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Research Article

DETECTION OF PRE-DIABETES AND UNDIAGNOSED DIABETES IN PERIODONTALLY HEALTHY AND CHRONIC PERIODONTITIS SUBJECTS -A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Periodontitis is considered to be an established risk factor for diabetes. Identification of individuals with diabetes and pre-diabetes is important to reduce diabetes-related complications including periodontitis. Knowledge of the diabetic status of dental patients, especially those with periodontal disease, is important as it may alter progression of periodontal disease.

Objective: To identify the subjects with undiagnosed diabetes or prediabetes conditions.

Material and Methods: Total of 120 subjects were included in which 60 were healthy subjects and 60 were chronic periodontitis subjects. All subjects were provided with questionnaires concerning their general health along with evaluating their body mass index (BMI), waist circumference and also fasting blood sugar (FBS) and postprandial blood sugar (PPBS) levels. They also underwent periodontal examination like probing pocket depth (PPD) and clinical attachment level (CAL).

Results: The waist circumference was slightly higher and was statistically significant in case group. The value of BMI in case and control was not statistically significant. FBS and PPBS values were comparatively more in case group. A significant positive correlation was observed when correlation was done between all parameters in case and control group, comparing FBS and PPBS values.

Conclusion: FBS and PPBS levels were slightly elevated in cases than in controls. Further studies are needed to determine whether the estimation of FBS and PPBS can improve early diagnosis and the management of pre diabetes and diabetes. Individuals with undiagnosed diabetes and pre-diabetes can be identified in the dental office by simple chair-side analysis of FBS and PPBS levels.

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INTRODUCTION

Diabetes is a common systemic disease with several major complications affecting both the quality and length of life resulting from inadequate insulin secretion and/or reduced insulin sensitivity. The diagnosis of diabetes mainly relies on the diabetes criteria given by World Health Organization (WHO). Impaired fasting glycemia (IFG) and impaired glucose tolerance (IGT) are defined as pre-diabetes (preDM), in which patient management can be adopted to prevent complications or delay progression from pre DM to DM.¹ It is the condition in which the blood glucose level is above normal but still less than that of diabetes. High risk individuals who have an abnormal glucose level, hypertension, family history of diabetes or obesity (BMI= 25 kg/m²) are more likely to develop IGT or IFG and later progress to DM. People with pre-diabetes and diabetes are at an increased risk for heart disease, stroke, and microvascular diseases typical of individuals with frank diabetes.² Therefore the paramount challenge is early detection

and intervention of these pre diabetes individuals and preventing them from further progressing into diabetes.³

Diabetes causes various complications and periodontal disease has been called diabetes sixth complication along with retinopathy, nephropathy, neuropathy, macrovascular disease, and altered wound healing.⁴ The primary methods used to diagnose diabetes mellitus and monitor blood glucose levels have been the fasting blood glucose and oral glucose tolerance tests among which fasting blood glucose (FBS) is suggested as the best and the most common test with the cutoff point >126 mg/dl. However, there are some issues about using FBS such as keeping the clients fast for about 8 hours and not being applicable in the afternoon.⁵

Periodontal diseases are inflammatory in nature; as such, they may alter glycemic control and induce or perpetuate an elevated systemic chronic inflammatory state, as reflected in increased serum C-reactive protein, interleukin-6, and fibrinogen levels seen in many people with periodontitis. Inflammation induces insulin resistance, and such resistance

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often accompanies systemic infections.⁴ Periodontal disease is also associated with obesity as determined by BMI and waist circumference and as expected demonstrates that periodontitis is more prevalent in patients with an unhealthy lifestyle.^{6,7}

Therefore as a large number of patients seek dental treatment each year, the dentist may increase his importance as a member of the health team by participating in the search for undiagnosed asymptomatic diabetes. The early detection of pre diabetes and diabetes can make considerable progress in reducing the progression of certain chronic diseases such as diabetes. There are many studies which have estimated the association between periodontitis and blood sugar levels in known diabetic individuals but only few studies have estimated the association between periodontitis and blood sugar levels in undiagnosed diabetic individuals. Therefore the objective of this study was to detect of pre-diabetes and undiagnosed diabetes in periodontally healthy and chronic periodontitis subjects and to determine the association between FBS and PPBS, BMI and waist circumference in those subjects.

MATERIALS AND METHODS

This study was a cross sectional study. A total of 120 subjects who were unaware of their diabetic status were selected for the study from the outpatient department of periodontology. The selection criteria were : 1) Subjects aged between 25 and 65 years; 2) Subjects having no systemic disease 3) Those willing for the study 4) Non smokers 5) Not pregnant 6) No history of antibiotic use in the past 6 months 7) No periodontal treatment within previous 6 months.

The case group included 60 patients with chronic periodontitis, and was defined as those having at least 10 teeth with probing depth ≥ 5 mm and $\geq 15\%$ sites with bleeding on probing (BOP) and clinical attachment loss > 1 mm. The control group included 60 periodontally healthy subjects with probing depth < 4 mm, BOP at $< 15\%$ of teeth sites. The study was approved by the ethical Committee of the institution and written consents were obtained from the selected subjects.

The FBS and PPBS were measured using a commercially available glucometer kit (Freestyle Freedom Lite) according to the manufacturer's instructions. The weights of the subjects, in kilograms (kg), and their height, in meters (m), were recorded. The body mass index (BMI) was calculated using the formula: $BMI = \frac{\text{weight (kg)}}{[\text{height (m)}]^2}$. Waist circumference was measured with a standard tape measure made around the approximated midpoint between the lower margin of the last palpable rib and the top of the iliac crest. Based on FBS levels subjects were identified as normal: 70-100mg/dl, pre diabetic: 101-125mg/dl, or diabetic: ≥ 126 mg/dl. Based on PPBS levels, subjects were identified as normal: ≤ 140 mg/dl, diabetic: > 140 mg/dl.⁸ Based on BMI recordings, participants were defined as; underweight: ≤ 18.5 kg/m², optimal weight: 18.5 - 25 kg/m², overweight: 25 - 30 kg/m² or obese: > 30 kg/m².⁹ According to waist circumference subjects were categorized in three diabetes risk categories; low risk: < 80 cm for women and 94 cm for men, moderate risk: between 80-88 cm for women and 94-102 cm for men, and high risk: > 88 cm for women and 102 cm for men.¹⁰

Statistical analyses

FBS and PPBS levels, BMI and waist circumference were expressed as mean values with range and SD, and analysis of the individuals based on these parameters was performed. Chi-square test with Fischer's exact test was used for comparison of FBS and PPBS levels, BMI and waist circumference between groups. For all analyses a $P < 0.05$ was considered statistically significant. Data organization and statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 22.0) program.

RESULTS

Table 1 shows characteristics between chronic periodontitis and healthy subjects. The waist circumference was slightly more and was statistically significant in case group compared to control group. The value of BMI in case and control was not statistically significant. FBS and PPBS values were comparatively more in case group compared to control group.

Table 1 Comparison of case and control groups with respect to respective parameters by t test

Variable	Groups	Mean	SD	SE	t-value	P-value
Age	Control	32.55	11.31	1.46	-4.0135	0.0001*
	Case	40.27	9.70	1.25		
BMI	Control	22.09	3.13	0.40	-0.8944	0.3729
	Case	22.61	3.34	0.43		
Waist circumference	Control	94.07	10.39	1.34	-2.9076	0.0044*
	Case	102.68	20.47	2.64		
FBS	Control	103.87	18.98	2.45	-1.9675	0.0500*
	Case	111.58	23.72	3.06		
PPBS	Control	146.28	55.52	7.17	-3.9579	0.0001*
	Case	189.73	64.40	8.31		

*p<0.05

Table 2 shows comparison of case and control groups with respect to FBS and PPBS. In case of FBS levels, 53.33% of controls did not have diabetes, 36.67% of controls had pre diabetes and 26.67% of cases had diabetes. In case of PPBS levels, 71.67% of the controls were non diabetic and 60.00% of the case group had diabetes.

Table 2 Comparison of FBS and PPBS levels in case and control groups

Factors	Control group	%	Case group	%	Total	%	Chi-square	p-value
FBS								
Normal	32	53.33	24	40.00	56	46.67	5.7836	0.0500*
Prediabetes	22	36.67	20	33.33	42	35.00		
Diabetes	6	10.00	16	26.67	22	18.33		
PPBS								
Normal	43	71.67	24	40.00	67	55.83	12.1994	0.0005*
Diabetes	17	28.33	36	60.00	53	44.17		

*p<0.05

When correlation was done between all parameters in case and control group, comparing FBS and PPBS values, a significant positive correlation was observed. (Table 3)

Table 3 Correlations of all parameters in control and case group

Samples	Variables	BMI	Waist circumference	FBS	PPBS
Control	BMI	-			
	Waist circumference	r=0.8008*	-		
	FBS	r=0.7098*	r=0.7003*	-	
	PPBS	r=0.6087*	r=0.5192*	r=0.8119*	-
Case	BMI	-			
	Waist circumference	r=0.8729*	-		
	FBS	r=0.4529*	r=0.5864*	-	
	PPBS	r=0.6669*	r=0.7999*	r=0.7324*	-

*p<0.05

DISCUSSION

Diabetes mellitus is a highly prevalent disorder, constituting a huge global public health burden. Periodontitis is the most common chronic oral infection and major cause of tooth loss in adults, and has been considered as the sixth complication of diabetes mellitus. Conversely, periodontitis is also shown to be a risk factor for poor glycemic control in patients with diabetes, due to bacteria and their by products in the inflamed periodontal tissue constituting a chronic source of systemic challenge to the host.¹¹ It is estimated that about one third of people with type 2 diabetes might be undiagnosed until the complications are developed.¹² Therefore early diagnosis is important in order to reduce pre diabetes and diabetes and diabetes complications.

In this study estimation of FBS and PPBS was done using glucometer. One advantage of doing FBS and PPBS by glucometer is that it is cost effective and it can be performed quickly and easily in a dental office setting and quick results can be obtained within few seconds.

There are many studies which have estimated the association between periodontitis and blood sugar levels in known diabetic individuals but only few studies have estimated the association between periodontitis and blood sugar levels in undiagnosed diabetic individuals.^{13, 14, 15} This study was intended to detect pre-diabetes and undiagnosed diabetes in healthy and chronic periodontitis subjects in non diabetic individuals.

In order to detect diabetics, fasting blood glucose (FBS) is suggested as the best and the most common test.⁵ However, there are some issues about using FBS such as keeping the subjects fast for about 8 hours and not being applicable in the afternoon. Besides, in centralized screening when laboratory facilities are available, HbA1c test which is the percentage of glycated haemoglobin is used.⁵ There is a controversy about the performance of HbA1c in case finding. It has been argued that due to problems in standardization and variations in styles of HbA1c test, it is not recommended as a routine test for screening of diabetes.¹⁶ However, in an epidemiological study, it has been concluded that FBS is more accurate than HbA1c.¹⁷ In our study the value of BMI in case group was slightly higher but it was not statistically significant but waist circumference was statistically significant in case group than in control group. This was in accordance to the results obtained by other studies.^{13,14} There is growing evidence that obesity has major pro-inflammatory effects, which cause chronic activation of the innate immune system and play an important role in alterations of glucose tolerance. Obesity constitutes a low grade

inflammatory state. An increased BMI is associated with an increase in the size and number of adipocytes. Adipocytes have a high level of metabolic activity and produce large quantities of TNF-and IL-6, and these increases are important in the pathogenesis of insulin resistance.¹⁸

When FBS and PPBS values were compared they were comparatively higher in case group compared to control group and showed significant results. This increase of glycemic levels associated with periodontitis may be due to persistent systemic challenge by periodontopathic bacteria and their products. This increases the tissue resistance to insulin, preventing glucose from entering target cells and causes elevated blood glucose levels.¹⁹ Thus increased bacterial challenge could be the cause of higher FBS and PPBS values in case group.

When correlation was done between all parameters in case and control group, comparing FBS and PPBS values, a significant positive correlation was observed. Screening for diabetes and periodontal disease in the dental office may provide benefit to the patients so that dentists can collaborate with the health care professionals and can take care of the patients.

CONCLUSION

FBS and PPBS levels were slightly elevated in chronic periodontitis group than healthy group. The waist circumference was slightly higher and was statistically significant in chronic periodontitis group. The value of BMI in chronic periodontitis group and healthy group was not statistically significant. Individuals with undiagnosed diabetes and pre-diabetes can be identified in the dental office by simple chair-side analysis of FBS and PPBS levels. Further studies are needed to determine whether the estimation of FBS and PPBS can improve early diagnosis and the management of pre diabetes and diabetes. Several other factors like fat percentage may also be evaluated along with BMI and waist circumference to check for the association among them

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