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Research Article

Association of Salivary Flow Rate and pH of Diabetes Mellitus Type II Subjects with Dental Caries and Gingivitis

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Abstract

Previously it is suggested that diabetes mellitus may be the major cause of oral diseases. We aimed to assess the gingival and caries indices in type II Diabetes patients and also their correlation with salivary pH and flow rate. For this purpose we collected 100 subjects and divided into: Group I is control group contain 25 subjects; Group II is diabetes contain 75 subjects. Oral examination is asses after confirming the fasting blood sugar level. Mean fasting blood sugar level was 263 ± 62.7 in diabetes group. Mean gingival indices was 2.28 ± 0.62 and dental caries indices was 2.25 ± 0.61 in diabetes group. A significant differences were found between salivary flow rate and salivary pH with gingival and dental caries indices ($p < 0.05$). We found negative correlation of salivary pH of diabetes patients with gingival and caries indices, positive correlation of salivary flow rate of diabetes patients with gingival and caries indices and strong and positive correlation of caries and gingival indices. We concluded that low salivary PH in type II diabetes mellitus patients may cause gingivitis and dental caries and inflammation of gingival tissues may be secondary to caries.

Keywords: *Gingivitis; Dental Caries; Diabetes Mellitus Type II*

Introduction

Diabetes mellitus is a common chronic disease that has emerged as a major health-care problem [1]. Currently Diabetes mellitus affects 240 million people worldwide and this number is projected to increase substantially to 380 million by 2025, with 80% of burden in low and middle income countries [2]. Pakistan belongs to high prevalence area, currently having 6.9 million affected people, with projected estimates expected to double by 2025 and affect 11.5 million people [2]. People with diabetes are at an increased risk of developing oral conditions such as gingivitis, periodontal diseases and alveolar bone loss, which has been associated with persistent poor glycemic control [3]. Goodson., *et al.* found that high saliva glucose was associated with a reduction in overall bacterial load and alterations to many relative bacterial frequencies in saliva when compared with LSG in samples from adolescents [4]. Periodontal disease can lead to recession of the gingival margin, which can expose more tooth surfaces to caries attack [5]. People with diabetes can also experience hyposalivation [6] and may suffer from salivary dysfunction [7]. It was also assumed that the problem of dental caries is aggravated by deficiency of calcium particularly in diabetes mellitus type 2 patients. Optimum concentration of calcium in saliva prevents dental caries

and promotes remineralization, by giving strength and perfectness to the structure of teeth [8]. Oral hygiene is of prime importance to all individuals. Oral health priorities seek to reduce the negative impact of oral disease and their consequences [9]. A new holistic approach of opportunistic screening for diabetes patient is an illustration of the shift towards recognizing the importance of interdisciplinary health care [10].

Gingival inflammation is a common clinical feature detected in children and adults. It is characterized by swelling, redness and bleeding at the gums and it is described as an inflammatory reaction upon-pro inflammatory cytokines that modulate the balance between humoral and cell associated immune responses. It is evident that plaque induced gingivitis is prevalent at all ages of the dentate population [11]. C Seethalakshmi., *et al.* found that there was a significant relationship between the diabetes mellitus and increased incidence of dental caries and periodontitis and there was also a significant reduction in the salivary pH in diabetes mellitus patients, compared to that of non-diabetic subjects [12]. Thus we aimed to investigate the association of salivary flow rate and pH with gingivitis and dental caries in patients of diabetes mellitus type II.

Materials and Methods

This study is conducted in Madinah medical center Karachi. Subjects who are agreed to participate, filled the consent form and are all volunteers. The study received the ethical approval from Muhammad Bin Qasim medical and dental college Karachi. The inclusion criteria for the study is: age limit should be between 30 - 60 years, fasting blood glucose level should at least 140 mg/dl or more, presence of type II Diabetes for atleast 6 months, no other systemic disease other than diabetes. Present study involved 100 adult human subjects after taking institutional ethical approval and informed consent. The subjects were divided into two groups.

- **Group I:** Control group contain 25 subjects having normal glucose level
- **Group II:** Diabetic group (type I/type II) contain 75 subjects. Fasting glucose level is measured by using glucometer.

Inclusion and exclusion criteria: Patients with diabetes mellitus type II having age range was 30 - 60 years. While patients having type II DM with other systemic diseases, taking any medicines, smokers etc. are excluded.

Saliva collection

Unstimulated saliva was collected for 5 minutes from participants using spitting method following preliminary mouth wash to water. Whole saliva was collected in sterile plastic bottle. The samples were transferred to Eppendorf tubes immediately after collection and stored at -20˚C until analysis.

Analytical method

pH is immediately done before store the saliva in Eppendorf tubes. Electronic pH meter was used to measure the pH of saliva after calibration standards of 4 and 7. Samples with very low volume, pH was determined with pH paper strip. The flow rate was measured as mg/ml.

Analysis of gingival index and dental caries

The criteria for gingival index was described according to the method of Suomi and Barbano 1968 [13]. Caries scores were classified according to ICDAS [14].

Statistical analysis

Results were presented as mean ± SEM. To analyze the level of significance between flow rate and pH with gingivitis and dental caries ANOVA with post hoc test was used. $P < 0.05$ was considered to be significant. Pearson's correlation was used to detect the correlation between flow rate and pH with gingivitis and dental caries.

Results

Demographic analysis

The demographic data showed that mean fasting glucose level is 263 ± 62.7 in diabetes subjects. Female subjects are 59.45% while male subjects are 32%. 46.42% of male and 53.5% of female diabetes subjects are claimed to gingivitis while 43.85% of male and 56.0% of female diabetes subjects are claimed to dental caries as shown in table 1.

Parameters	Mean ± SD	Total %	Male %	Female %
Control	109 ± 11.9	25	11	16
Diabetes	263 ± 62.7	75.0	32	59.45
Salivary PH of diabetes	6.70 ± 0.96	75	32	59.45
Salivary flow rate of diabetes	0.307 ± 0.19	75	32	59.45
Gingival indices	2.28 ± 0.62	74.0	46.42	53.5
Dental caries indices	2.25 ± 0.61	72.7	43.85	56

Table 1: *Demographic analysis.*

Effect of Diabetes, salivary flow rate, salivary pH on Gingival and Dental caries indices

We observed a significant results between salivary flow rate and pH with gingivitis. Similarly a significant differences were also observed between salivary flow rate and pH with dental caries as shown in table 2.

Parameters	Gingival indices	Dental caries indices	P < 0.05
control	0.00	0.001	Significant
Diabetes	0.00,a n/s	0.001	Significant
Salivary flow rate	0.00d/b n/s	0.001	Significant
Salivary PH	0.00f/c n/s	0.001	Significant

Table 2: *Effect of Diabetes, salivary flow rate, salivary PH on Gingival and Dental caries indices. One way ANOVA showed significant results.*
a, b, c represents: When compared gingival indices with dental caries; n/s: Non-Significant.

Correlation between diabetes, salivary flow rate and salivary pH with gingivitis and dental caries

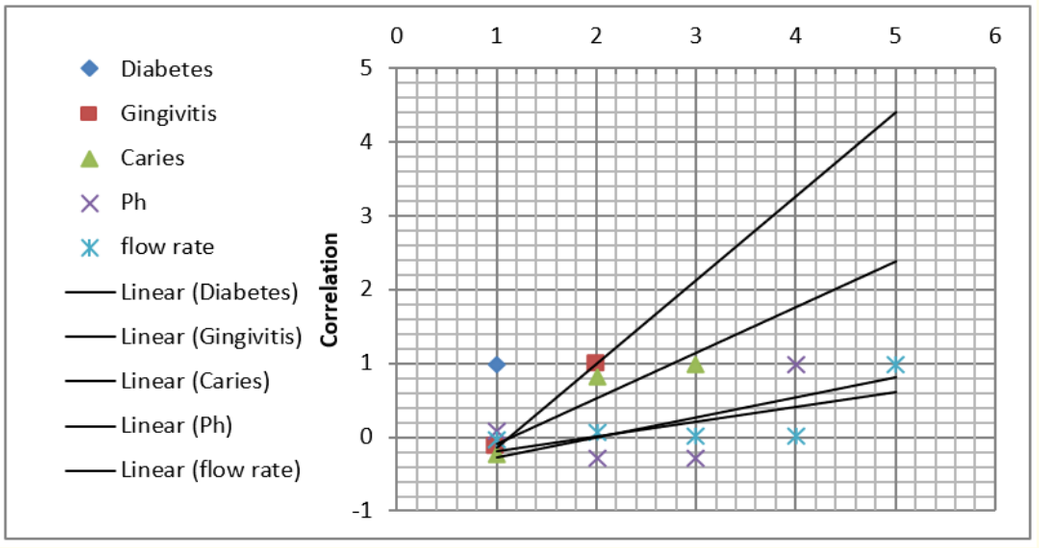

Figure 1: *Showed a linear positive correlation of salivary flow rate with gingivitis and dental caries. A linear negative correlation is observed between salivary pH with gingivitis and dental caries. Strong and positive correlation is also observed between gingivitis and dental caries.*

Discussion

We found significant results of gingival and periodontal indices in diabetic patients. A significant results also found between salivary flow rate and pH of diabetes group. Diabetes is found to have several oral diseases including salivary and oral dysfunction, oral bacterial, fungal infections and oral mucosa lesions [15]. We found significant association of diabetes with gingivitis and dental caries. Xerostomia is characteristic feature of diabetes mellitus patients, which may facilitate oral fungal infections [16]. It was also found that Xerostomia frequently associated with frequent snacking behavior and uses of cigarettes [17].

Previously reports [18] have emphasized the close relationship between diabetes and dental caries. We found significant result of diabetes and dental caries indices as shown in table 2. We observed negative correlation between diabetes and dental caries (Figure 1). Nichols [19] found the same result and they suggested that cariogenic diets containing large amounts of sugar or inoculation of infectious cariogenic bacteria into the oral cavity to induce caries in experimental animals. We found low salivary flow rate and pH of DM type II patients when compared to control as discussed in previously. The low saliva pH is strong evidence of reduced buffer salivary capacity and increased caries risk [20]. The acidic pH of saliva leads metabolic acidosis which in turn loss the protective mechanism of saliva in diabetes patients [21]. This acidic pH promotes the growth of aciduric bacteria and allows the acidogenic bacteria to proliferate creating an inhospitable environment for the protective oral bacteria. Oral environmental balance is changed and is favorable for cariogenic bacteria, lowers the PH further and the cycle is continues [22].

We found significant results in gingivitis indices when compared with positive control. One of the major complications of diabetes is change in microvascular integrity. Advanced glycation end products are formed irreversibly in chronic diabetes mellitus patients in the tissues and changes the collagen stature, altered immune function. This lead impairment of polymorphonuclear leukocyte function and facilitate bacterial proliferation in the tissues. Causes increased pro-inflammatory IL 1 -β, TNF-α leads to increase collagenase activity and decreased collagen synthesis. This results in compromised wound healing and oral health [23].

A negative correlation is found between pH of saliva with dental caries and gingivitis indices which suggested that when pH of saliva decreased there is high chances of dental caries and gingivitis. While we observed positive and strong correlation of gingivitis and dental caries. Therefore, it is highly likely that severe gingivitis or marginal periodontitis might have occurred due to severe periapical inflammation due to dental caries in male diabetic WBN/KobSlc rats [24].

Conclusion

We found significant decreased level of salivary flow rate and pH in diabetes mellitus patients. A significant differences were observed when compared salivary flow rate with gingivitis and dental caries indices. We also observed significant differences of salivary pH with gingivitis and dental caries indices when compared. A negative correlation was observed between salivary pH with gingivitis and dental caries indices while, positive and strong correlation is observed between gingivitis and dental caries indices. It is therefore concluded, that diabetes mellitus is directly effect on oral health and gingivitis is secondary to dental caries.

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