



## **Glycated Hemoglobin: A Link between Periodontitis and Diabetes: A Review**

<sup>1</sup>Vinod V.C., <sup>2</sup>Roza R. Baviskar, <sup>3</sup>Rutuja N. Jivane, <sup>4</sup>Raksha R. Baviskar, <sup>5</sup>Aditya R. Nawale

<sup>1</sup>Prof. and Head, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune, Maharashtra, India

<sup>2</sup>Post Graduate Student, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune, Maharashtra, India

<sup>3</sup>Post Graduate Student, Department of Periodontology and Oral Implantology. M.A. Rangoonwala College of Dental Science, Pune, Maharashtra, India.

<sup>4,5</sup>Under Graduate Student, Bachelor of Medicine, Bachelor of Surgery. Byramjee Jeejeebhoy Medical College (BJMC), Pune, Maharashtra, India.

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**Corresponding Author:** Roza R. Baviskar, Post Graduate Student, Department of Oral Medicine and Radiology. M.A. Rangoonwala College of Dental Science, Pune, Maharashtra, India

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### **Abstract**

The cornerstone of any healthcare expertise is the ability to diagnose. Diagnosis and a holistic treatment plan play a yeoman's role in providing relief to an ailing patient. Periodontitis is a chronic inflammatory disease of multifactorial etiology. The primary ideological factor remains pathogenic microorganisms whereby the destruction of periodontal apparatus results from the interplay between host immune microbial interactions. Moreover, microbiologic cause periodontitis is often influenced by systemic factors. Thus, many systemic

disorders have an impact on periodontal health. Diabetes mellitus an autoimmune disorder is considered as a risk factor of periodontitis, which is often regarded as six complications of diabetes. Epidemiological studies have clearly identified that diabetes is a major risk factor for periodontitis, increasing the risk approximately three-fold compared to non-diabetic individuals, particularly if glycemic control is poor. Oral health (including periodontal health) is a fundamentally important component of general health, and particularly so in diabetes. Studies

have shown that there is a possible correlation between the amount of glycosylated hemoglobin and the periodontal status. Thus, the paper aims to provide a review about the link of glycosylated hemoglobin between periodontitis and diabetes.

### **Keywords**

Diabetes, Periodontitis, Glycosylated hemoglobin, Infections, Diagnostic Investigations.

### **Introduction**

Periodontitis is widely regarded as the second most common dental disease worldwide, after dental decay. The bridge between oral and systemic health has been reinforced during the past decade, describing this important connection in both dental and medical journals. The oral focus has been on periodontal diseases, being the most common dental conditions. Periodontitis (CP) is an inflammatory disease of the supporting tissues of the teeth, caused by pathogenic microorganisms, which may result in attachment loss and alveolar bone resorption through a specific elicited inflammatory host response<sup>(1)</sup>. Periodontitis has been widely associated with different systemic diseases such as cardiovascular disease (CVD)<sup>(2)</sup> diabetes<sup>(3)</sup> and metabolic syndrome<sup>(4)</sup>. The following paper provides an insight about the role glycosylated hemoglobin (HbA). Hemoglobin A1c, or HbA1c, and the different levels of periodontal health and also highlights the importance of glycosylated hemoglobin investigation in detection of diabetes.

### **Infections and Diabetes**

Dental infections most commonly occur when bacteria invade the pulp and spread to surrounding tissues; this can be due to dental caries, trauma, or dental procedures. Periodontal infections first involve the gingival tissues causing gingivitis and, over time, may progress to periodontitis. Diabetics have an

impaired defense mechanism, are more susceptible to infection and infections in diabetics are more severe when compared with non-diabetics. Bacterial infections decrease the effectiveness of insulin receptors on target tissue cells, reducing the ability of the body to utilize glucose. Poor metabolic control of diabetes results with a consequent increased risk of developing diabetic complications (5). Many specific infections are more common in diabetic patients, and some occur almost exclusively in them. Other infections occur with increased severity and are associated with an increased risk of complications in patients with diabetes. Common infections in patients with diabetes include respiratory tract infections, urinary tract infections, pyelonephritis, cystitis, otitis media, sinusitis, cholecystitis, and candidiasis<sup>(6)</sup>. The risk of oral infections, particularly periodontitis, among patients with diabetes needs to be considered and may be higher compared to non-diabetic individuals<sup>(7)</sup>. Periodontitis can lead to more serious oral infections such as fascial space infections and may be a major factor in bacteremia<sup>(8)</sup>.

### **Periodontitis**

Periodontitis is defined as “an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of periodontal ligament and alveolar bone with pocket formation, recession or both”<sup>(9)</sup>. Some risk factors for periodontitis are smoking, diabetes, stress, neutrophil dysfunction, hyper-lipidaemia, hormonal, health care, socio-economic status, oral hygiene, diet, and alcoholism. Identification and consideration of these risk factors is critical to successful periodontal treatment because they can affect the onset, the rate of

progression, and the severity of periodontal disease. These risk factors may determine treatment strategies and explain variability in the therapeutic responses of patients. Risk factor assessments can alter the way patients are viewed by the practitioner, leading to a decision process based on risk.

### **Link Between Diabetes and Periodontitis**

The link between periodontal and systemic health is a two-way street, particularly when it comes to periodontitis and diabetes mellitus. There are a number of systemic diseases and conditions that can increase a patient's susceptibility to periodontitis, and one of the leading cause is diabetes mellitus. Diabetes mellitus and periodontitis are chronic diseases that result from various etiologic factors. Diabetes is the leading cause of blindness in adults, end-stage renal disease, cardiovascular complications, and nontraumatic amputations are additional complications. The Diabetes Control and Complications Trial (DCCT) found that improved control of blood glucose reduces the risk of a number of long-term complications, particularly retinopathy, nephropathy, and neuropathy. Although the biologic mechanisms linking periodontitis to impaired glucose metabolism have not been fully elucidated, a popular theory is that inflammatory mediators (particularly IL 6 and TNF  $\alpha$ ) generated within the inflamed periodontal tissues or in response to oral bacteria that translocate into the systemic circulation interfere with the actions of insulin receptors, thereby decreasing insulin sensitivity. Glucose can bind irreversibly to hemoglobin through a non enzymatic reaction to form glycosylated hemoglobin (HbA). Hemoglobin A1c, or HbA1c, is the major subfraction of HbA. HbA1c is considered as a beneficial indicator of long term

homeostasis, reflecting an average blood glucose concentration for the past 2-3 months.

Several techniques are used to measure hemoglobin A1c. Laboratories may use high performance liquid chromatography, immunoassay, enzymatic assay, capillary electrophoresis or boronate affinity chromatography. Point of care (e.g., doctor's office) devices use immunoassay boronate affinity chromatography.

Glycated serum protein levels are an emerging intermediate marker of control, but HbA1c levels are most commonly used today to determine long-term control in the diabetic patient. It is the primary objective of most physicians to keep these levels low to prevent long-term complications. Diabetes treatment guidelines are based primarily on the establishment and maintenance of HbA1c levels.

### **Signs and Symptoms**

It is important for dentists to recognize the classic signs and symptoms of diabetes, which should be taught as an integral part of the dental education process. Classic signs and symptoms include polydipsia, polyuria, nocturia, polyphagia, unexplained weight loss, general fatigue, and increases in infections. Other symptoms are leg cramps, numbness in the extremities, impotence, and blurred vision. Poor glycemic control is known to be a major risk factor for periodontitis.

### **Periodontitis—The Sixth Long-Term Complication of Diabetes.**

There exists a two-way street between diabetes and periodontal disease in that diabetics are at a greater risk for developing infections and these infections can impair a diabetic's metabolic control (12-13). The main mechanisms by which diabetes and periodontitis are related are via alterations in host

responses and collagen metabolism. The primary factor responsible for the development of diabetic complications is prolonged tissue exposure to hyperglycemia, which results in the production of advanced glycation end products (AGEs). There may be an increase in the local production of cytokines that enhance the inflammatory response, leading to connective tissue damage, bone resorption and delayed wound repair. Significantly higher cytokine levels have been found in the gingival crevicular fluid of diabetics when compared with non-diabetics, with both groups demonstrating periodontitis. Patients with diabetes have an increase in gingival crevicular fluid collagenase activity when compared with non-diabetics.

#### **The Dentist's Role in The Detection of Diabetes**

The dentist can be pivotal in the diagnosis of diabetes by recognizing tell-tale features of gingivitis and periodontitis that are consistent with diabetes-related conditioning of periodontal responses to plaque. Dentists should be suspicious of patients presenting with multiple periodontal abscesses, unusual gingival reddening or abnormal responses to plaque that persist after tooth debridement and plaque control, mobile teeth indicating bone loss. Oral symptoms reported by diabetic patients may include burning mouth, dry mouth and altered taste. These symptoms relate to neuropathy associated with diabetes.

A recent study conducted by Beikler (17) et al. found glucose levels in blood sampled after bleeding on periodontal probing had a high correlation with blood samples taken from fingertips. This work suggests that the general dentist could use gingival blood samples in glucose self-monitoring devices as a simple screening method

to detect undiagnosed diabetics and identify patients with poor metabolic control.

Several trials by Katz et al(18). on a large scale demonstrated that patients who presented abnormally high blood glucose levels had a significantly higher odd to manifest severe periodontitis. More specifically, Katz et al. found that patients with hyperglycemia presented a double risk for having severe periodontitis compared with those who presented normal glucose levels, supporting the evidence of a two-way relationship between periodontitis and elevated glucose level.

#### **Conclusion**

If your eyes are the window to your soul, then your mouth is a mirror of your health. Although that idea may seem farfetched, health experts believe that good oral health care does more than prevent tooth decay and gum disease.

"Any disease related to the oral cavity has an impact elsewhere in the body". Oral health does not mean only an attractive smile; the term encompasses a comprehensive view of the oral cavity under physiological conditions. Today we know that pathologies in this area can affect the overall condition of the body, and the connection is evaluated in the context of many systemic diseases. As stated by Desiderius Erasmus, "Prevention is better than cure". Periodontal diseases are a major concern. Important factors to consider in assessing the periodontal status of patients with diabetes are the patient's degree of metabolic control, the duration of the disease, the presence of other long-term complications, and concurrent risk factors.

Therapeutic strategies should include reduction of bacterial infection, modulation of the host response, and risk reduction to help improve

therapeutic outcomes in the susceptible diabetic patient. Improving diagnostics is important for early detection and intervention. In addition, for improved patient care, treatment plans should be individualized, patient education and motivation are paramount, and routine maintenance is necessary.

Although periodontal diagnostic testing initially served to delimit patients at higher risk for developing this disease, the future of these laboratory tests is now extended to patients at risk of developing systemic diseases caused by periodontitis, and if this risk is confirmed, the disease may be reduced by an effective treatment. There is an undeniable link between diabetes mellitus and periodontitis with complex interactions occurring between these diseases. The well-informed dentist has the opportunity to be at the forefront of diagnosing diabetes; The associations between diabetes mellitus and periodontitis in the hope of arming the clinician with the knowledge to provide the diabetic patient with the best possible dental care and advice Finding suitable markers, whether for early diagnosis, exacerbation or other consequences of this disease would mean not only a reduction of the suffering of more than tens of millions of people around the world, but also be reasonable for the treatment. The data emerging from studies of diabetic patients are important for establishing the absolute necessity for periodontal health. The treatment of periodontal disease should not be considered an option or elective and the demand for preventive care hence will increase. There is an urgent need for knowledge transfer, which will be facilitated by the integration of the emerging data and concepts into both dental and medical school curriculum at all levels.

To conclude, an accurate insight to evaluate signs and symptoms so as to prevent further damage. Oral physicians, dental professionals and general health professionals play an important role to detect preliminary signs and symptoms, as well as reduce the morbidity and further prognostic entity of the disease.

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