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RESEARCH ARTICLE

QUANTITATIVE ESTIMATION AND COMPARATIVE STUDY OF SERUM ALBUMIN LEVELS IN HEALTHY AND CHRONIC PERIODONTITIS PATIENTS

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ABSTRACT

Background: Serum albumin is negative acute phase protein and might be the practical marker of general health status of patient. Albumin concentration is associated with nutritional and inflammatory status of individual. Periodontitis is a chronic inflammatory disease caused by bacterial infection of periodontium.
Aims: The aim of this study was to evaluate the relationship between periodontal health status and serum albumin levels.
Material and Methods: Total 100 subjects irrespective of gender, with age range of 40–70 years were included in the study. Patients were divided into two groups. Group I: clinically healthy Subjects and Group II: patients with chronic periodontitis and loss of attachment ≥5 mm. Serum albumin concentration was estimated by bromocresol green albumin method.
Results: Mean value of serum albumin level for Group I was 4.710g/dL with standard deviation (SD) of 0.127 and for Group II, the mean value of serum albumin level was 4.125g/dL (SD 0.128). The difference between serum albumin level in Group I and Group II were found to be statistically significant ($P \leq 0.001$).
Conclusions: The findings of this clinical study suggest an inverse relationship and statistically significant correlation between the serum albumin concentration and chronic periodontal disease.

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INTRODUCTION

Periodontitis is a chronic inflammatory disease caused by bacterial infection of the supporting tissues of the teeth. Periodontal diseases are well documented as risk factor for many systemic diseases like coronary heart disease, diabetes mellitus and pre term low birth weight babies in pregnancy. Periodontitis is a major public health issue because (not in hierarchical order, Baehni & Tonetti 2010, Eke et al. 2012): it is common, it is a source of social inequality, it reduces quality of life, reduces chewing function and impairs aesthetics, causes tooth loss and disability, responsible for a substantial proportion of edentulism and masticatory dysfunction, has an impact on escalating dental costs and it is a chronic disease with possible impact on general health (Maurizio, 2013). Serum albumin is the most abundant protein, about half of serum protein in plasma, produced by liver. It transports hormones, fatty acids, and other compounds, buffers pH, are among other functions. Albumin is synthesized in the liver as proalbumin, which has an N-terminal peptide which is removed before the nascent protein is released from the rough endoplasmic reticulum.

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The product, proalbumin, is cleaved in the golgi vesicles to produce the secreted albumin. Most common reference range concentrations in serum are approximately 35 - 50 g/L (3.5 - 5.0 g/dL) (Jonathan Berg, 2012). Serum albumin level is a practical marker of the general health status as it demonstrates the severity of an underlying disease and mortality in the elderly patients (Phillips, 1989). Moreover, malnutrition may also be monitored by means of its concentration (Don, 2004). Although serum albumin level may also be affected by acute factors such as trauma and surgical stress, it is predictive of operative outcome because it is a marker of disease and malnutrition as well as possibly conferring a direct protective effect through several biological mechanisms (Goldwasser, 1997). It is a better prognostic indicator than anthropomorphic markers of nutritional status (Mullen, 1979 and Buzby, 1980; Detsky, 1987; Agarwal, 1988; Apelgren, 1982). Serum albumin has ability to detect protein-energy malnutrition, which is not necessarily accompanied by lower body weight and may not be clinically recognizable, but is associated with significantly increased risk of morbidity and mortality (Blackburn, 1982; Blackburn, 1981; Lipschitz, 1982). Periodontitis is multifactorial inflammatory disease of supporting periodontal tissue, caused by microorganisms results in loss of attachment as well as bone. In periodontal diseases, bacteria triggers inflammatory host response causing

destruction of the alveolar bone and periodontal ligament tissue. The individual characteristics that diminish the efficiency of host response may include medical factors such as malnutrition, which impairs the innate and adaptive immune response of the host, including phagocytic function, cell-mediated immunity, complement system, secretory antibody, and cytokine production as well as function (Genco, 2000). Similarly, inflammation and malnutrition both reduces albumin concentration by decreasing its rate of synthesis. Consequently, it is very important to study the correlation between periodontal disease and serum albumin levels, which predicts the general health status and morbidity in the patients who may be at a higher risk of developing inflammatory conditions.

MATERIALS AND METHODS

Present study was conducted in outpatient Department of Government Dental College and Hospital, Ahmedabad. Total 100 patients aged 40 to 60 years were included in study. Male and female patients randomly recruited. All participants were agreed and informed consents were signed. This study was approved by Institutional ethical committee and all the procedures followed were in accordance with the Helsinki Declaration of 1975 as revised in 2000. Inclusion criteria for the study groups were: Patients with periodontitis, i.e., LA≥5 mm and systemically healthy, having mean dentant ratio of 28 teeth present. Patients with history of hospitalization or institutionalized requiring special care for their daily activities and previous antibiotic or steroid drug intake were excluded from the study.

Group I: Periodontally and systemically healthy subjects
Group II: Patients with chronic periodontitis with LA≥5 mm.

At baseline, intra-oral examination was done under sufficient illumination using artificial light by single examiner, for number of teeth present, gingival index, plaque index, probing depth and loss of clinical attachment. This study focused on clinical attachment loss, which is measured for periodontal tissue loss caused by periodontal disease process. Clinical attachment loss is distance from cementoenamel junction to base of the pocket. This distance was calculated by subtracting distance from gingival margin to CEJ from pocket depth. The periodontal condition, measured as the clinical attachment level (CAL) and pocket depth, was recorded using mouth mirrors and UNC 15 probe. Teeth were probed at six sites i.e. mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual & distolingual, and measurements were recorded approximately to the nearest whole millimetre. Gingival index (loe and silness 1963) (Loe, 1962) and plaque index (quigley and hein plaque index modified by Turesky Gilmore Glickman 1970) were recorded. A personal interview was conducted to obtain the information regarding smoking habit. Anthropometric evaluation which included measurements of weight and height for the calculation of body mass index (BMI) was done.

Technique to evaluate BMI (Anthropometric evaluation) included:

- Measurement of patient's weight (in kg)
- Measurement of patient's height (in meters)
- Calculation of body mass index (BMI) as the ratio of (body weight) to (body height) (Eke, 2012; Maurizio, 2013).

For Biochemical Tests

A volume of 1 ml blood was drawn from the antecubital vein, centrifuged at 2,500 rpm for 10 mins using a centrifugal machine. Biochemical value of serum albumin level was measured by bromocresol green albumin method. Analysis was done using fully automated biochemical analyzer. Analysis was done by Selectra E Kit (Merck®) using fully automated biochemical analyzer. The recorded data were compiled and Student's unpaired t test was used for statistical analysis.

RESULTS

Table 1. Comparison of clinical and anthropological parameters in group I and group II patients

	Group I	Group II	Mean difference	P value
Age	56.32± 7.834	57.53±5.675	1.202	>0.05 NS
GI	0.785±0.242	2.005±0.614	1.220	<0.001 **
PI	0.853±0.245	1.782±0.552	0.929	<0.001 **
CAL	1.42± 0.502	7.88±1.802	6.46	<0.001 **
Serum albumin level	4.710±0.127	4.125±0.128	0.585	<0.001 **
BMI	22.03±3.33	23.38±4.21	1.348	>0.05 NS

NS P>0.05, not significant;
*P<0.05, significant;
**P<0.001, highly significant.
BMI=Body mass index,
GI=Gingival index,
PI=Plaque index,
CAL= clinical attachment loss

Table 2. Within Group II (chronic periodontitis) comparison of relationship between serum albumin and other parameters

	Serum albumin	
	r	P
AGE	-0.389	0.038*
BMI	0.112	0.511 NS
PI	-0.799	<0.001**
GI	-0.561	0.002*

r- Pearson correlation coefficient;
NS P>0.05- not significant;
*P<0.05- significant;
**P<0.001- highly significant.
BMI=Body mass index,
GI=Gingival index,
PI=Plaque index

Demographic data of the population in the study is compared in the tables 1 and 2. There was no significant difference in age for cases and controls (Table 1). Mean values of the GI, PI, CAL and serum albumin level in blood for patients with periodontitis were significantly higher than for the control group. Standard deviation and mean values for PI score, GI score, serum albumin level, BMI and CAL are elaborated in Table 1. On comparison within Group II a statistically significant association was found between serum albumin and age of the patients ($P < 0.038$). When relationship between serum albumin and BMI was found out to be non significant ($P = 0.511$) [Table 2].When comparison done between oral health indicators like PI and GI done. A statistically significant association between serum albumin and GI has been observed ($P < 0.002$) whereas, with PI there is a statistically highly

significant association ($P < 0.001$) found when using pearson correlation coefficient (Table 2).

DISCUSSION

"The global burden of oral diseases is most common (non-communicable diseases), their impact on individuals and communities is considerable in terms of pain and suffering, impairment of function and reduced quality of life and cost of treatment" (FDI, World Dental Parliament, 2012). Preservation of periodontal health is a key component of oral and overall health and as such is a fundamental human right (Baehni, 2010). (Consensus of the European Workshop on Periodontal Education). Serum albumin is down-regulated in inflammatory status. As such, it is not a valid marker of nutritional status; rather, it is a marker of an inflammatory state (Sachin Jain, 2011). The American Dental Association recently stated that oral health and nutrition have a synergistic bidirectional relationship (Mullen, 1979). According to Hermann et al. (1992), many conditions, such as inflammatory states, liver diseases, and renal diseases, have been indicated to reduce serum albumin levels (Maurizio, 2013). In this cross sectional clinical trial, 50 patients with chronic periodontitis and clinical attachment loss ≥5mm and 50 clinically healthy controls were selected. Highly significant difference in concentration of serum albumin was observed between two groups. These results showed inverse independent correlation of serum albumin level and periodontal disease. Similar findings have been reported in the studies conducted by Ogawa et al. (Agarwal, 1988). However in the study conducted by Ogawa et al, number of teeth present in oral cavity were < 20 or >20 per subject and age range was 70 years and above but in this study age range is between 40 and 60 years with an approximate presence of 28 teeth per subject. In the study by Kaur et al age range was 40 to 70 years and results showing inverse correlation between periodontitis and serum albumin coincide with our study results (Kaur, 2015).

Earlier studies showed, elderly individuals have impaired dentition status and a lean lifestyle along with possibility of compromised systemic health status would reflect within the values of serum albumin concentration (Maurizio, 2013 and Kaur, 2015). It is possible that poor periodontal condition induces masticatory inefficiency and thereby resulting in malnutrition. Takeuchi et al. (Takeuchi, 2008), reported that mean CAL was negatively associated with total biting force in patients with chronic periodontitis during the maintenance phase of therapy. Because loading forces during mastication induced by masticatory muscles are controlled by mechanoreceptors in the periodontal ligament, reduced periodontal support may decrease the threshold level of mechanoreceptor function (Hannam, 1976). Biting ability is closely related to masticatory performance and dietary selection (Okiyama, 2003 and Heath, 1982). It is possible that patients with reduced periodontal support may unconsciously limit their biting force or prefer to take soft diet. This finding indicates that the periodontal condition of each tooth affects nutritional status more than occlusion status. This possibility of general systemic health/nutritional status in any way affecting the serum albumin concentrations was somewhat eliminated in our clinical trial, as the subjects included in this study were systemically fit and the mean dentate percentage being 28 teeth per subject. Thus, we can legitimate to infer that the lower serum albumin concentrations were solely affected by the inflammatory mediators of chronic periodontitis. Our results are similar to those reported by Yoshihara et al. and Kaur et al (Kaur, 2015; Yoshihara, Yoshihara, 2003) and substantiate the association between oral health status, in particular periodontal disease and serum albumin concentrations. In results of our study serum albumin and loss of attachment shows inverse correlation. Highly significant negative correlation found between level of albumin and clinical attachment loss in periodontal disease and healthy controls. Clear relationship between these two groups cannot be established, but this might be explained by chronic inflammatory reaction process. Clinical attachment loss is important clinical measure of severity of periodontal disease. Serum albumin is falls in category of negative acute phase protein, supports the contention that serum albumin is a marker of inflammation.[28] Chronic diseases are associated with inflammation and the release of inflammatory cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor-α, which cause a decrease in serum albumin (Kaur, 2015). It appears that cytokines IL-1, IL-6 and TNF-α are important down regulators of the synthesis of these negative acute-phase reactants. Albumin and transferrin, the serum iron transport protein, are decreased during inflammation, potentially to starve the microorganisms of iron required for growth and virulence expression. Inflammation and malnutrition both reduce albumin concentration by decreasing its rate of synthesis (Ogawa, 2006). Moreover; malnutrition may also be monitored by means of serum albumin concentration. Therefore, albumin concentration is associated with nutrition and inflammation (Don, 2004). Studies have demonstrated that serum albumin concentrations are associated with general health status among elderly (Corti, 1994). Ogawa et al. also found that mean CAL was a significant factor associated with lower albumin in community-dwelling elderly individuals (Ogawa, 2006). Yoshihara et al. reported that the number of decayed teeth was a significant factor associated with lower serum albumin in an elderly population (Yoshihara, 2003). Therefore, it is required to infer whether serum albumin concentrations are affected by an inflammatory component of chronic periodontitis or the compromised nutritional status, owing to the general health status of the individual.

Many previous studies shows high or low BMI are associated with increase in CRP levels among individuals with periodontal diseases and the Atherosclerosis Risk in Communities (ARIC). According to Slad GD extensive periodontal disease and BMI are jointly associated with increased CRP levels in otherwise healthy, middle-aged adults. so he suggested the need for medical and dental diagnosis when evaluating response of acute-phase proteins like serum albumin in patients. This study also demonstrated that at low BMI levels, periodontal disease is associated with CRP; at BMI levels >30 kg/m^2, the association is attenuated markedly (Slade, 2003). Obesity may elicit an inflammatory response (Hak, 1999). In present study both table I and table II shows no significant association of BMI in intergroup and intra group comparison so we can rule out confounding factor of BMI. A negative correlation between gingival index and serum albumin level was found in this study population, it showed statistically significant results. It can be suggested that high gingival index score is reflecting higher level of inflammation and release of high rate of inflammatory cytokines, which in turn decrease the level of serum albumin. Similar justification could be given for clinical attachment loss. Many previous studies showed link between serum albumin level and mortality rate of patients. Investigations by Corti et al. have

reported graded increase in mortality rate with decreasing serum albumin levels (Corti, 1994). In populations without systemic disorder, Takata et al. reported that mortality rate in the lower serum albumin group (≤4.0 g/dL) was 3.1-fold higher than in the higher serum albumin group (≥4.5 g/dL), after rule out for confounding factors (Takata, 2010). Other researchers have reported that, among patients with colorectal and lung cancer with serum albumin levels <4.0 g/dL, mortality is higher than in patients with albumin levels >4.0 g/dL (Neal, 2009 and Espinosa, 1995). In patients with head and neck cancer, Liu et al. reported that those with albumin concentrations <4.15 g/dL had a significantly lower survival rate (Liu, 2006). Shibata et al. reported significantly different 10 years survival rate with a quartile of serum albumin levels (Shibata, 1991). However, it seems more evident that serum albumin levels below 4 g/dL have higher mortality rate. Maruyama 2012 defined the cut-off value for serum albumin concentration as 3.85 g/dL based on a previous studies, in which serum albumin concentrations of <3.85 g/dL tended to be associated with higher mortality in patients with head and neck cancer (Maruyama, 2012). Therefore, the periodontal disease status has a substantial influence not only on the subject's serum albumin levels but also on general health aspects (Shibata, 1991). The mean serum albumin levels in this trial in chronic periodontitis patients was 4.125 g/dL, which would lead to an assumption that the survival rate would be better for the subjects included in the trial. In a longitudinal study by Iwasaki, et al. a significant association was found between the numbers of periodontal disease events over 4 years and serum albumin levels.[38] Though in this study, a correlation between periodontal disease events and serum albumin levels could be established, the subjects in Group II, that is, chronic periodontitis, exhibited an average of 30% of teeth exhibiting LA≥ 5 mm. Hence, this group of patients does reflect the severity and extent of periodontal destruction at many sites within the oral cavity, representing periodontal disease events.

Conclusions

In light of this study finding we come on concluding remarks that there is inverse relationship of serum albumin level and chronic periodontal diseases. So, serum albumin level can be used as a predictive marker for severity of periodontitis. To prove actual cause to effect relationship between periodontal diseases and serum albumin concentration, randomized clinical trials and longitudinal evaluations in a larger population would be required to substantiate.

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