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Evaluation of Immunomodulatory Effect of Lycopene in Chronic Periodontitis with Type-2 Diabetes Before and After Phase-I Therapy

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Abstract

Objectives: Patients with type 2 diabetes may have an increased prevalence of periodontitis due to their bidirectional effect. Systemic antioxidant therapy with lycopene (antioxidant) may have an immunomodulatory effect. So this study was planned to compare the efficacy of systemic lycopene as an adjunct to scaling and root planing (SRP) and its immunomodulatory effect. The main objectives of the study were to evaluate the effect of lycopene on immunomodulatory effect (IgG) before and after SRP, to evaluate the effect of lycopene on HbA1c before and after SRP.

Methods: Twenty subjects were randomly assigned into two groups, Group A (SRP only) and Group B (supplemented with systemic lycopene along with SRP).

All the clinical parameters like gingival index, probing depth, clinical attachment level along with serum levels of IgG and HbA1c were evaluated before and after SRP.

Results: The mean IgG levels were increased and mean HbA1c levels were decreased in group B when compared to group A.

Conclusions: Lycopene, as an adjunctive treatment, has a profound effect on treatment outcomes and has a prominent immunomodulatory effect in patients with chronic periodontitis with type-2 diabetes.

Keywords: Lycopene, diabetes, periodontitis, Immunoglobulin G(IgG)

Introduction

The periodontal disease ranges from a relatively benign form of periodontal disease known as gingivitis to the chronic form of periodontal disease, all of which not only threaten the dentition but may also be a threat to general health[1]. Periodontal disease is associated with chronic inflammation, resulting in the destruction of supporting structures. If left untreated, significant tissue damage occurs; the affected teeth can become loose and may be lost if the disease continues to be active. Periodontitis represents a specific inflammatory response to microbial residents of the subgingival bacteria. The inflammatory and immune response to the bacteria that colonize the periodontal and associated tissues involve the systemic circulation and, ultimately the peripheral systems of the body. This creates a bi-directional series of host-microbial interactions involving cellular and humoral factors and network of cytokines, chemokines and growth factors[2,3].

Periodontitis is identified as the sixth complication of diabetes[4] and its prevalence in type 2 diabetes mellitus patients is more than twice that in non-diabetic patients. Diabetes mellitus is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion and insulin action or both. Diabetes mellitus is a metabolic disorder manifested by abnormally high levels of glucose in the blood. The degree of glycaemic control is an essential variable in the relationship between diabetes and periodontal diseases, with a higher prevalence and severity of gingival inflammation and periodontal destruction being seen in those with poor diabetes control.

Various antioxidants are tried locally and systemically in periodontal diseases and have shown beneficial outcomes. Lycopene is a hydrocarbon carotenoid and has a potential role in preventing prostate cancer[5], cardiovascular disease[6], and long term diabetic complications in humans[7], and also has shown promising results in preeclampsia[8], leucoplakia[9], oral submucous fibrosis[10], gingivitis[11] and chronic periodontitis[12,13,14]. Lycopene stimulates the immune system by acting against the oxidative damage of the lymphocytes DNA. It stimulates lymphocytes by increasing the production of IL-2 and interferon-gamma, a potent activator of T lymphocytes. Lycopene may also affect the immunoglobulin production, increasing the blood levels of IgA, IgG, IgM and enhances immunity.

The present study evaluated the efficacy of scaling and root planing (SRP) with adjunctive systemic lycopene versus SRP alone with clinical parameters HbA1C, IgG in patients with type 2 diabetes and chronic periodontitis.

Materials And Methods

Twenty subjects aged between 20 – 60 years of age were selected from the outpatient segment from the Department of Periodontics, St Joseph Dental College, India. All the 20 subjects fulfilled the inclusion criteria for the study, which includes the age limit and patients with type 2 diabetes and chronic periodontitis. The patients were assigned into two groups of 10 each. Group A consisting of 10 subjects who underwent SRP alone. Group B consisting of 10 subjects supplemented with systemic lycopene along with SRP.

The patients with a history of periodontal treatment within the past six months, patients who have a smoking habit, pregnant and lactating women and history of any viral infections in the past six months were excluded from the present study. Subjects fulfilling the selection criteria were chosen and ethical clearance was obtained from the institutional review

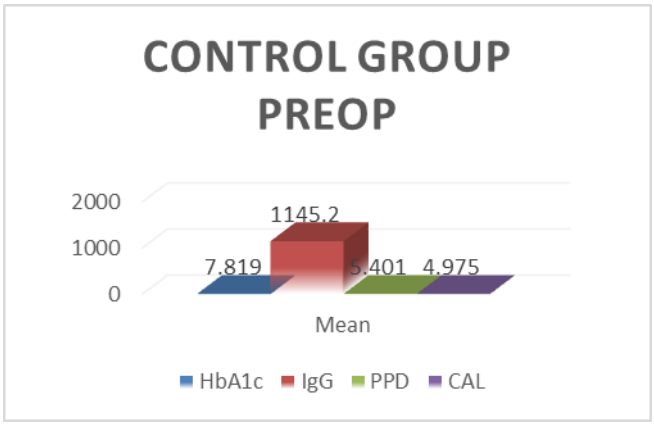
board. Admissible information regarding the study protocol was elucidated to each patient and written informed consent was obtained from all participants in line with Helsinki's declaration. Initially the deepest pocket is measured using an acrylic stent.

The following parameters were recorded: Gingival Index (GI), Probing Pocket Depth (PPD) measured with Williams periodontal probe, Clinical Attachment Level (CAL) measured from a fixed point i.e., cementoenamel junction.

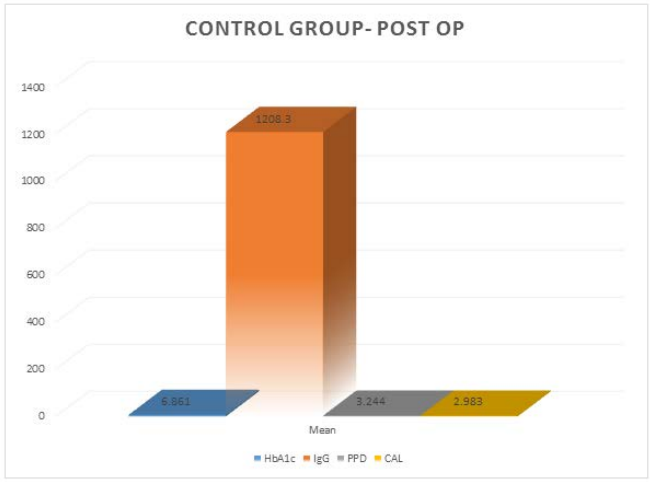
5ml of blood samples were collected from all two groups (group A and group B) at baseline and recalled after six weeks for assessment of parameters. Centrifugation was done which seperates the serum and stored at -4 degree centigrade and it was transferred to labs for further evaluation of HbA1c and IgG.

Results

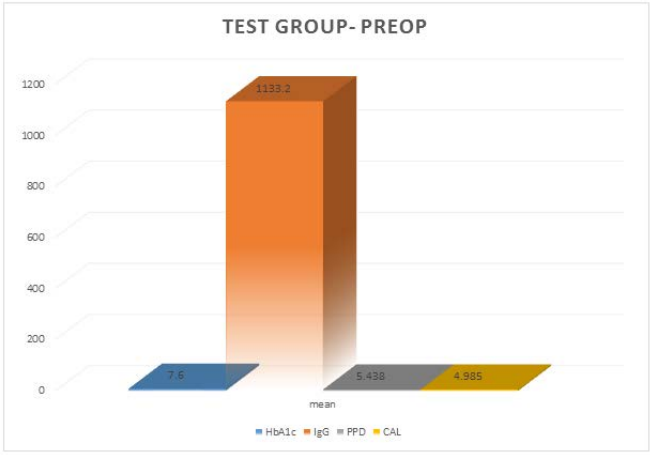
The results have shown a statistically significant reduction in the mean values of the gingival index, clinical attachment level, probing pocket depth and serum levels of HbA1c, with an increase in IgG levels.



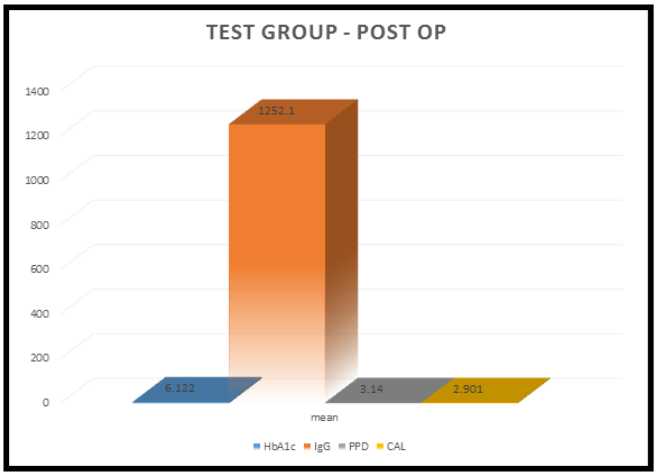
Graph 1: mean values of hba1c, igg, ppd, cal of group a at baseline.



Graph 2: mean values of hba1c, igg, ppd, cal of group a at 6weeks



Graph 3: mean values of hba1c, igg, ppd, cal of group b at baseline.



Graph 4: mean values of hba1c, igg, ppd, cal of group b at 6weeks.

Table 1: Comparitive evaluation of hba1c, igg, ppd, cal of group a and group b at baseline.

	Group1 mean±sd	Group2 mean±sd	t-value	p-value	d.f
HbA1c	7.81 ±0.02	7.60 ±0.03	15.710	<0.05	18
IgG	1145.2±22.56	1133.2±20.19	1.253	>0.05	18
PPD	5.40±0.02	5.43±0.03	-2.657	<0.05	18
CAL	4.97±0.02	4.98±0.03	0.686	>0.05	18

Table 2: Comparitive evaluation of hba1c, igg, ppd, cal of group a and group b at 6 weeks.

	Group1 mean ± sd	Group2 mean ± sd	t-value	p-value	d.f
HbA1c	6.86 ±0.013	6.12 ±0.022	88.680	<0.05	18
IgG	1208.3±9.14	1252.10±19.92	-6.318	<0.05	18
PPD	3.24±0.036	3.14±0.036	6.390	<0.05	18
CAL	2.98±0.036	2.90±0.034	5.186	<0.05	18

Discussion

One of the characteristic pathological mechanisms linking chronic periodontitis and diabetes mellitus is oxidative stress, inflammation & innate immunity activation. Reactive oxygen species production and antioxidant defense imbalance, leading to tissue damage is oxidative stress. Advanced glycation end products (AGEs) present in gingiva leads to a state of enhanced oxidative stress, a potential mechanism for accelerated tissue injury[15]. The reactive oxygen species produced, such as, hydroxyl radicals, superoxide anioin and peroxyl radicals, resulting in damage to DNA, lipids, and protein, and prolonged existence of these reactive oxygen species promotes severe tissue damage and cell death. Therefore, treating oxidative stress through systemic antioxidant therapy improves the symptoms of both diseases.

In the present study, systemic lycopene in physiological doses, i.e., 8 mg daily for one month, was used as an adjunct to SRP and compared with SRP alone. Although lycopene is similar in structure to the much studied β-carotene, lycopene does not have provitamin A activity. Lycopene also had the strongest singlet oxygen-quenching capacity of several carotenoids, with α-carotene, β-carotene, and lutein ranking next in capacity[16].

The present study showed statistically significant reductions in mean values of all clinical parameters (GI, PPD and CAL) from baseline to 6weeks within the groups of group A (SRP) and group B (lycopene+SRP). Statistically significant reductions were seen in the gingival index (GI), probing pocket depth (PPD) and clinical attachment level (CAL) in the present study, in both the groups with a more significant reduction in group B. These findings are in favor of the results

obtained in the studies conducted by Bridges R et al[17], Kiran et al[18], Guglielmo Campus et al[19], Mattout C et al[20] and Patricia Connell et al[21].

The present study, when compared with both group A and group B in terms of biochemical parameters (HbA1C), showed significant reductions in group B than in group A at six weeks. Studies in favor of the present study such as Manvi Chandra Agrawal (2018)[22] evaluated the effect of periodontal therapy and scaling and root planing (SRP) on the metabolic control in type 2 DM patients with chronic periodontitis based on the estimation of glycated hemoglobin (HbA1C) this study was conducted for six months. The results showed significant reductions in HbA1C levels and all clinical parameters (PI, GI, PPD, CAL, BOP), with 25.8% reductions in PPD at six months. These findings corroborated with the results of the present study as well as other supporting studies Rodrigues et al[23].

The present study showed a statistical increase in IgG from baseline to 6 weeks. The stimulation of lycopene on IgG production has been observed in other studies, like that carried out by Luo and Wu (2011)[24], showing that lycopene can increase blood levels of IgA, IgG and IgM, improving the immunity of rats with cancer. Similarly, Neyestani et al. (2007)[7], mainly IgG isotype, reporting that lycopene is not only a common immune enhancer because it provides a specific immune stimulation.

Conclusions

Within the limitations of the study, an increase in IgG levels and decrease in HbA1c levels after the administration of lycopene along with SRP showed that there could be a positive correlation between lycopene, chronic periodontitis and diabetes. The advantages of lycopene administration can be fully appreciated if it could be used on a long-term basis or as a stop-gap monotherapy, for which studies evaluating the consequences of its prolonged administration should be conducted.

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