COMPARATIVE EVALUATION OF SALIVARY PH IN HEALTHY PATIENTS, GINGIVITIS AND CHRONIC PERIODONTITIS PATIENTS – A CROSS SECTIONAL STUDY

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ABSTRACT

\textbf{Background:} Saliva contains numerous of host defense factor. It maintains microbiological flora and oral hygiene. It has varying composition and plays an important role as diagnostic biomarker and has prognostic value. The present cross sectional study was aimed at finding the association between salivary pH and periodontal disease and how saliva can be used as a chair side tool diagnosing periodontal diseases.

\textbf{Materials and methods:} The study population consisted of 90 patients. They were divided into three groups of 30 patients each. Group A included patients with clinically healthy gingiva, Group B had patients with generalized chronic gingivitis and Group C included patients with generalized chronic periodontitis. Unstimulated salivary samples were collected from each patient and pH analysis was done using pH meter. ANOVA Test was used for statistical analysis.

\textbf{Results:} Results shows that the salivary pH of gingivitis patients was alkaline and salivary pH of patients with chronic generalized periodontitis was acidic when compared with healthy individuals. The difference between the groups was significant (p value =0.001).

\textbf{Conclusion:} Salivary pH can have diagnostic and prognostic value in diagnosing periodontal disease.

\textbf{KEY WORDS:} Salivary biomarker, pH meter, periodontitis.

\textbf{I. INTRODUCTION}

Saliva is colourless, odourless fluid that maintains oral hygiene. Sufficient amount of salivary secretions is important to maintain good oral hygiene. \cite{1} The normal salivary flow rate is 800-1500 ml per day, which is altered under conditions such as circadian rhythms, individual health status and individual physical activity. \cite{2}

Unstimulated salivary secretion contribution at resting by parotid gland (25%), submandibular gland (60%), sublingual gland (7-8%) and minor salivary glands (7-8%). Stimulated salivary secretion determines the quantity, constitution and pH of saliva. Normal pH of oral cavity is maintained between 6.7 to 7.3. \cite{3}
The pH of saliva ranges from 6.7 to 7.3 that maintains oral cavity with its buffering action and eliminating acid produced by bacteria during metabolism of carbohydrates. When pH level reduces below 5.5 (i.e., critical pH value) and longer exposure to low salivary pH leads to the development of dental caries.²

The concentration of salivary pH depends on various factors that includes oral microflora and metabolites in the oral cavity. Variations in salivary pH due to local factors in the oral cavity influence the periodontal and gingival health.

The diagnosis of active phases of periodontal disease and the identification of patients at risk for active disease represents a challenge for both clinicians and clinical investigators.

Use of saliva as a diagnostic fluid meets the demands for being inexpensive, non-invasive and easy to use in diagnostic methods. Salivary collection has an advantage in clinically difficult situations in collecting samples from patients who were more anxious, physically challenging people and in whom blood sampling will be difficult and helps in reducing the risk of contracting infections.⁴

As a clinical tool, saliva has many advantages over serum, including ease of collection, storage and it can be obtained at low cost in sufficient quantities for analysis. Physical parameters like salivary pH, buffering capacity, flow rate, viscosity and chemical assays like salivary hormones, antibodies and tumour markers are gaining importance in the diagnosis of many systemic disorders.⁵

Aim of the present study was to find the correlation between salivary pH and periodontal disease severity and to establish the use salivary pH as a chairside diagnostic biomarker.

II. MATERIAL AND METHOD

Study population

The study was conducted in the out-patient Department of Periodontology, Vinayaka missions, Sankarachariyar Dental College, Salem. The study population consisted of 90 patients within the age group of 15-45 years. Group A – Clinically Healthy patients -30 patients, Group B - Generalized chronic Gingivitis patients -30 patients and Group C– Generalized chronic periodontitis patients-30 patients. All patients were verbally explained about nature of the study and from all patients written consent was obtained (as per Helsinki declaration).

Exclusion Criteria:
- Patients with history of systemic diseases
- completely edentulous patients,
- malocclusion,
- mouth breathing, smokers
- Patients with recent history of hospitalization, intake of medications in a period of 6 months,
- patients with tobacco chewing habit

Inclusion Criteria
- For control group- patients with clinically healthy gingiva with probing depth less than or equal to 3mm were included
- For test group patients with generalized chronic gingivitis selected based the National Institute of Dental Research criteria (bleeding index).⁶
- 0 = No bleeding.
- 1 = Bleeding after the probe is placed in the gingival sulcus up to 2 mm and drawn along the inner surface of the gingival sulcus.
- For The criteria for periodontitis were based on loss of attachment with pocket depth of ≥ 5 mm in at least 30% sites

For All Patients Gingival and periodontal findings were recorded.
Saliva sampling

Patients who were selected for the study were instructed to do overnight fasting and advised not to drink any beverages except water. The drinking water was given to patients and asked to rinse their mouth. Salivary collection was done as per the protocol derived from the World Health Organization/International Agency for Research on Cancer guideline “Common Minimal Technical Standards and Protocols.” Patients were asked to tilt their head and allowed saliva to flow naturally. After 5 mins, the subject was asked to spit whole saliva in the collection tube for ten minutes. 5 ml of the saliva was collected in sterile beakers immediately to prevent any deterioration of the sample.

Salivary analysis

All salivary samples were analyzed using Deluxe -Digital pH Meter and values were recorded for each sample.

Statistical Analysis:

The mean and standard pH for all three groups was calculated. The P value was calculated by one-way analysis of variance (ANOVA) using SPSS software and was considered statistically significant if P value was < 0.05.

Results

Table 1 ANOVA analysis for periodontitis, gingivitis and healthy subjects

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>ANOVA</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Periodontitis</td>
<td>30</td>
<td>5.15</td>
<td>6.93</td>
<td>5.89</td>
<td>0.48</td>
<td>0.09</td>
<td>87.45</td>
<td>&lt; 0.001**</td>
</tr>
<tr>
<td>Healthy Subjects</td>
<td>30</td>
<td>6.03</td>
<td>8.17</td>
<td>7.08</td>
<td>0.47</td>
<td>0.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>5.15</td>
<td>8.79</td>
<td>6.92</td>
<td>0.72</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N- number of patients in each group. Min – minimum value of PH recorded. Max - maximum value of PH recorded. SD- standard deviation. SE- standard error of mean. p value** (significant <0.005)

Table 1 indicates ANOVA analysis for periodontitis, gingivitis and healthy subjects, which is statistically significant (p< 0.001). Table 2 indicates post Hok analysis for diagnosis of healthy, with periodontitis and gingivitis cases.
Table 2 POST-HOC ANALYSIS

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>Subset for alpha = .05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Periodontitis</td>
<td>30</td>
<td>5.89</td>
</tr>
<tr>
<td>Healthy Subjects</td>
<td>30</td>
<td>7.08</td>
</tr>
<tr>
<td>Gingivitis</td>
<td>30</td>
<td>7.80</td>
</tr>
</tbody>
</table>

Table 3 Distribution of salivary pH among the study group and control group

On comparing the mean salivary pH of the generalized chronic periodontitis, gingivitis patients and healthy controls, the average pH for the clinically healthy gingiva was 7.08. The average pH of the group having chronic generalized gingivitis was 7.80 and in chronic generalized periodontitis was 5.89. It was found that the pH of saliva from population having chronic generalized periodontitis comparatively had a more acidic pH of saliva than the clinically healthy group (P < 0.001**) (Table 3).

III. DISCUSSION

Saliva is a complex fluid, being made up of 99% water. Apart from secretions from minor and major salivary glands it also contains desquamated oral epithelial cells, microorganisms and their products, leucocytes, serum constituents, fluid from gingival crevice and food remnants.

Henskens et al. studied the effect of periodontal treatment on the protein composition of parotid and whole saliva. After treatment there was a Significant change in protein composition including that of albumin occurred only in whole saliva, after treatment. Gingival crevicular fluid secreted in gingival sulcus is also contributory to the pH of saliva. Because of this reason, unstimulated whole saliva was collected from the subjects.

Baliga, et al. 2012 conducted study to find association between salivary pH and periodontal disease. In test group patients with chronic gingivitis, saliva was more alkaline and Saliva of patients with chronic periodontitis was more acidic as compared with control group (healthy individuals).
Takahashi, et al. 1997 studied the tolerance to acid and the acid-neutralizing activity of three important periodontopathic bacteria, Porphyromonas gingivalis, Prevotella intermedia and Fusobacterium nucleatum. They observed that mildly acidic pH was needed for growth of pathogens leading to periodontitis. 9

Galgut et al. 2001 concluded there is not significant association between salivary pH and gingivitis but periodontitis was significantly associated with pH of periodontal pocket. 10

Fujikawa et al. conducted a study to find the correlation between the pH level and the microflora in periodontal pockets in the various stages of periodontal disease. A change in pH level in deep pockets or severe gingival inflammation and a close correlation was seen between salivary and crevicular pH was seen. Results showed the pH level was significantly positively related with the proportion of coccoid forms, but was negatively correlated with the proportion of motile organisms that are reported to be related with periodontal disease. 11

Uma maheswari et al. 2015 assessed the association between salivary pH and periodontitis in subjects with and without diabetes mellitus. The results showed a decreased salivary pH level was in subjects having periodontitis with diabetes as compared to subjects having periodontitis without diabetes. They concluded diabetes mellitus have a direct effect on salivary pH. 12

Yugantar et al evaluated total protein and albumin concentration, salivary flow rate, salivary pH, buffering capacity in chronic periodontitis patients, gingivitis and healthy subjects. pH meter was used to analyze the salivary pH, calorimetric method was used to analyse total salivary protein and titration method was used to evaluate buffering capacity. unstimulated saliva was collected for this study. Results shows significant rise in total protein and albumin concentration in periodontitis and gingivitis patients whereas salivary flow rate, buffer capacity and salivary pH did not show significant results. They have concluded role of total protein and albumin concentration serves a biomarker in periodontal disease. 13

Rajesh et al. (2015) evaluated salivary pH, calcium, phosphate, magnesium and salivary flow rate in periodontitis patients, healthy subjects and patients with dental caries. They have concluded subjects with increased salivary pH are at high risk of developing periodontitis. 14

Rufi et al. (2016) conducted a study on estimation of salivary pH, calcium, phosphate, alkaline phosphatase levels in chronic periodontitis patients. They have concluded based on the significant increase in levels of phosphorous, calcium and reduced salivary pH shows these can be used as salivary biomarker. 15

Mayuri et al. 2019 evaluated salivary pH and periodontal disease and salivary pH. They assessed the salivary pH in gingivitis patients, periodontitis patients and healthy subjects. Results shows periodontitis patients has more acidic salivary pH. 16 Mohammed et al. (2019) conducted a study to find correlation between the unstimulated and stimulated salivary flow rate to the periodontitis patients. They have concluded the study with significant association between the salivary flow rate and periodontitis. 17

Ranjith et al. (2020) conducted a study to assess the prevalence between the chronic periodontitis and salivary pH. They assessed the pH in patients with chronic gingivitis, periodontitis and healthy subjects. The results show patients with gingivitis shows alkaline pH and acidic pH in periodontitis patients and statistical difference was insignificant. They have concluded there is no influence of salivary pH in periodontal health status. 18

Present study assessed the salivary pH and periodontal disease severity. Salivary pH was significantly acidic in periodontitis and alkaline in gingivitis patients when compared to the healthy subjects. Acidic pH in periodontitis shows the disease severity and increased acid production by microorganisms due to poor periodontal condition. Further studies to be conducted to analyze the role of salivary pH and association with disease severity.

IV. CONCLUSION

Saliva is a complex dilute fluid that can be easily collected, contains locally-derived and systemically derived markers of periodontal disease and it may offer the basis for a patient specific diagnostic test for periodontal disease. Salivary pH in patients with chronic generalized periodontitis was more acidic than the control group. Changes in the environmental dynamics may increase the potential for pathogenicity within a microbial ecosystem and subsequently initiate and promote oral diseases. Salivary pH may be used as a quick chair side diagnostic biomarker.
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