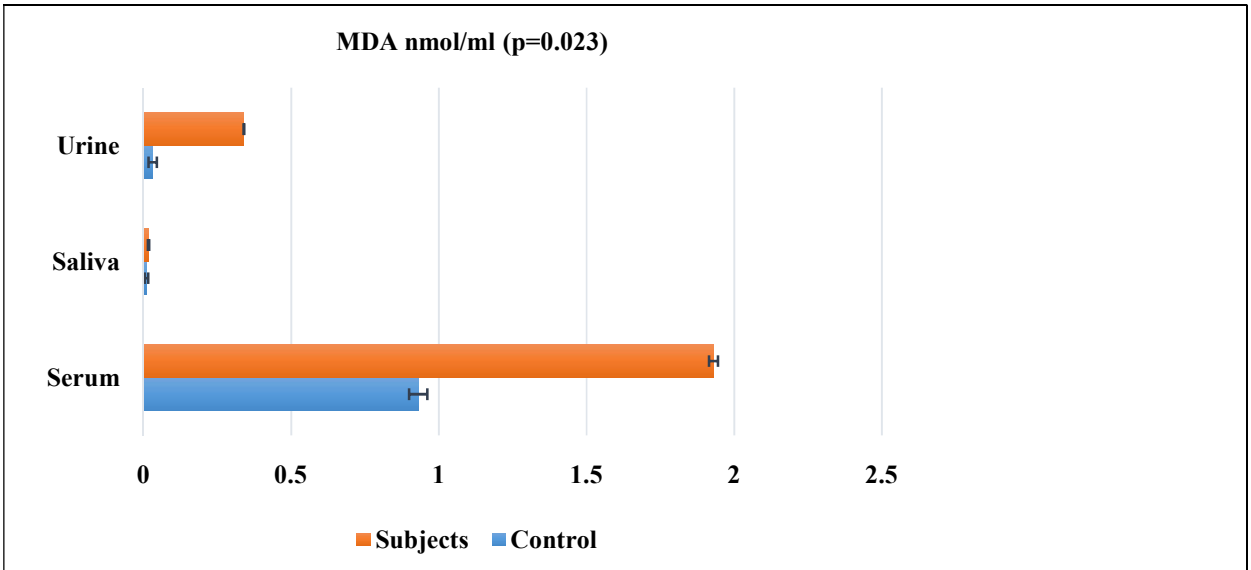

FIGURE A

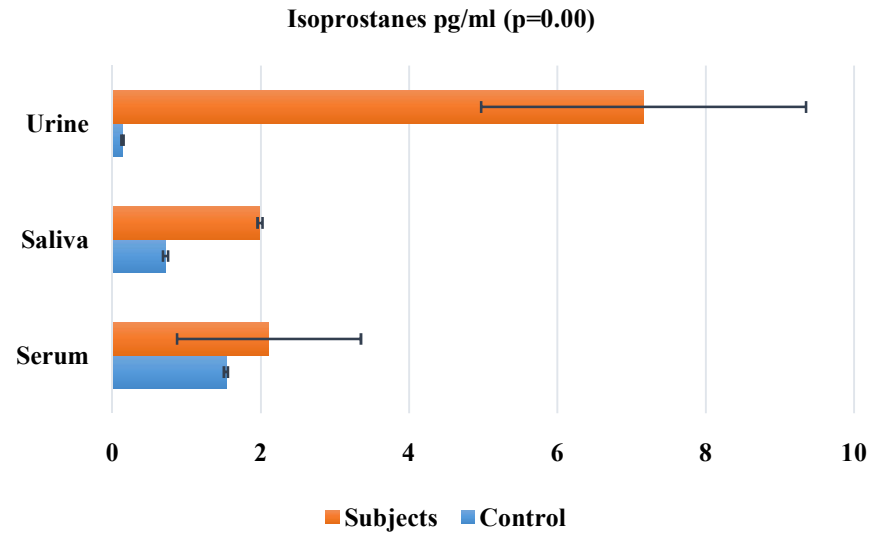

FIGURE B

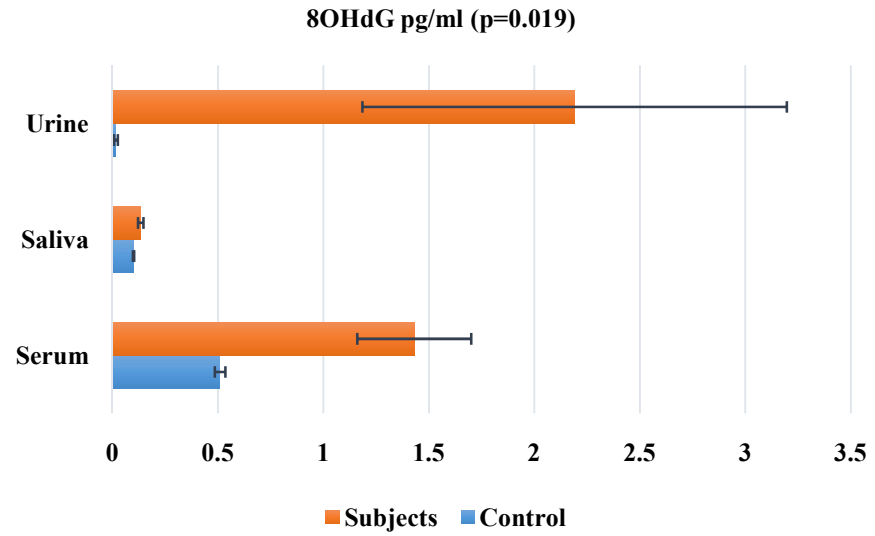

FIGURE C

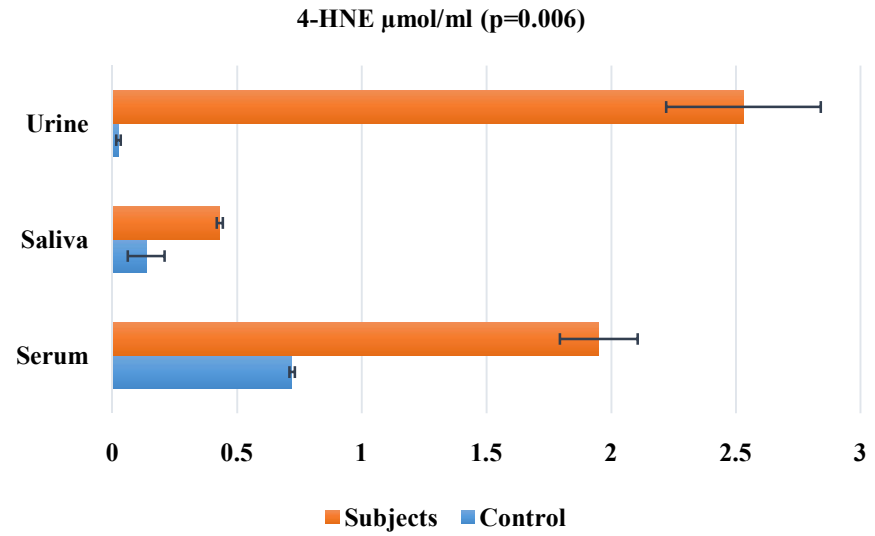

FIGURE D

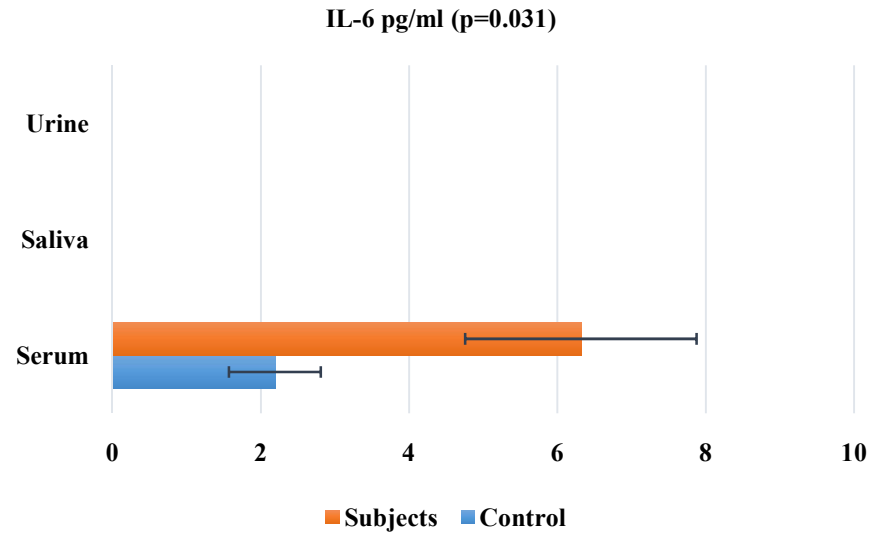

FIGURE E

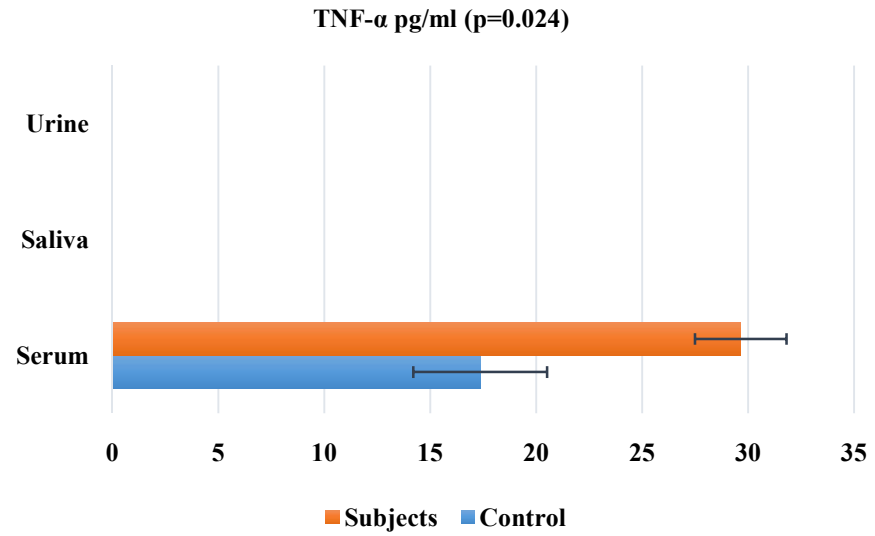

FIGURE F

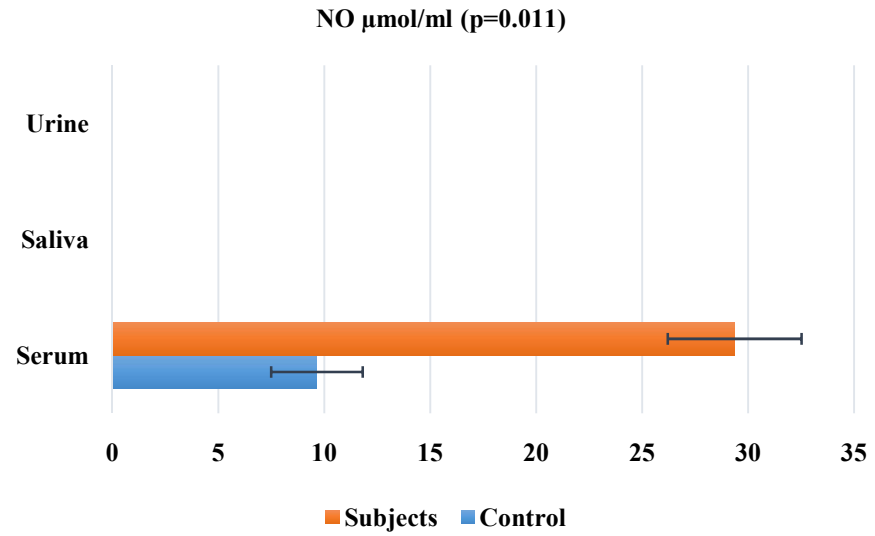

FIGURE G

DISCUSSION

Various studies reported the role of imbalance between oxidants and antioxidants leading to cause oxidative stress in patients diagnosed with dental implant failure and peridontiits, that leads to the severe effects of ROS in the oral cavity and dental environment [12]. Ellis and collaborators analyzed gingival tissues from patients with lethal periodontal disease and showed that the oxidative stress was increased significantly [13]. Results showing in the present study showed that failure of dental implant due to inflammation leads to the

increase levels of ROS. ROS production is predictable in all aerobic animals including humans, those who have the proper system of immunity and antioxidant defense system. [14]. If oxidants and antioxidants balance is intruppted because of over production of ROS, it will results in oxidative stress.High flux of ROS attacks on the polyunsaturated fatty acids (PUFA) of cell membrane of dental cells leading to release high amount of MDA. MDA from the cell membrane moves into nucleus and damages the DNA by generating DNA adducts known as 8-hydroxy-deoxy guanosine (8-OHdG). It has been observed in various diseases there is a strong relation between the oxidative stress and immune system, and same situation has been observed in the dental implant failure cases, increased oxidative stress leads to induce various inflammatory cytokines leading to induce pathogenesis of periodontal disease [15]. Most significant difference in values of inflammatory and stress biochemical markers were expressed in serum as compared to urine and saliva. But the most useful impact of serum and saliva is that it is easy to draw sample of urine and saliva in comparison with blood.

Alsaadi and his coauthors suggested that another risk factor involved that is the type of edentulism plays a key role in early dental implantitis [16]. These authors evaluated that the major risk factors for the development of dental implant failure are location of natural teeth in oral cavity and its relation with the dental implant, length of the dental implant, full edentulism, teeth that is present in opposing arch, teeth that is present in the same arch and not adjacent to the dental implant, natural teeth that is present adjacent to the implant in oral cavity and they observed a significant risk factors in the patients have dental implant placed adjacent to the teeth leading to induce dental implant failure.

CONCLUSION

Dental implant failure might be due to the inflammatory oral environment. Titanium based dental implantfailed due to increase inflammatory cytokines as concluded in present study that increase levels of NO and TNF-α induces inflammation. Inflammation leads to the production of ROS leading to lipid peroxidation and DNA damage resulting in oxidative stress.

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