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ORIGINAL ARTICLE

Association of Oral Candidal Carriage, Candidiasis, and Periodontal Disease with the Degree of Glycemic Control in Type I and Type II Diabetes Mellitus

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ABSTRACT

Aim: To assess the possible association of candidal carriage, candidal infection, periodontal disease and diabetes mellitus with glycemic control.

Materials and methods: This study enrolled 100 patients with diabetes mellitus (DM) (50 type I and 50 type II diabetics) visiting the "Jnana Sanjeevani Diabetes Centre," Bengaluru, and 100 nondiabetic subjects visiting the outpatient Department of Oral Medicine and Radiology, RajaRajeswari Dental College & Hospital, Bengaluru, Karnataka, India.

The study subjects were analyzed for their glycemic status by evaluating the hemoglobin A1c levels. All the subjects were clinically examined for the signs and symptoms of candidiasis. All subjects were analyzed for their periodontal status by using Russel's periodontal index for field studies and the presence of oral candida by quantitative culture of saliva samples on Sabouraud dextrose agar.

Comparisons between the study group and control group were done for the presence of oral candidal carriage, oral candidiasis, and periodontal status. Correlation of glycemic control and type of diabetes with periodontal disease status was analyzed.

Results: The prevalence of high candidal carriage [>400 colony-forming units (CFU)/mL] was significantly more in the study group ($p < 0.001$) compared with the controls. High candidal carriage was significantly increased in patients with poor glycemic status (55.6%) ($p = 0.002$). Candidal carriage was higher in type II diabetics, but not significant ($p = 0.822$). Prevalence of poor periodontal status was significantly more associated with the study group ($p < 0.001$). Glycemic control is significantly correlated with periodontal status with a $p < 0.001$. Poor periodontal status is significantly associated with type II diabetes than type I ($p < 0.001$).

Conclusion: The present study establishes that diabetes predisposes to high oral candidal carriage when compared with nondiabetics. Among diabetics, there was no significant difference in the prevalence of high candidal carriage between type I and type II diabetics. A positive association was seen between poor glycemic control and the prevalence of high candidal carriage. The study also reinforces that DM is a risk factor for periodontal disease. Poor glycemic control is positively associated with increased severity of periodontal disease.

Keywords: Diabetes mellitus, Glycemic control, Oral candidiasis, Periodontitis.

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INTRODUCTION

Diabetes mellitus is defined as a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin.[1] The incidence of diabetes has soared worldwide in recent years and is expected to keep growing, with the greatest increase seen in metabolic forms of diabetes, notably type II.[2] Classical clinical complications of DM, which is a major cause of high morbidity and mortality rate, are a group of microvascular and macrovascular complications affecting multiple organ systems like eyes, kidneys, nervous system, skin, oral mucosa, and the cardiovascular systems.[3]

Among a number of oral disorders that have been associated with DM, periodontitis is one of the major complications. Evidence also suggests that periodontal changes are the first clinical manifestation of DM and are risk factors for poor glycemic control. Studies show that *Candida* species are more prevalent in the oral cavities of diabetic patients than in those of healthy, nondiabetic individuals. Especially patients with long-standing,

poorly controlled DM are at risk of developing oral candidiasis and other clinical complications.[3]

This study was aimed to reinforce the association of *Candida* and periodontitis with diabetes and diabetic control.

MATERIALS AND METHODS

This study enrolled 200 subjects. The subjects were categorized into two groups,

1. The study group, including 100 patients with DM visiting the "Jnana Sanjeevani Diabetes Centre," Bengaluru, India.
2. The control group, including 100 nondiabetic subjects visiting the outpatient Department of Oral Medicine and Radiology, RajaRajeswari Dental College & Hospital, Bengaluru, Karnataka, India.

The study group was further divided into 50 subjects with type I and 50 subjects with type II diabetes.

An informed consent was obtained from all the subjects. Each subject was given a proforma that consisted of questionnaires including demographic data of age, gender, height, weight, social status, education, marital status, and address. Patients reporting to have diabetes were requested for their medical records and prescriptions to confirm their diabetic status. A glycosylated hemoglobin level of known diabetic subjects was recorded. The glycemic control was divided as good: 0–8, fair: 8.1–10, poor: 10.1. The controls underwent a random blood sugar test to exclude the presence of DM.

Examination of the oral cavity included the identification and diagnosis of candidiasis. A Russell's periodontal index fulfilling the criteria for field studies was performed to assess the patients' periodontal status. The periodontal status was then divided as good: 0–1, fair: 1.1–2, poor: > 2.1.

Each subject was supplied with a universal container containing 10 mL of sterile saline solution, and asked to rinse the mouth thoroughly for 60 seconds in the presence of a clinician and expel the mouth rinse into a sterile container. The sample was plated on Sabouraud dextrose agar medium. The plates were then incubated at 37°C for 48 hours. The growth of *Candida* was identified by the smooth, white, creamy colored, buttery colonies. After 48 hours of incubation, the numbers of colonies on each plate were enumerated and the number of CFU/mL of oral rinse was derived by the formula.

$$\text{CFU/mL} = 1{,}000 \times \text{number of colonies}/4$$

The samples of saliva with <400 CFU per mL were designated as carriers, >400 CFU/mL without oral signs and symptoms were designated a high candidal carriage status, and > 400 CFU/mL with oral signs and symptoms were designated positive for candidiasis.

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented as mean ± standard deviation (Min–Max) and results on categorical measurements are presented as number (%). Significance is assessed at 5% level of significance.

The chi-squared/Fisher's Exact Test has been used to find the significance of study parameters on a categorical scale between two or more groups. The statistical software namely SAS 9.2, Statistical Package for the Social Sciences 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0, and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables, etc.

RESULTS

The prevalence of high candidal carriage (>400 CFU/mL) was significantly more in the study group ($p < 0.001$) compared with the controls, with 27 subjects positive for high candidal carriage in the study group and 10 subjects in the control group (Table 1). Candidal carriage was higher in type II diabetics, but was not significant ($p = 0.822$). High candidal carriage was significantly increased in patients with poor glycemic status (55.6%) ($p = 0.002$) as compared with patients with good (18.5%) and fair glycemic status (25.9%) (Table 2).

Prevalence of poor periodontal status was significantly more associated with the study group ($p < 0.001$) (Table 3). Glycemic control is significantly correlated with periodontal status with a $p < 0.001$ (Table 4). Poor periodontal status is significantly associated with type II diabetes than type I ($p < 0.001$) (Table 5).

Table 1: Comparison of candidal carriage in the two groups of patients studied

	Study group		*Control group*	
Candidal carriage	*No.*	*%*	*No.*	*%*
Negative	73	73.0	90	90.0
Positive	27	27.0	10	10.0
Total	100	100.0	100	100.0
Inference	Prevalence of high candidal carriage is significantly more in the study group (27.0% *vs* 10.0%) with $\chi^2 = 9.584$; $p < 0.001$**			

**Strongly significant ($p \leq 0.001$)

Table 2: Correlation of glycemic control and type of diabetes with candidal carriage

	Candidal carriage		
Variables	*Negative (n = 73)*	*Positive (n = 27)*	*p-value*
Glycemic control			
Good	34 (46.6%)	5 (18.5%)	0.002**
Fair	24 (32.9%)	7 (25.9%)	
Poor	15 (20.5%)	15 (55.6%)	
Type of diabetes			
Type I	37 (50.7%)	13 (48.1%)	0.822
Type II	36 (49.3%)	14 (51.9%)	

**Strongly significant ($p \leq 0.001$)

Table 3: Comparison of periodontal disease of the patients studied

Periodontal status	*Study group*		*Control group*	
	No.	*%*	*No.*	*%*
Good	30	30.0	33	33.0
Fair	10	10.0	26	26.0
Poor	60	60.0	41	41.0
Total	100	100.0	100	100.0
Inference	Prevalence of poor periodontal disease significantly more associated with the study group with $\chi^2 = 10.828$; $p < 0.001$**			

**Strongly significant ($p \leq 0.001$)

Table 4: Correlation of glycemic control with periodontal status

Glycemic control (n = 100)	*Periodontal status*		
	Good	*Fair*	*Poor*
Good	21 (21.0%)	5 (5.0%)	13 (13.0%)
Fair	6 (6.0%)	3 (3.0%)	22 (22.0%)
Poor	3 (3.0%)	2 (2.0%)	25 (25.0%)
Total	30 (30.0%)	10 (10.0%)	60 (60.0%)
Total	Glycemic control is significantly correlated with periodontal status with $p < 0.001$**		

**Strongly significant ($p \leq 0.001$)

Table 5: Correlation of the type of diabetes with periodontal status in the study group

Type of diabetes	*Periodontal status*		
	Good	*Fair*	*Poor*
Type I	26 (26.0%)	4 (4.0%)	20 (20.0%)
Type II	4 (4.0%)	6 (6.0%)	40 (40.0%)
Total	30 (30.0%)	10 (10.0%)	60 (60.0%)
Total	Poor periodontal status is significantly associated with type II diabetics with $p < 0.001$**		

**Strongly significant ($p \leq 0.001$)

DISCUSSION

The DM is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.[4] Persistent, long-standing, uncontrolled DM is associated with numerous complications.[5] This study basically focused on two important oral complications of DM (candidiasis and periodontitis) in relation to the status of diabetic control.

Oral rinse technique using sterile saline was used in the present study to collect saliva samples, which were then assessed quantitatively after culturing them in Sabouraud agar. This method is shown to be more sensitive in determining the degree of candidal carriage than the nonquantitative methods.

About 20 to 60% of normal individuals harbor *Candida albicans* intraorally without any signs and symptoms of candidiasis.[6] In the present study, none of the subjects showed any signs and symptoms of candidiasis. All the subjects showing colony counts of more than 400 CFU/mL of saliva were considered as high candidal carriage in concurrence with a study by Epstein et al.[6] The present study proved an increased prevalence of high candidal carriage in diabetics than in nondiabetics, which was strongly significant ($p < 0.001$). This is in concurrence with other studies that state that the high carrier rate is attributed to increased salivary glucose concentration.[7-12]

The present study showed significant correlation between high candidal carriage and glycemic control ($p = 0.002$), with increase in prevalence of candidal carriage status in subjects with poor glycemic control as compared with good and fair glycemic control. However, in contrast to previously published reports where oral candida was found to be higher in type I DM,[13-15] there was no significant difference in the present study between numbers of type I and II patients for high candidal carriage.

It is estimated that between 10 and 15% of adults from 21 to 50 years of age and about 30% of subjects >50 years of age have severe periodontitis.[16] Periodontitis has been described as the "sixth complication of diabetes."[17] A number of surveys have suggested the association of DM with severe periodontal destruction. Grossi et al[18] showed that diabetic patients were twice as likely as nondiabetic subjects to have attachment loss. The present study also confirmed that the prevalence of poor periodontal status was significantly more associated with the diabetics than nondiabetics ($p < 0.001$). The reason for this is not certain, although the possibility of abnormal polymorphonuclear leucocytes function is known to play a role presumably because they compromise the host defense mechanisms; other factors may be angiopathy, altered microbial flora, and abnormal collagen metabolism. Increased periodontitis has been linked with alterations in salivary flow and composition, and these alterations reduce the factors that promote healing within the oral cavity.[19]

The present study also found that glycemic control is significantly correlated with periodontal status with a $p < 0.001$. When diabetes types I and II are directly compared by Bacic et al,[20] both increase periodontal disease prevalence to a similar extent. Poor periodontal status was significantly associated with type II diabetes than type I in the present study.

CONCLUSION

The present study concluded that candidal carriage and severe periodontal disease are significantly associated with poor glycemic control in both type I and type II DM. However, the association of different habits and local predisposing factors for candidiasis and periodontitis other than DM were not included in the present study design. Hence, for a more definitive result, a longer longitudinal study with a larger sample size may be required.

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