Journal of Global Diabetes & Clinical Metabolism

Research Article

A Comparative Study of Oral Health Status between Type 2 Diabetics and Non Diabetic Subjects

This article was published in the following Scient Open Access Journal:
Journal of Global Diabetes & Clinical Metabolism
Received April 10, 2017; **Accepted** May 02, 2017; **Published** May 17, 2017

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Abstract

Background and Objective: Dentists play a major role as part of an allied health team in providing oral care to patients with diabetes. They may detect undiagnosed cases of diabetes on routine dental examinations and refer patients to physicians for further evaluation. This study was undertaken for the identification of significant risk factors for Type 2 diabetes mellitus which may be useful tools for the early detection of this debilitating systemic disease.

Study Design: Comparative study

Method: A total of 100 subjects selected from the outpatient department of Oral Medicine and Radiology, Vokkaligara Sangha Dental College and Hospital Bengaluru, were included in the study. 50 patients with Type 2 diabetes mellitus, 50 patients who were age and sex matched and healthy were included as control group. They were subjected to detailed oral examination for oral mucosal alterations, collection of unstimulated and stimulated saliva and measurement of flow rate in ml/min, scraping of the dorsum of the tongue and staining for microscopic viewing and detection of candidal pseudohyphae and assessment of periodontal status using probing method by CPI probe and posterior bitewing radiographs to visualize bone loss.

Results: Statistically significant differences were seen with respect to presence of oral mucosal alterations- specifically fungal infections, subjective feeling of dryness, unstimulated and stimulated salivary flow, presence of candidal pseudohyphae in tongue smear, clinical attachment loss and periodontal bone loss between the Type 2 diabetics' group and control group. The risk factors in diabetics for Fissured tongue, Benign migratory glossitis, Leukoedema, Leukoplakia, Lichen planus, Nicotinic stomatitis, Irritation fibroma, traumatic ulcer and periodontal disease have also been described.

Conclusion: Diabetes mellitus may be detected early by a dentist with knowledge of certain justified risk factors. Diagnosed diabetics must be advised to take extra care in view of the possible complications of the disease, inspite of appropriate drug control of glycemic level within normal limit.

Keywords: Candidiasis, Diabetes Mellitus, Non-Insulin Dependent, Oral mucosal lesions, Periodontal breakdown, Xerostomia

Introduction

The term "diabetes mellitus" describes a group of disorders characterized by elevated levels of glucose in the blood and abnormalities of carbohydrate, fat and protein metabolism. More than 371 million people have Diabetes mellitus and half the patients are undiagnosed. 4.8 million people have died due to Diabetes [1].

If left untreated, DM can cause many complications. Acute complications include diabetic ketoacidosis and nonketotic hyperosmolar coma. Serious long-term complications include cardiovascular disease, stroke, chronic kidney failure, foot ulcers, and damage to the eyes [2].

With this study we aim to evaluate Oral health in Type 2 Diabetics and compare it with that of non-diabetics which could be an early indicator for Diabetes and effective for prompt treatment and prevention of complications in diabetics. We have considered four important factors in association with diabetes mellitus which include Oral mucosal lesions, Hyposalivation, Candidal pseudohyphae and lesions and Periodontal breakdown, these were assessed in diabetic patients and compared with non-diabetic controls.

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Materials and Method

50 patients, known cases of Type 2 diabetes mellitus, diagnosed at least 5 years prior to study, on medication reporting for regular dental check-up were selected. 50 patients, apparently healthy, age and gender matched patients with the Type 2 diabetic group reporting for regular dental check-up were selected for the study as controls. Patients with other systemic disorders and medications and diabetes secondary to other systemic conditions were excluded.

Comparative study over one and half years and sample selection done using Systematic randomized sampling.

It was ensured that all diabetics included in the study had an HbA1c which was below 8%, thereby categorising them as controlled diabetics. Also were ruled out other systemic conditions that were causative of candidiasis like corticosteroid intake, infections, immunocompromised state, denture wearers, etc as it would influence the results. 50 systemically healthy subjects without diabetes who were similar in socio-economic level, age and gender were used as control subjects. All subjects completed a structured questionnaire with questions regarding demographic data, tobacco usage and daily medication use. In relation to diabetes, data was recorded regarding time of diabetes onset and they were sent for an RBS estimation at the time of examination.

Oral examination

A systematic clinical examination of the oral mucosa was carried out using artificial light, a dental mirror and a gauze square. Moreover, in cases requiring further examination, biopsies were performed to establish an accurate diagnosis. The oral mucosa alterations were classified into four types: Development conditions, Potentially malignant disorders (PMDs), Fungal infections and Other, less commonly seen mucosal alterations.

A ''development conditions'' diagnosis was considered to include a fissured tongue, benign migratory glossitis and leukoedema. The potentially malignant disorders noted in this study included lichen planus, leukoplakia and nicotinic stomatitis. Fungal infections included angular cheilitis and atrophic glossitis. Other alterations included disorders or alterations of the oral mucosa observed with low prevalence, for example Irritation fibroma, Traumatic ulcers. Appropriate treatment and follow-up of the patients were established after diagnosis of the oral mucosa alterations.

Assessment of xerostomia

Patient's subjective feeling of dry mouth was taken note of and salivary function assessed by 2 self-report measures.

Unstimulated flow determination- Patient was instructed not to swallow for 5 minutes and expectorate into funnel inserted into graduated collection vial and measured and plotted in ml/min.

Stimulated flow determination: Patient was asked to chew on a 1 inch square of Paraffin for 2 minutes and expectorate into funnel inserted into a graduated collection vial and measured and plotted in ml/min.

Assessment of periodontal bone level

The clinical attachment level was measured with a CPI probe. The presence of pocket depth equal to or exceeding 4 mm was recorded at four sites on all teeth. Pocket depth values of <4 mm were regarded as normal variation. For presentation in this study two groups were classified, pocket depth 4–5 mm and 6 mm, respectively.

Bitewing radiographs are recorded with short cone technique and uniform angulation, of the posterior teeth region, for all 100 patients and mounted on X-ray viewer and bone loss is assessed using a scoring system given by Sandberg, et al. [3]. Following the scoring, appropriate grades are given as described in the scale.

5 point scale according to Sandberg GE, et al. [3].

0	No loss of supporting bone tissue
1	Initial loss of supporting bone tissue
2	Loss of supporting bone tissue not exceeding 1/3 of calculated root length
3	Greater than or more than 1/3 loss of supporting bone tissue
4	Angular bone defects or loss of bone in furcation for multi rooted teeth

Grades 1 - 2 were diagnosed as mild periodontitis

Grades 3 and above as advanced periodontitis.

Assessment of candida

Cytological samples for Candida pseudohyphae were obtained by scraping a wet tongue depressor 4 times across the posterior midline dorsal surface of the tongue. Material was spread on a glass slide on an area of 2cm, fixed with fixative and allowed to dry. Slides were stained with Periodic Acid Schiff stain and the number of pseudohyphae in the densest 1-cm^2 area was counted. Slides with smears containing less than 1 pseudohyphae per square centimeter were separated. Values for Candida counts were summarized for statistical analysis as absent or present. A separate tabulation was made for those slides where the density of candidal pseudohyphae was more than 10/cm2.

Results

The oral mucosa alterations were divided into four types and a significantly higher prevalence was observed in type 2 diabetic subjects ($p < 0.05$) as compared to their age matched controls.

Significant prevalence was observed for fungal infections ($p < 0.05$) and Angular cheilitis ($p < 0.05$) in the DM2 group

Distribution of oral mucosal alterations in patients has been depicted in Table 1. However no significant correlation was noted between the duration of diabetes and any mucosal alteration or type of oral hypoglycemic drug used by the patient (Table 2).

A statistically significant higher prevalence of subjective feeling of oral dryness ($p < 0.05$), unstimulated salivary flow ($p < 0.05$) and stimulated salivary flow ($p < 0.05$) was noted in diabetics as compared to healthy controls.

Angular cheilitis and presence of candida pseudoyphae in tongue smear is seen significantly more in Type 2 diabetic subjects as compared to healthy, age-matched controls ($p < 0.05$).

A higher percentage of type 2 diabetic patients with Angular cheilitis and atrophy of tongue papillae were seen to have candidal pseudohyphae ≥ 10/cm^2 (Table 3).

Type 2 diabetic subjects showed a significantly higher attachment loss of ≥ 6mm ($p < 0.05$) and severe bone loss ($p < 0.05$) as per grading system of periodontal bone loss using scale given by Sandberg et al. Mild bone loss was seen significantly higher among the control group ($p < 0.05$) (Table 4).

Duration of diabetes mellitus seemed to be a significant factor correlating with the clinical attachment loss of 4-5mm ($p < 0.05$) and also ≥ 6mm. ($p < 0.05$) as well as mild bone loss ($p < 0.05$) and severe bone loss ($p < 0.05$) which may make it a risk factor for occurrence of periodontal disease in diabetic patients.

Discussion

Diabetes mellitus has paralleled the growing population of

CLASSIFICATION	ALTERATION	DM2	CONTROL	P VALUE
DEVELOPMENTAL CONDITIONS	FISSURED TONGUE BENIGN MIGRATORY GLOSSITIS LEUKOEDEMA	16 (32%) 9 (18%) 2 (4%) 5 (10%)	10 (20%) 7 (14%) 1 (2%) 2 (4%)	0.09 0.47 0.40 0.10
POTENTIALLY MALIGNANT DISORDERS LEUKOPLAKIA LICHEN PLANUS NICOTINIC STOMATITIS 6 (12%) 1 (2%) 3 (6%) 2 (4%) 3 (6%) 2 (4%) 0 1 (2%) 0.15 0.41 - 0.41	LEUKOPLAKIA LICHEN PLANUS NICOTINIC STOMATITIS	6 (12%) 1 (2%) 3 (6%) 2 (4%)	3 (6%) 2 (4%) 0 1 (2%)	0.15 0.41 - 0.41
FUNGAL INFECTIONS*	ATROPHY OF TONGUE PAPILLAE ANGULAR CHEILITIS*	15 (30%) 7 (14%) 8 (16%)	5 (10%) 3 (6%) 2 (4%)	0.001* 0.07 0.007*
OTHERS	IRRITATION FIBROMA TRAUMATIC ULCER RECURRENT APHTHOUS STOMATITIS	5 (10%) 1 (2%) 3 (6%) 1 (2%)	3 (6%) 1 (2%) 1 (2%) 1 (2%)	0.317 1 0.15 1

*p<0.05

Table 1: Distribution of Oral Mucosal Alterations.

	DIABETICS (n =50)	CONTROL (n =50)	P VALUE
SUBJECTIVE DRYNESS*	20 (40%)	7 (14%)	0.0001*
UNSTIMULATED SALIVARY FLOW*	15 (30%)	5 (10%)	0.001*
STIMULATED SALIVARY FLOW*	11 (22%)	3 (6%)	0.002*

Table 2: Assessment of Hyposalivation.

	ALL SUBJECTS (n=100)		P Value	SUBJECTS WITH PSEUDOHYPHAE (n=21)		P Value	SUBJECTS WITH PSEUDOHYPHAE ≥10/CM^2 (n=6)		P value
	CONTROL	DM2		CONTROL	DM2		CONTROL	DM2	
SUBJECTS	50	50		6 (12%)	15 (30%)	0.005*	2 (4%)	4 (8%)	0.38
LESIONS ANGULAR CHEILITIS	2 (4%)	8 (16%)	0.007*	1 (16.6%)	4 (26.6%)	0.12	1 (50%)	2 (50%)	1
ATROPHY OF TONGUE PAPILLAE	3 (6%)	7 (14%)	0.07	0	3 (20%)	-	0	2 (50%)	-

Table 3: Comparative Distribution of Candidal Lesions and Pseudohyphae.

PERIODONTAL FINDINGS	TYPE 2 DIABETICS (n=50)	CONTROLS (n=50)	P VALUE
SUBJECTS WITH CAL	45 (92%)	33 (66%)	0.03*
CAL 4-5mm	31 (67.3%)	30 (90.9%)	0.06
CAL ≥6mm	14 (32.7%)	3 (9.1%)	0.0001*
SUBJECTS WITH BONE LOSS	49 (98%)	37 (74%)	0.06
SUBJECTS WITH MILD BONE LOSS	31 (63.3%)	33 (89.2%)	0.03*
SUBJECTS WITH SEVERE BONE LOSS	18 (36.7%)	4 (10.8%)	0.0001*

Table 4: Assessment of Periodontal Bone Level.

overweight and obese individuals. Early detection of prediabetes and diabetes, as well as lifestyle interventions including diet and exercise, are the objectives in preventing and managing diabetes.

Some specific oral mucosa alterations also have been associated with diabetes mellitus (DM). In the present study, a significantly higher prevalence of oral mucosa alterations (68%) was seen in the type 2 diabetic subjects0 as compared to controls. This is similar to the results in a study by Guggenheimer J [1], Bastos A [2], Carlos Antonio Negrato [4] and Syed Fareed Mohsin, et al. [5].

Mounting evidence demonstrates that diabetes is a risk factor for periodontitis and possibly oral pre-malignancies and oral cancer. The systemic inflammatory response generated by inflamed periodontal tissue may in turn exacerbate diabetes, worsen cardiovascular outcomes, and increase mortality. Chronic hyperglycemia leads to several events that promote structural changes in tissues and are associated with impaired wound healing, higher susceptibility to infections and micro and macrovascular dysfunctions [6].

We found a significantly increased prevalence of fungal infections (30%) in the Type 2 diabetic population as compared to controls. This was similar to a study done by Guggenheimer et al. [1]. who found a prevalence (15.1%) of fungal infection in patients with diabetes as compared to controls as well as study by Bastos A [2] who found a significant difference in total prevalence of fungal infections between DM2 group and controls.

There was a higher prevalence of Angular cheilitis (16%) in the Type 2 diabetic subjects as compared to controls. This was also similar to the results from study by Guggenheimer J, et al. [1]. where angular cheilitis (3.2%) and atrophy of tongue papillae (8.9%) was reported. Patients with diabetes are more prone to fungal infections, probably due to xerostomia, immunological alterations or saliva composition.

Although recent studies have highlighted a link between DM and various human cancers [7], studies on its association with oral cancer and precancer have produced conflicting results. The atrophic oral mucosa of diabetics has been proposed to promote the development of leukoplakia and other precancerous lesions. Our study found a positive correlation between smoking and leukedema as was reported by Rosnah Bte Zain, et al. [8]. However contradictory results were obtained by C. W. van Wyk [9] who found no association of leukoedema with smoking.

We found a greater prevalence of Xerostomia in Type 2 diabetics (as compared to healthy controls. This result was similar to the findings of Quirino MR, et al. [10]. Similar reports were given by Guggenheimer, et al. [1], Ravindran R, et al. [11], Ben-Aryeh H, et al. [12], Soell M, et al. [13], Beatrice K. Gandara, et al. [14].

The mechanism by which salivary flow is affected in diabetic patients is thought to be the result of autonomic nerve dysfunction or microvascular changes that diminish the ability of the salivary glands to respond to neural or hormonal stimulation. Other causes may include dehydration or side effects of concomitant drug therapy commonly used in diabetic patients (e.g., antihypertensives, diuretics, and antidepressants) [11].

In patients with Diabetes mellitus, the immunologic status is impaired. As a consequence, the chemotaxis is lower, as the phagocytosis, both situations leading to a reduction of bacterial attack by the polymorphnuclear cells. Besides this, the microcirculation can be affected, what leads to a diminished blood supply, which can also contribute to increase the susceptibility of diabetic patients to infections, not only in the oral cavity, but in the whole body [4].

In this study, Candidal pseudohyphae were found significantly higher (30%) in the patients with Type 2 diabetes mellitus than in controls (12%). The pseudohyphae >10/cm^2 were also seen higher in patients with Type 2 diabetes mellitus (8%) as compared to healthy controls (4%). These results were in accordance with those given by Guggenheimer J, et al. [1], Carlos Antonio Negrato, et al. [4], M. Manfredi, et al. [15] and Richard J. Jurevic, et al. [16].

The risk factors for periodontal disease are: a) smoking; b) hormonal changes of pregnancy; c) hormonal changes of menopause; d) hormonal changes of infertility treatment; e) hormonal changes after use of oral contraceptives; f) alterations caused by poor control of diabetes; g) immunosuppression; h) nutritional metabolic alterations and i) alterations after low immunological resistance in HIV positive individuals [3].

Shlossman, *et al. [17]* and Emrich, *et al. [18] stated that* Type 2 diabetes significantly increases the risk for periodontal disease, with either attachment loss or bone loss as a criterion. This was in accordance with the results of this study. The severity of periodontal disease is also increased by type 2 diabetes as seen in this study with respect to Loss of clinical attachment level (92%) and radiographic bone loss (98%).

We also found a clinical loss of attachment of greater than ≥6mm (14%) significantly more prevalent in the Type 2 diabetics as compared to healthy controls (3%). Our study also found particularly severe bone loss of score 3 and 4 (36.7%) significantly higher than that in controls, on the scale given for the measurement of bone loss by Sandberg, et al. Our results were based upon radiographs and pocket depth measurements and correspond to both Emrich [18], who observed that individuals with diabetes were three times more likely to have periodontal disease defined by radiographic bone loss than non-diabetic controls, and Collin [19] whose results were stated on radiographs and pocket depth. Similar results were reported by Gun E. Sandberg, et al. [3], Shlossman, *et al. [17],* Ravindran R, et al. [11], Carlos Antonio Negrato, et al. [4].

Conclusion

Statistical significance was found between the groups in, presence of oral mucosal alterations, specifically fungal infections, angular cheilitis, subjective feeling of dryness, unstimulated and stimulated salivary flow, clinical attachment loss and periodontal bone loss between the Type 2 diabetics' group and control group. Knowledge of the oral signs and symptoms can help catch this morbid disease at the earliest and the knowledge of its oral complications can help the existing diabetics maintain optimum oral health.

Limitations

1. Limited population studied while diabetics constitute a much larger proportion of the population.

2. Uncontrolled diabetics are under larger risk of debilitation but could not be included in the study.
3. Majority diabetics were concurrently hypertensive, and could not be included in the study.

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