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BI - DIRECTIONAL RELATIONSHIP BETWEEN PERIODONTAL DISEASE APICAL PERIODONTITIS AND DIABETES MELLITUS - A REVIEW

Dentistry

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ABSTRACT

Diabetes mellitus has become a major global public health concern in recent years due to a notable rise in its prevalence. When age, ethnicity, education, sex, and smoking were taken into account, the prevalence of severe periodontitis was substantially greater in persons with a HbA1c level of >9% in the US National Health and Nutrition Examination Survey (NHANES) III than in those without diabetes (OR 2.90; 95% CI 1.40, 6.03). Dry mouth (xerostomia), tooth decay (including root caries), gingivitis, periodontal disease, oral candidiasis, burning mouth (particularly glossodynia), altered taste, geographic tongue, coated and fissured tongue, oral lichen planus (OLP), recurrent aphthous stomatitis, abnormal wound healing, and increased susceptibility to infections are some of the oral symptoms and complications associated with diabetes mellitus. This review focuses on relationship between diabetes mellitus on periodontal tissue and its influence on apical periodontitis.

KEYWORDS

Diabetes; Diabetes mellitus; Periodontitis; Periodontal disease; Periodontal treatment; Apical periodontitis.

INTRODUCTION:

Diabetes mellitus (DM) is a chronic, complex disease that involves numerous pathophysiological features. Between 1990 and 2022, the prevalence of this condition in the adult population increased from 7% to 14%. Persistent hyperglycaemia is responsible for various types of organ and tissue damage in diabetic patients that results in long-term, systemic, debilitating complications.[1] Dry mouth (xerostomia), tooth decay (including root caries), periapical lesions, gingivitis, periodontal disease, oral candidiasis, burning mouth (particularly glossodynia), altered taste, geographic tongue, coated and fissured tongue, oral lichen planus (OLP), recurrent aphthous stomatitis, increased susceptibility to infections, and impaired wound healing are some of the oral manifestations and complications associated with diabetes mellitus.

The relationship between oral health and diabetes has been investigated widely, especially its association with periodontal disease and dental caries. [2]

Two important oral diseases currently contribute to the global burden of chronic disease, one of which is periodontal disease and other includes apical periodontitis.[3] While periodontitis is inflammation of the tissues surrounding and supporting the teeth, which frequently results in gum disease and bone loss, apical periodontitis is inflammation of the tissues at the root tip brought on by a pulp infection.

Diabetes Mellitus

Diabetes mellitus has emerged as a significant global public health concern with a remarkable increase in its prevalence. Chronic hyperglycemia, which arises from deficiencies in insulin secretion, insulin action, or both, is the primary characteristic of diabetes mellitus, a set of illnesses affecting the metabolism of carbohydrates. Notably, insulin plays an important role as an anabolic hormone, affecting the metabolism of carbohydrates, lipids, and proteins [4]. The metabolic abnormalities associated with diabetes mainly affect tissues such as adipose tissue, skeletal muscles, and the liver due to insulin resistance. Xerostomia, dental caries, gingivitis, periodontal disease, an increased risk of oral infections, burning mouth, taste alteration, and poor wound healing are some of the significant oral symptoms and problems associated with diabetes.

Classification Of Diabetes Mellitus

Type 1 Diabetes

This type of diabetes mellitus is also called autoimmune diabetes and previously known as juvenile-onset or ketosisprone diabetes. Type 1 is usually characterized by the presence of anti–glutamic acid decarboxylase, islet cell or insulin antibodies which identify the autoimmune processes which leads to beta-cell destruction.[5] Type 1 diabetes (due to the destruction of b-cell which is usually leading to absolute insulin deficiency) (American Diabetes Association, 2014).

Markers of immune destruction, including islet cell auto-antibodies, and/or auto antibodies to insulin, and auto antibodies to glutamic acid decarboxylase (GAD) are present in 85-90 % of individuals with Type 1 diabetes mellitus when fasting diabetic hyperglycemia is initially detected [6]. The exact cause of diabetes mellitus is remains unknown, although, in most people, there is evidence of an autoimmune mechanism involving auto-antibodies that destroy the beta islet cells [7]. Caries and periodontal disease are two oral infectious illnesses with tissue-degradative characteristics that are more likely to develop in T1 diabetes mellitus patients. Reduced salivary flow, a typical occurrence in people with type 1 diabetes, lowers the salivary buffer and remineralization capacities and raises the risk of developing gingivitis and caries lesions.

Type 2 Diabetes Mellitus

Type 2 diabetes mellitus is also known as adult-onset diabetes. The progressive insulin secretary defect on the background of insulin resistance (American Diabetes Association, 2014) [8]. NIDDM is characterized by impaired carbohydrate, lipid, and protein metabolism due to diminished insulin secretion, insulin resistance, or a combination of both. The main cause of this condition is the progressive impairment of insulin secretion from the beta cells of the pancreas, usually in skeletal muscle, liver, and adipose tissue, which is known as insulin resistance.[9]

Periodontal Disease

Periodontal diseases are disease processes involving the periodontium, a term used to describe the supportive apparatus surrounding a tooth, which includes the gingival tissue, alveolar bone, cementum, and periodontal ligament.

Periodontitis is when the periodontal condition has progressed beyond gingivitis into a chronic, destructive, irreversible inflammatory disease state. The bacteria then can penetrate deeper into the tissues and surrounding periodontium. This triggers a host response in an attempt to defend against the invading bacteria. Periodontitis leads to loss of attachment of the periodontium, which subsequently progresses to alveolar bone loss, potentially resulting in loss of the affected tooth [10 11 12]

Investigations have demonstrated associations between periodontitis and various systemic diseases[13 14] such as cardiovascular disorders[15 16], respiratory diseases, osteoporosis, immunodeficiencies and also diabetes mellitus. [17]

Interrelationship Between Periodontitis And Diabetes

Diabetes has been associated to different oral diseases such as salivary and taste dysfunction, oral bacterial and fungal infections (*i.e.*, candidiasis), and oral mucosa lesions (*i.e.*, stomatitis, geographic tongue, traumatic ulcer, lichen planus..)[18 19]. Diminished salivary flow and burning mouth are other oral characteristics in diabetic patients with poor glycemic control.

Evidence suggests that diabetes leads to worsening of periodontal disease, and a significant association between diabetes and periodontitis has been demonstrated.

Lalla *et al* [20] determined the prevalence of periodontitis in different age cohorts. It was 4.8 times higher among diabetic patients compared to non diabetics when the 15 to 24-year age cohort was considered, and 2.3 higher in the 25-34 year group. Also, CAL was higher in diabetic patients when the 15 to 55-year age cohort was considered. Lim *et al*[21] estimated that the glycemic control was the most important risk factor related to severity and extent of periodontitis. Other authors like Lalla *et al*[20] established that the rate of periodontal destruction is related to inappropriate glycemic control in diabetic patients so that accurate metabolic control could be important to prevent periodontal complications. Thus, glycemic control and the diabetes onset are critical factors in periodontal disease progression but it should be considered that substantial heterogeneity exists within diabetics[22]

A two-way association between Type 2 diabetes mellitus and periodontitis has been reported, with a significantly higher prevalence of periodontitis in patients with Type 2 diabetes mellitus and vice versa. A significantly worse periodontal status, as reflected by deeper periodontal pockets and more attachment loss, was found in patients with Type 2 diabetes mellitus compared to those without Type 2 diabetes mellitus. [23]

It has been demonstrated that intensive periodontal care (by scaling, subgingival curettage, periodontal surgery and maintenance care) for 12 months may obviously decreased the HbA1c levels by 0.5%, relative to scaling only group in Type 2 diabetes mellitus patients with moderate to severe periodontitis.[24]

Other report also suggests that periodontal treatment with subgingival instrumentation may reduce the HbA1c levels by 0.3 to 0.5% after 3 to 12 months of follow up. A 36 months follow-up study in Sweden found that Type 2 diabetes mellitus patients showed a reduction of HbA1c value after non-surgical and surgical periodontal treatment. However, 3 to 12 months after periodontal surgery, the HbA1c level decreased in Type 1 diabetes mellitus patients, but not in Type 2 diabetes mellitus patients as studied in Lithuania.[25]

Simpson et al. collected the data of 35 studies with 3249 participants and found that periodontal treatment really reduces the HbA1c value 3 to 6 months after treatment in Type 2 diabetes mellitus patients.[26]

This indicates that in untreated periodontitis and apical periodontitis (AP), the infection of pathogenic microorganisms in the periodontium and root canal may induce inflammatory mediators' production, hyperlipidemia. Further bacterial invasion and systemic inflammation may affect the blood sugar control, and provoke the exacerbation and complications of DM.

The Association Between Apical Periodontitis And Diabetes Mellitus

Apical periodontitis is the local inflammation of the periapical tissues that originate from pulp disease. Severe inflammatory reactions can lead to pulpal cell injury, potentially compromising pulpal vitality and survivability. Although the infection activates an immune response, immune cells and molecules are unable to effectively penetrate dentin to remove pathogens due to the narrow apical foramen of the tooth and the hard enamel surrounding the internal structures.[27]

In addition to systemic diseases, apical periodontitis can also be affected by periodontal disease. Conversely, apical periodontitis can lead to destruction of surrounding periodontal tissues, resulting in periodontal disease. Although many microbial pathogens are common in both periodontal disease and apical periodontitis.

Segura-Egea JJ et al showed that 7% of teeth in diabetic patients had apical periodontitis compared to 4% in those individuals without diabetes.[28] Yip N et al reported that 14.6% of those with apical periodontitis had Type 2 diabetes mellitus, which is about twice as many as those without apical periodontitis (7.6%).[29] Furthermore, apical periodontitis was also found to be more severe in those with poor glycemic control. All of these studies suggest that the prevalence of apical periodontitis is indeed higher in patients with diabetes and that Type 2 diabetes mellitus and poor glycemic control are significantly associated with apical periodontitis.[30]

Periapical healing was significantly less in the diabetic group compared to the non-diabetic group. In addition, the HbA1c levels were found to increase at each follow-up after RCT in the diabetic group.[31]

CONCLUSION:

We can draw the following conclusions within the parameters of this review: Diabetes mellitus is one of the systemic illnesses associated with periodontitis and apical periodontitis, relatively widespread infectious disease. Numerous oral conditions, including xerostomia, neurosensory abnormalities, various diseases of the oral mucosa, tooth decay, and periodontal disease, have been linked to diabetes. Diabetes mellitus may have an impact on the tissue repair, inflammation, and infection of apical periodontitis and periodontitis. By altering pathogenic bacteria, impairing neutrophil activity, host immunological responses, cytokine generation, and inducing oxidative stress, diabetes mellitus may have an impact on periodontal and periapical disorders.

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