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Julia Garza Villarreal
Master of Sciences Student, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, CP, Mexico

Fanny Lopez Martinez
Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Idalia Rodriguez Delgado
Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Fatima Del Muro Casas
Professor, Universidad Autonoma de Zacatecas, Unidad Academica de Odontologia, Zacatecas, Zacatecas, Mexico

Nelly Alejandra Rodriguez Guajardo
Professor, Universidad Autonoma de Zacatecas, Unidad Academica de Odontologia, Zacatecas, Zacatecas, Mexico

Maria Argelia Akemi Nakagoshi Cepeda
Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Leslie Flores Eguia
Dentistry student, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Juan Manuel Solis Soto
Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Corresponding Author:
Juan Manuel Solis Soto
Professor, Universidad Autonoma de Nuevo Leon, Facultad de Odontologia, Monterrey, Nuevo Leon, Mexico

Oral manifestations of Type I diabetes mellitus in pediatric patients

Julia Garza Villarreal, Fanny Lopez Martinez, Idalia Rodriguez Delgado, Fatima Del Muro Casas, Nelly Alejandra Rodriguez Guajardo, Maria Argelia Akemi Nakagoshi Cepeda, Leslie Flores Eguia and Juan Manuel Solis Soto

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Abstract
Introducción: Diabetes mellitus is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. There is a significant relationship between type 1 diabetes mellitus (T1DM) and an increased prevalence of oral cavity-related diseases in the pediatric population.
Objective: To analyze the literature and describe T1DM and its oral manifestations, including alterations in saliva and dentobacterial plaque, as well as periodontal disease and caries, and to emphasize its importance in pediatric dentistry.
Methodology: An exhaustive search was carried out in PubMed with the keywords Type I diabetes Mellitus, children, oral manifestations, caries, periodontal disease, gingivitis, xerostomia, pediatric dentistry, candida.
Results: Salivary flow could be considered decreased with T1DM. Higher plaque levels and higher incidence of chronic gingivitis. Higher risk of developing periodontal disease. Higher caries levels, higher prevalence of xerostomia. Insulin treatment may cause local reactions such as lipohypertrophy, lipoatrophy and instant and delayed allergy. Erythema multiforme, leukocytoclastic vasculitis, drug eruptions and photosensitivity have been described as adverse reactions to oral antidiabetics.
Conclusion: Childhood and adolescent patients with T1DM have a predisposition to xerostomia and this leads to halitosis and a favorable environment for the proliferation of bacteria and the formation of dental caries, they present greater accumulation of plaque and therefore are susceptible to gingival inflammation and this ends in periodontal disease at an early age producing bone loss. Patients receiving insulin often present skin lesions. Medications can immunosuppress and this makes them susceptible to Candida.

Keywords: Type I diabetes mellitus, children, oral manifestations, caries, periodontal disease, gingivitis, xerostomia, pediatric dentistry, candida

1. Introduction
Diabetes mellitus (DM) is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both [1]. Type 1 diabetes mellitus (T1DM) is one of the most common chronic diseases in childhood resulting from autoimmune destruction of β cells [2]. T1DM requires a demanding and slow treatment regimen that includes blood glucose monitoring, multiple doses of insulin, carbohydrate counting and physical activity [3]. According to statistics from the International Diabetes Federation (IDF) the global prevalence of diabetes is about 9.3% (463 million people) in 2019, and is projected to increase to 10.2% (578 million people) in 2030 and 10.9% (700 million people) by 2045 [4]. The prevalence of T1DM in very young (6-year-old) children (YC-DT1) was approximately 3.6% of cases in 2009 (but the incidence of YC-DT1 may be increasing by as much as 5.4% per year). The public health impact of this trend is of concern, as these patients will have YC-DT1 longer, enduring more exposure to risks of long-term complications [5]. Each year, more than 3,000 children and adolescents under the age of 15 years, approximately 23 out of every 100,000, are newly diagnosed with T1DM [6].

There is a significant relationship between diabetes mellitus and an increased prevalence of oral cavity-related diseases in the pediatric population [7]. Periodontal disease comprises a group of conditions affecting the gingiva, periodontal ligament, cementum, alveolar bone and tissue structures supporting the teeth. The predominant form of periodontal disease in children and adolescents is gingivitis [8]. Dental caries is a complex, dynamic and multifactorial disease. Numerous risk factors contribute to dental caries, host susceptibility, dysbiotic microbiota and frequent intake of dietary sugars [9]. Poorly controlled diabetic children exhibit a higher gingival index, plaque index and salivary glucose concentration along with decreased salivary flow and salivary pH. As such, these children fall into a high-risk category for dental caries according to the American Academy of Pediatric Dentistry [10].

In dental practice, we encounter complications that can reduce the success rate of treatment. The percentage of children with type I Diabetes mellitus is increasing, which is a challenge for the pediatric dentist as they present a series of oral manifestations that must be taken into account when providing clinical care, The objective of this review is to analyze the literature and describe diabetes mellitus type I, as well as its oral manifestations, among which are studied the alterations in saliva and plaque, as well as periodontal disease and caries, and to emphasize the importance in pediatric dentistry.

2. Materials and methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion. It was assessed using the measurement tool for evaluating systematic reviews. The search was performed using Boolean logical operators AND, OR and NOT; with the keywords: “Type I diabetes mellitus”, “children”, “oral manifestations”, “caries”, “periodontal disease”, “gingivitis”, “xerostomia”, “pediatric dentistry”, “candida”. The keywords were used individually, as well as each of them related to each other.

3. Results & Discussion

3.1 Saliva

The oral microbiota in children with T1DM is significantly different quantitatively compared to healthy children. There are also visible qualitative differences in the oral microbiota profile in type 1 diabetic children and healthy children [11]. Salivary flow could be considered decreased with T1DM [12]. The prevalence of decayed, missing and filled teeth with respect to salivary properties was higher in leukemic patients followed in descending order by diabetic and asthmatic patients [13]. Regarding buffering capacity, children with T1DM have a low buffering capacity, while children in the control group have a high buffering capacity [14]. These patients were associated with more risk factors for the development of dental caries, a lower saliva flow rate and a higher bacterial load in saliva and dental biofilm [15]. It was indicated that an increased value of interleukin-18 in oral fluid is associated with the presence of diabetes mellitus in children. Furthermore, this cytokine can be considered a potential biomarker of gum inflammation in children with diabetes mellitus [16]. Salivary cytokine levels were higher in children with T1DM than in non-diabetic children [17]. Both salivary cholesterol and triglyceride levels were significantly higher in children with T1DM. Salivary triglycerides showed a significant association with dental caries in these children [18]. The findings suggest that salivary glucose concentrations may be useful in monitoring glycemia in T1DM [19].

Due to T1DM, the amount of salivary flow is decreased, not significantly, which makes us have to teach and train the patient and/or parents depending on the age, with the techniques of prevention and early detection of pathologies or lesions.

3.2 Dental plaque

Many studies confirmed higher plaque levels and a higher incidence of chronic gingivitis in both adults and children with diabetes [20]. Adolescents affected with T1DM show a higher level of bacterial plaque, gingival inflammation with bleeding on probing and probing depth, compared to healthy subjects [21]. Children with T1DM present worse periodontal health status [22], as well as presenting poor oral health status with higher plaque accumulation than children without diabetes [23]. The accumulation of bacterial biofilms in T1DM subjects may lead to more severe gingivitis, which in turn may increase the risk of developing periodontitis [24]. The prevalence of periodontal pathogens in diabetic and healthy children was 6% and 16% for E. corrodens, 18% and 36% for C. rectus, 2% and 2% for P. intermedia, 4% and 0% for P. nigrescens respectively. Statistically no significant difference was observed for the prevalence of the four periodontal pathogens between children with T1DM and healthy children [25]. Children with T1DM showed a continuous relationship between less favorable glycemic control and increased early markers of periodontal disease. Glycemic control was also related to the complexity and richness of the plaque microbiota, with diversity increasing as HbA1c levels increased [26]. The results of the present study showed more gingival changes and higher oral health literacy in the diabetic group compared to the control group [27].

Patients with T1DM present greater plaque accumulation than healthy patients, as well as greater probing depth, bleeding on probing and tooth brushing, and this plaque accumulation can lead to gingivitis and periodontal disease from an early age. This is related to poor control of the disease; patients with good control do not have significant data.

3.3 Periodontal disease

Patients with T1DM have a higher risk of developing periodontal disease than individuals without T1DM. Results further showed that the number of T1DM interventions, i.e., annual emergency visits and hospitalizations were associated with an increased risk of developing periodontal disease [28]. The instability in oxidative status that accompanies diabetes may be considered a significant pathogenic factor in diabetes-related periodontal inflammation [29]. A higher gingival index was found in diabetic patients compared to healthy children, which was not related to microbial plaque accumulation [30]. Analysis of gingival inflammation using GI and SBI gingival indices showed no statistically significant differences between the groups examined [31]. The periodontal conditions of patients with and without DM were similar, with no statistical differences in periodontal indices. When considering patients with gingivitis, all lipid parameters evaluated were higher in the DM group; Capnocytophaga sputigena and Capnocytophaga ochracea were more prevalent in the periodontal sites of children with DM. "Red complex" bacteria were detected at few sites in the DM and non-DM groups. Fusobacterium nucleatum and Campylobacter rectus

were frequently found in both groups [8]. The glycemic status of children affects periodontal disease parameters. Salivary alkaline phosphatase levels could be a useful tool to analyze the periodontal status of children with uncontrolled T1DM [32]. Although pubertal status, age and poor glycemic control rather than the presence of diabetes and its duration are associated with gingivitis and other forms of periodontal disease, puberty had a more profound effect on the pathogenesis of periodontal disease in T1DM [33]. Metabolic control had an impact on caries prevalence and gingival health in these patients, in case of permanent dentition. As glycemic control became poorer, the prevalence of caries and gingival inflammation increased. When primary dentition was taken into account, the correlation was not significant [34].

Patients with T1DM have a greater predisposition to develop periodontal disease at an early age, especially in poorly controlled patients, so it is recommended that parents be informed of this predisposition so that the professional can act and avoid periodontal problems, improving the quality of the patient's oral health throughout his or her life.

3.4 Caries

It appears that children with T1DM are exposed to a higher risk of caries and oral health than non-diabetic children [14]. Higher levels of caries, higher prevalence of xerostomia and decreased unstimulated salivary flow were reported in poorly controlled diabetics [35]. The parameters analyzed showed increased levels of salivary antioxidants, decreased salivary flow, increased incidence of dental caries, decreased salivary pH compared to the control group [36]. Dental caries in the primary dentition was lower in diabetic children, but was not statistically significant, while dental caries in the permanent dentition was significantly higher [37]. CRT analysis revealed a higher frequency of "critical" pH values (pH = 4.5-5.5) and higher Lactobacillus counts in diabetic children than in non-diabetic children, indicating a higher caries risk in the former group [38]. The level of decay-missing-filled teeth (DMFT), decay-missing-filled surfaces, and decay-missing-filled primary teeth (dmft) index was higher in children/adolescents with T1DM than in non-T1DM [12]. The prevalence of dental caries was high among children and adolescents with type 1 diabetes; preventive treatment should be included in the dental clinical routines for diabetic children and adolescents, especially in those with poor metabolic control [39]. Regarding the interaction of caries risk indicators and metabolic control on caries experience in diabetic children, the only variable that showed a significant effect was mutans streptococci [40].

It is concluded that patients with T1DM have a higher level of caries, which may be triggered by the xerostomia that is generally characteristic of T1DM, together with poor glycemic control. It is more evident in adolescents with permanent dentition than in children with primary dentition, due to the time elapsed with the disease and possible lack of control.

3.5 Other manifestations

The results imply that young people with T1DM have a lower level of oral hygiene and are potentially at higher risk for future oral diseases, particularly when their metabolic disorder is uncontrolled. However, factors outside the oral cavity may also have a considerable impact on the onset and progression of oral diseases [41]. The previously reported association between T1DM and periodontal bone loss is confirmed radiographically [42]. The dentition of the healthy control group showed no morphological alterations, while morphological alterations were observed in the dentition of the test group (DMT1 group) [43]. Candida spp. in uncompensated diabetes and in those using immunosuppressive treatment could intensify plaque-related gingivitis [44]. The antifungal resistance of Candida spp. isolates to ketoconazole from patients with T1DM was significantly higher than that of their matched control [45]. Insulin treatment can cause local reactions such as lipohypertrophy, lipoatrophy, and instant and delayed allergy. Erythema multiforme, leukocytoclastic vasculitis, drug eruptions and photosensitivity have been described as adverse reactions to oral antidiabetics [46]. Erosive esophagitis, a rare complication of diabetic pediatric ketoacidosis (DKA), may manifest with odynophagia or substernal chest pain. This complication can lead to recurrence of DKA, probably due to increased insulin resistance due to inflammation and pain and reduced oral intake and insulin administration. Patients with odynophagia associated with DKA should be closely monitored to allow for timely evaluation and treatment of esophagitis [47]. Burning in the mouth, as a result of diabetic neuropathy, and taste disturbance may also be observed. It has long been known that there is delayed wound healing in patients with diabetes, especially if uncontrolled [48].

Speaking of the complications of diabetic patients, conditions such as diabetic ketoacidosis can be triggered at an early age, therefore, the dentist should be aware of the problem as well as consider periodic controls to be able to intervene. It is important to recognize the oral manifestations due to the medications used by the patients, as well as to diagnose them correctly in order to treat them. Among the frequent manifestations are candidiasis in children.

4. Conclusions

Childhood and adolescent patients with T1DM have a predisposition to xerostomia and this leads to halitosis and a favorable environment for the proliferation of bacteria and the formation of dental caries. At the same time, they present greater accumulation of plaque and therefore are susceptible to gingival inflammation and this ends in periodontal disease at an early age producing bone loss. They are more susceptible to Candida due to immunosuppressive drugs. Patients with insulin treatment may present cutaneous manifestations. Oral antidiabetics can cause erythema multiforme, leukocytoclastic vasculitis, drug eruptions and photosensitivity. Pediatric dentists have the responsibility to educate the parents of diabetic children about the oral complications they may present, as well as to emphasize the importance of prevention and periodic visits. It is important to emphasize the clinical history, as well as to check glycemic values before complicated procedures.

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