Effect of non-surgical periodontal therapy on clinical response and glycemic control in diabetic patients with periodontitis

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Source of support: Nil

Conflicts of interests: None declared

ABSTRACT

BACKGROUND: A complex two-way relationship exists between periodontitis and diabetes mellitus (DM). Diabetes mellitus is often preceded by low- grade inflammatory response.

AIM: To evaluate the effect of non surgical periodontal therapy on clinical response and glycemic control in diabetic patients with periodontitis.

MATERIALS AND METHODS: A prospective interventional comparative clinico - biochemical study was planned in 60 subjects with type 2 DM having moderate generalized chronic periodontitis. Clinical diagnosis of moderate generalized chronic periodontitis was made on the basis of probing pocket depth ≤ 5mm and clinical attachment loss of 3-4 mm in a minimum of 6 teeth. Clinical parameters recorded were plaque index, gingival index, bleeding on probing, probing pocket depth and clinical attachment level at sites of selected teeth. Subsequently, the clinical and biochemical parameters were recorded at baseline and 6 months post therapy.

RESULTS: Mean HbA1c at baseline was 7.884±0.42 which reduced to 7.0214±0.26 which was statistically significant ($p<0.05$). The correlation between difference in the mean values of the PPD and HbA1c from baseline to 6 months was statistically significant($p<0.05$)

showing r =0.6924. The correlation between difference in mean value of CAL and HbA1c from baseline to 6 months was statistically significant ($p<0.05$) showing r =0.7240.

CONCLUSION: The clinical improvements obtained were accompanied by significant reduction in HbA1c values in type 2 diabetic subjects. The findings in this study accentuate a need to promote oral health in patients with diabetes as an elemental component of total patient care.

Key words: Diabetes Mellitus, Glycosylated Hemoglobin, Periodontal Therapy

INTRODUCTION

Diabetes Mellitus (DM) with its complication is the most rising chronic health problem in the world currently[1]. Diabetes is analogous with periodontitis[2], and higher in the blood glucose level, it is likely that these patients with DM develop periodontitis compared with individuals devoid of DM[3]. The biologic relationship between DM and periodontal disease is well documented[4,5]. Literature search shows the mechanism underlying the interaction between DM and periodontitis. Studies report a strong inflammatory response characterized by a large secretion of inflammatory mediators (proinflammatory cytokines) which have local and systemic effects (impaired glycemic control)[6,7].

Arising from epidemiological studies, diabetes is thought to affect the periodontal status through direct effects of hyperglycemia and be indirectly modulated by advanced glycation end products (AGEs) navigating to an overall impairment to wound healing and changes in periodontal tissues[8]. In prolonged hyperglycemic status AGEs form as a consequence of extensive glycation of proteins and lipids with reactive oxygen species (ROS) as by products[9]. AGEs contribute to (i) oxidative stress in diabetes patients, (ii) modify the linking of matrix molecules and (iii) impair the efficiency of growth factors. AGEs crosslink with collagen making it less soluble and less likely to be repaired and replaced[10].

With the above background, the current clinical study was designed to determine whether an improvement in the periodontal status of type 2 diabetes subjects is accompanied by an improvement in their metabolic control.

MATERIAL AND METHODS

A prospective interventional comparative clinico - biochemical study was planned. 60 subjects aged 45 to 58 years with type 2 DM having moderate generalized chronic periodontitis were recruited with their informed consent from the outpatient, department of Periodontology, Awadh Dental College, Jamshedpur. Approval was obtained from the Institutional Ethical Committee. The reference number of the ethical clearance was ADCH/IEC/2022/FEB39. Clinical diagnosis of moderate generalized chronic periodontitis was made on the basis of probing pocket depth ≤ 5mm and clinical attachment loss of 3-4 mm in a minimum of 6 teeth.

Patients with diabetic complications such as retinopathy, nephropathy, current smokers, pregnant women, patients with radiographic evidence of periapical pathology, patients who have undergone periodontal treatment in the preceding 6 months were excluded from the study. The sample size was homogenous existing of individuals from the same socio – economic class and environment. The clinical and biochemical parameters were recorded at baseline and 6 months post therapy. All examinations were carried out by a single examiner to maintain the standardization. During the study period, the patients were instructed to continue with their medication for the management of DM without any modification.

The following clinical parameters were recorded:

- Plaque Index (PI)[11]
- Gingival Index (GI)[12]
- Bleeding on Probing (BOP) assessed by Sulcus Bleeding Index

- Probing pocket depth (PPD) measured from the gingival margin to the base of the pocket using UNC 15 probe
- Clinical attachment level (CAL) measured from cementoenamel junction (CEJ) to the base of the pocket using UNC – 15 probe
- HbA1c

Venous blood samples were taken for each patient to measure HbA1c (glycosylated hemoglobin) value at baseline and after 6 months. Patients received a full-mouth scaling and root planing after baseline recording by performing the supra and subgingival scaling using an ultrasonic scaler and root planing using Gracey curettes. Oral hygiene instructions were given to all patients and were instructed to brush twice daily and rinse with 0.2% chlorhexdine mouthwash twice daily.

To ensure consistency, all blood samples were sent to a single laboratory for analysis. HbA1c values were determined using electrophoresis.

RESULTS

The mean plaque index was 1.8410±0.35 at baseline which declined to 1.262±0.18 6 months post therapy. The mean gingival index at baseline was 1.8010±0.3248 which declined to 1.2536±0.2931 at 6 months post therapy. PPD and CAL value showed significant difference when baseline values were compared to 6 months post therapy. Mean HbA1c at baseline was 7.884±0.42 which reduced to 7.0214±0.26 which was statistically significant ($p<0.05$) [Table 1].

Table 1 : COMPARISON OF PARAMETERS BETWEEN BASELINE AND SIX MONTHS

CLINICAL PARAMETERS	BASELINE	6 MONTHS	p VALUE
PI	1.8410±0.3586	1.2632±0.1898	<0.05
GI	1.8010±0.3248	1.2536±0.2931	<0.05
SBI	2.6842±0.4528	0.8263±0.5131	<0.05
PPD	3.8928±0.2618	2.3218±0.1489	<0.05
CAL	4.9261±1.2367	3.2551±0.6931	<0.05
HbA1c	7.8864±0.4231	7.0214±0.2671	<0.05

The correlation between difference in the mean values of the PPD and HbA1c from baseline to 6 months was statistically significant($p<0.05$) showing r =0.6924. The correlation between difference in mean value of CAL and HbA1c from baseline to 6 months was statistically significant($p<0.05$) showing r =0.7240 [Table 2].

Table 2 : CORRELATION BETWEEN DIFFERENCES IN THE MEAN VALUES OF DIFFERENT PERIODONTAL PARAMETERS WITH HbA1c [BASELINE AND 6 MONTHS]

PAIR PARAMETERS	r VALUE	+ VALUE	p VALUE
PI and HbA1c	0.6432	6.2884	<0.05
GI and HbA1c	0.5284	4.3814	<0.05
SBI and HbA1c	0.4220	3.6284	<0.05
PPD and HbA1c	0.6924	6.2931	<0.05
CAL and HbA1c	0.7240	6.6331	<0.05

The correlation between the differences in the mean values of PI, GI, SBI, PPD and CAL with HbA1c from baseline to 6 months was done by paired t test.

DISCUSSION

Glycated hemoglobin also known as HbA1c is a form of hemoglobin which is measured primarily to identify average plasma glucose concentration over prolonged periods. It is formed in a non – enzymatic glycation pathway by hemoglobin's exposure to plasma glucose[13,14]. HbA1c is a reliable indicator of diabetes control except in one situation where the average life span of RBC is significantly less than 120 days which will give rise to low HbA1c because 50% of glycation occurs in 90 – 120 days[15]. Determination of glucose in plasma or urine is not an appropriate indicator of long term metabolic control because the values can change within a few minutes due to various factors like diet, physical activity, medication and time of sampling[16]. HbA1c does not account for the short term fluctuation in plasma glucose level[17].

Periodontitis is a chronic localized oral infection that induces a local as well as systemic immune – inflammatory response which could be a source of bacteremia, because of the large epithelial surface with ulcerated periodontal pockets[18]. The biologic relationship between DM and periodontal diseases is well established[19]. In vitro studies have disclosed that the bacterial microflora at periodontally diseased sites in diabetes subjects is similar to that of non diabetes subjects[20,21].

The obvious lack of significant differences in the bacterial microflora advocates that alterations in the host immunologic response may have a stronger influence on the prevalence and severity of periodontal diseases seen in diabetes[22]. One of the mechanisms causing periodontal destruction involves activation of the innate immunity, mainly by upregulation of pro – inflammatory cytokines in the presence of gram negative micro – organisms, potentially

indicating presence of periodontitis can be systemically modulated by pro – inflammatory cytokines[23].

Patients with diabetes complication such as retinopathies, neuropathies and cardiovascular complexity show increased susceptibility to periodontal disease with increased attachment loss[24]. Studies have also shown that subjects with good metabolic control measured in terms of glycated hemoglobin levels (HbA1c) exhibit a reduced rate of attachment loss when compared to their poorly controlled counterparts[25].

Diabetes affects periodontal health directly by the effects of hyperglycemia and indirectly by advanced glycation end products [AGEs][26]. Hyperglycemia appears to decrease the effect of chemotaxis and phagocytosis and increases apoptosis. It causes the production of reactive oxygen species [ROS]. It lowers the proliferation, migration and differentiation potential of periodontal ligament cells, gingival fibroblasts and mesenchymal stem cells [MSCs][27]. Hyperglycemia also triggers a variety of collagen changes. This alteration of collagen metabolism steers to impaired wound healing and microangiopathy[28].

The formation of AGEs occurs when excess available glucose is in contact with structural and other proteins. Once formed AGEs bind to a specific cellular receptor, known as receptor for AGE [RAGE][29]. RAGE is found on epithelial cells and monocytes, which is of importance in periodontitis. The binding of AGE and RAGE results in a series of proinflammatory events which might be self sustaining because AGE – RAGE binding on the surface of endothelial cell induces the expression of vascular cell adhesion molecule – 1 which will attract monocytes to the luminal side of the endothelial cells thus perpetuating the inflammatory response[30].

The AGE RAGE interaction on monocyte increases cellular oxidant stress and activates transcription factor, nuclear factor – Kappa ß which alters the phenotype of monocyte /

macrophage and results in the increased production of proinflammatory cytokines such as IL-1ß and TNF-α[31]. These proinflammatory cytokines contribute to the pathogenesis of periodontal diseases and probably play a major role in the patients with diabetes, especially when the glycemic control is poor[32]. Only a small number of longitudinal studies have compared progression of periodontitis and HbA1c levels[33,34]. Certain studies have evaluated patients with periodontitis but without DM and reported a gradual inverse in their HbA1c levels[35,36]. The current study showed a positive correlation between the clinical parameters and HbA1c levels. A significant correlation was found when the mean values of the parameters were correlated with HbA1c. Similar results were found by Lim LP et al[37].

Our findings confirms previous reports of significant improvement in glycemic control in DM after non - surgical periodontal treatment in moderate to severe periodontitis[38,39]. Our results differ from those showing no improvement in metabolic control after periodontal treatment[40].

In the current study long term evaluation of periodontal status was not possible which can be considered as one of the limitations of the study. The strength of the study is radiographic examination to exclude the periapical pathology. Inflammatory mediators released in periapical inflammation are associated with development of insulin resistance which may affect the metabolic control of patients with DM[41,42]. The periodontal tissues are highly vascular. Vascularity is further increased during inflammation. Inflammatory cytokines such as IL-1, IL-6, TNF-α and inflammatory mediators have been found to have important effects on glucose and lipid metabolism[43,44].

It is well known that randomized control trials (RCTs) are the best study design to evaluate the relationship between periodontal disease and DM. owing to the methodologic limitations of the RCTs published including sample size, patient characteristics, biases associated with

criteria to define periodontitis, the relationship is not very clear. Hence we need more observational studies in order to identify possible risk factors and predictors for changes in HbA1c levels in patients with DM even though their strength of evidence is lower than that of RCTs[45,46].

CONCLUSION

Despite the differences and constraints, evidence supports the concept that periodontal diseases can contribute to poor glycemic control in people with diabetes. The glycemic control status should be assessed by the oral health care professionals in patients with diabetes. It is also important to correspond with the physicians and those involved in diabetic care about the emphasis of referring patients with diabetes for meticulous oral health evaluation and necessary oral health care.The findings in this study accentuate a need to promote oral health in patients with diabetes as an elemental component of total patient care. Longitudinal studies are warranted to evaluate the long term treatment outcome.

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