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Do Periodontal Disease and Diabetes go Hand in Hand?

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Abstract:-According to the American Diabetes Association, periodontitis is the sixth most common complication of diabetes. Detecting the relationship between Periodontal (PD) and Diabetes Mellitus (DM) has been conducted in numerous studies over the last 50 years. PD has adverse effects on glycemic control, and DM exaggerates PD, compromising overall health. In that both diseases have immunity as their underlying cause, and both are affected by the severity of the other, both share a similar pathophysiology. In both DM and PD, there is a long-term effect on the standard of living if left untreated. In this article, we intend to introduce the interrelationship between periodontal disease and diabetes, which is believed to occur because of the alterations in the metabolic environment of the body caused by diabetes mellitus.

Keywords:-*Periodontitis, Diabetes Mellitius, Lipopolysaccharides, Glycated Hemoglobin.*

I. INTRODUCTION

Periodontitis (PD) and Diabetes Mellitus (DM) are both pyogenic disorders associated with immune-regulatory dysfunction. There is an apparent inter-relationship between these two diseases due to their relatively high incidences in the world population and their similar pathogenetic origins. However, some authors agree otherwise[1]. It is characterized by excessive insulin secretion, leading to hyperglycemia as the body is unable to absorb glucose from the bloodstream into the tissues. Consequently, the body then excretes sugar in urine and blood glucose levels rise[2]. A progressive loss of teeth and bone occurs due to PD as an infectious disease that results in inflammation of the support tissues of teeth[3] . The majority of the damage to connective tissues that occurs in a periodontal disease is caused by bacteria and their products interacting with mononuclear cells[4]. The American Diabetes Association lists periodontitis as a risk factor for diabetics, and clinical researchers have long recognized diabetes as a risk factor for PD in adults. Periodontal disease is also a sixth complication of diabetes mellitus[5]. Researchers included DM-associated gingivitis in the most recent classification of PD. A variety of studies conducted by the WHO suggest that PD is more prevalent and severe among adults than among younger people. Over 62 million Indians suffer from DM, which accounts for more than 7.1% of the India's adult population. In the US, only 9.6% of the population is affected by DM[6]. DM has profound effects on the oral cavity, especially the periodontium, and the dentist is often the first health care provider to encounter a patient suffering from an undiagnosed or untreated condition. In most cases, the dentist will help diabetic patients with their oral health[7].

II. AN ANALYSIS OF ORAL MICROBIOTA IN DIABETICS

Some microbial species may grow more readily in an environment associated with diabetes. Diabetes is associated with elevated levels of urea and glucose in the crevicular fluid[8]. Researchers have found that inflammating gums have a lower glucose concentration than healthy gums, which indicates that serum glucose may be utilised by inflamed gum tissues[9]. When rats receive experimental diabetes, their subgingival flora changes from a nearly equal ratio of Grampositive and Gramnegativecocci to predominantly Gramnegative rods and filaments and the resulting periodontally deepened pockets are well documented[10]. Approximately 24% of the cultivable flora in periodontal lesions of young patients with insulin-dependent diabetes mellitus (IDDM) belonged to Capnocytophaga species, as reported by Mashimoet al[11]. Three of nine diabetics with

periodontitis were colonized with Aggregatibacteractinomycetemcomitans, and neither gingivitis nor normal periodontal tissues contained the bacteria[12]. Capnocytophaga species are not associated with periodontitis in Type I diabetics, according to a number of subsequent studies[13]. The authors found P. intermedia, W. recta, and P. gingivalis as the 3 most predominant pathogens in subgingival dental plaque of non-insulin dependent diabetes mellitus (NIDDM) patients[14]. A high risk of periodontitis is known to be associated with patients with poorly controlled diabetes. Since there is no relationship between having periodontitis and metabolic control of diabetes, it is likely that this disease is a consequence of factors other than greater pathogenesis of subgingival flora in poorly controlled diabetics[15].

- ***Systemic inflammation and periodontal disease***

In addition to understanding periodontal disease pathophysiology and treatment options, subgingival dental plaque has been recognized as a microbial biofilm[16]. In addition to causing gingivitis and periodontitis, Diabetes can also increase their severity. Contrary to what may be thought, diabetic complications may also worsen as a consequence of periodontitis[17]. In addition, periodontal bacteria shed lipopolysaccharide (LPS), causing the endothelium to become reactive and activating a pro-inflammatory cascade with sustained elevations of pro-inflammatory cytokines.Interleukin-1ß (IL-1), interleukin-6 (IL-6), Tumor necrosis factor-α (TNF) and prostaglandin-E2 (PGE2) in turn signals different target cells and tissues, such as the liver to produce an acute-phase response, and pancreatic beta cells and adipose tissue affecting functions such as insulin sensitivity and glucose transport[8,18]. Developing a subgingival biofilm seems to be a convenient adaptation to permit microbial survival even when fully exposed to the host's defenses over the long term. Periodontal disease is caused by Porphyromonasgingivalis, as opposed to just being associated with it. As a pathogen, P. gingivalis is able to produce virulence factors and extracellular proteases that provide a source of nutrients that enable the subgingival plaque community to grow and persist[19]. Despite its endotoxic nature, P. gingivalissubgingival LPS also exhibits immunological properties. Particularly, P. gingivalis LPS is an efficient nuclear factor-kappaB (NF-kappaB) inducer. The LPS produced by P. gingivalis activates a proinflammatory response by directly affecting endothelial cells. The invasion of endothelial cells by P. gingivalishas recently been demonstrated[19]. The persistent elevation of IL-1, IL-6, and TNF in type 2 diabetes affects the liver, stimulates the release of acute-phase proteins, changes lipid metabolism, and affects the beta cells in the pancreas as well. An enlarged inflammatory response seen in diabetes is believed to be responsible for lipid dysregulation, insulin resistance, and microvascular long-term complications. In diabetics, persistent elevation of these mediators may also be caused by reduced physical activity, poor eating habits, and infection[20]. We found a significantly higher percentage of Prevotellaintermedia at deep pockets and attachment loss sites[21]. The goal of the study was to identify the association between diabetic Hispanics' periodontal status, their periodontal bacteria, and their type 2 host response patterns. In order to determine the prevalence of type 2 diabetes among Hispanic Americans, 63 plaques and serum samples were collected. It is possible that diabetes influences how periodontal bacteria exert their pathogenic potential as well as the host's inflammatory response, leading to an altered homeostasis of the periodontium[22].

- ***Diabetes and periodontal health***

An explanation for this relationship can be found in the data showing that diabetes is associated with gingivitis and periodontitis and that glycemic control is a key factor in this relationship. There has been some debate if diabetes and gingival inflammation are significantly associated, however, many studies have demonstrated that the severity of gingivitis and its prevalence is higher in individuals with diabetes[23]. A study carried out by the NHANES III, reports patients with good glycemic control (HbA1c ≤ 9%) had better periodontal prognosis than patients with poor glycemic control (HbA1c> 9%), suggesting a dose response relationship between glycemic control and periodontitis[24]. It has been observed that PD is a possible risk factor for poor metabolic control in diabetic subjects, as have a number of oral diseases associated with DM. Diabetic symptoms can be seen as early as periodontal disease[25]. Longitudinal research has also shown an increasedrisk of progressive periodontal destruction in people with diabetes. A study of 2,273 individuals 15 years or older found that periodontal disease was prevalent among the Pima Indians. There was a 60% prevalence of periodontitis among diabetics and 36% among non-diabetics[26]. According to an additional longitudinal study conducted over two years, subjects with type 2 diabetes were four times more likely to suffer progressive alveolar bone loss than subjects without the disease.loss than subjects without the disease. It is difficult to determine conclusively what relationship metabolic control of diabetes has with periodontal disease[27]. In other words, glycemic regulation is often associated with retinopathy and nephropathy, suggesting that diabetic populations are highly heterogeneous. As a result, despite diabetes complications clearly increasing with poor control, many people with poorly controlled diabetes do not experience major health problems. It has also been demonstrated that some diabetic patients suffering from poor glycemic control may suffer from extensive periodontal damage, while others may not. Conversely, some diabetics with excellent periodontal health, but others develop periodontitis[28]. In a study by Ervasti and colleagues, 50 adult diabetics and 53 healthy controls were compared to find out how their periodontal health fared. Diabetes patients were further subdivided according to their level of controlled diabetes. A correlation was not found between the duration of diabetes, its complications, and its medication and bleeding gums. A poorly controlled diabetic with increased bleeding could either have inflammation or vascular changes in the gingiva[29]. There is an association between diabetes and an increase in periodontitis risk even in children. Researchers at Lalla et al. surveyed children (6-18 years old) on early childhood bone loss and diabetes mellitus. A study found an association between diabetes and periodontal damage, suggesting it should be standard of care

to treat periodontal needs among diabetic youth[30]. Periodontitis is associated with insulin-dependent diabetes mellitus (IDDM), also known as Type 1 diabetes. Cells isolated from diabetic patients showed significantly lower alkaline phosphatase activities when exposed to TGF, Platelet-derived growth factor-BB (PDGF-BB), Insulin like growth factor-1 (IGF-1) or PDGF-BB + IGF-1 together. In insulin-dependent diabetics, periodontal ligamental cell populations may not be capable of forming mineralized tissues or responding to growth factors, which are necessary and critical for maintaining and regenerating the periodontium[31]. Diabetic periodontitis is possibly caused by vascular changes, neutrophil dysfunction, altered collagen synthesis, and genetic predispositions.

- ***A change in the vasculature***

Long-term hyperglycemia is the major factor in the development of diabetic vascular abnormalities. Specifically, the vascular pathophysiologic changes include accumulations of Periodic acid-Schiff (PAS)-positive deposits of carbohydrate-containing plasma proteins, matrix expansion of vessel walls, and cellular proliferation and proliferation of other cell types. Basement membrane thickening is the most basic structural change in small blood vessels[32]. Patients with diabetes not only have significantly thicker gingival capillaries, but they also have other abnormalities such as a disruption of the true membrane, collagen fibers inside, and swelling of endothelium. It has been proposed that diabetic patients' elevated levels of metabolite wastes may impede oxygen diffusion, metabolite separation, leukocyte migration, nutrient delivery and immune factor diffusion[33,34], which may result in worsening periodontitis and delayed healing.

- ***Dysfunction in neutrophils - Defects in the host response***

Studies have determined that a number of defects in polymorphonuclear leukocytes (PMNs) function, such as
impaired migration, phagocytosis, intracellular killing, and chemotaxis, may cause bacterial infections in diabetic individuals[35]. Among non-diabetic, first-degree relatives of diabetics, Molenaaret al. found a similar decrease in chemotactic index. Studies have shown that insulin therapy can correct abnormal PMN functions[36]. There has been evidence showing diabetics with severe periodontitis exhibit reduced peripheral blood leukocyte chemotaxis as compared to diabetics with mild periodontitis or non-diabetics with severe or mild periodontitis. According to McMullen and coworkers, decrease PMN chemotaxis may be a consequence of genetic factors in patients who have a family history of diabetes and severe periodontitis[37]. Diabetic patients with abnormal PMN function might be predisposed to periodontitis by two factors: 1) Bacterial infection associated with periodontal disease; or 2) Primary dysfunction of the PMN response. An IDDM patient's PMNs showed lowered chemotaxis of a putative periodonttal pathogen found at the periodontal destruction site with decreased phagocytosis by Cutler et al[38].

- ***Metabolic processes involved in collagen formation***

Alveolar bone is composed of 90% organic matrix and 60% connective tissue, which is composed of collagen. Diabetes would be expected to alter collagen metabolism, leading to periodontal disease progression and impaired wound healing[27]. Golub and his team found that diabetes reduced osteoblastic collagen production and gingival Collagenase activity[39]. It is also possible that under certain circumstances, the increased collagenase activity is due to the neutrophil type of collagenase (MMP-8) that is secreted by fibroblast[40]. Glucose-derived crosslinks between collagen molecules reduce its solubility and turnover rate when exposed to a hyperglycaemic environment. An insulin treatment can restore near-normal solubility properties to diabetic gingival collagen[39].

- ***Predisposition to genetic disorders***

Several human lymphocyte antigens (HLAs) are associated with type I diabetes. It has been found that IDDM is strongly associated with HLA-B8 and B15. DR3 and DR4 antigens also exhibit strong HLA associations. A large majority of IDDMs are either DR3 or DR4 or both35. HLA-DR4 was found in 80% of non-diabetic patients with aggressive periodontitis, while that antigen was only found in 38% of the control population, which suggests that it may act as a risk factor for development of periodontitis[15]. Within a control population, 30% of people had DR4. It has been suggested that HLA-DR4 molecule expression on peripheral blood antigen cells can indicate increased susceptibility to periodontitis. However, further studies are required to clarify how this antigen affects diabetics' periodontal disease[15]. Diabetes appears to increase the risk of periodontitis through unknown mechanisms. The extent and severity of periodontitis, metabolic control, and duration of the condition are all key variables. There are differences among diabetics in regards to changes in vascular function, neutrophil dysfunction, and genetic predisposition[15].

- ***Treatment effectiveness with periodontal therapy in patients with diabetes***

First and foremost, dental treatment for patients with DM should aim to control acute oral infections. The periodontal condition of the patient should be discussed with the physician, because infections, such as advanced periodontal disease, can worsen diabetes. According to a pilot study conducted by Miller, the reduction of inflammation is correlated with lowered blood glucose levels in poorly-controlled diabetic subjects (measured by bleeding on probing)[41]. In this study, 75 patients suffering from DM (59% of them with IDDM, 41% with NIDDM) were examined. Glycosylated hemoglobin was used to monitor blood glucose. Both groups of patients with poor diabetic control had comparable levels of plaque control though the patients with poor diabetic control had significantly more calculus. The world is home to many chronic diseases, such as diabetes mellitus and periodontal disease. Periodontal infection may adversely affect glycemic control in people with diabetes. According to Taylor, periodontal diseases affect glycemic control. People with diabetes can benefit from oral examinations and periodontal care when managing their diabetes. A patients' glycemic

control level should be assessed and they should be counseled about the importance of referring them for thorough oral health evaluations and necessary treatment[42].

· ***Diabetic patients and periodontal disease treatment***

In addition to its detrimental effects on the patient, subgingival biofilms are notoriously difficult to remove due to their resistance to normal host defenses. The biofilms within the gingiva cannot be removed by daily oral hygiene methods and must be physically removed. Periodontitis treatment includes mechanical scaling and root planing because of this reason[43]. When the patient is suffering from DM, periodontal infection poses an even greater health risk, as it does with patients who suffer from periodontal disease. Infections caused by periodontal disease and biofilm formation are recurrent infections[43]. Therefore, a near-ideal oral hygiene is essential to reduce dental plaque re-formation and to prevent the formation of dental bones and their deterioration[44]. Furthermore, various studies indicate that periodontal therapy can have a moderate effect on DM control and vice versa.

III. CONCLUSION

The development of complications associated with diabetes, such as PD, is complicated due to significant variations in the disease. Diabetes mellitus and periodontal disease have many similarities in pathophysiology and are highly prevalent chronic diseases. Diabetes with prolonged duration, poor metabolism, and poor controls on insulin are known to increase the risk of Parkinson's disease. As we age, both DM and PD increase. There is no doubt that diabetes increases the risk of periodontal diseases; however, it is less clear how periodontal diseases affect the glycemic control of diabetes and how they do so. Similarly to obesity, periodontal diseases can cause insulin resistance and complicate glycemic control. A greater understanding of the connection between periodontal disease and diabetes requires further study.

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