Possible complications in oral surgery and their management in patients affected by type 1 diabetes: narrative review

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Abstract

Diabetes mellitus is a disease that affects millions of people worldwide, both in its juvenile form (type 1 diabetes) and in the form that affects adults and is related to lifestyle, diet, and sedentariness (type 2 diabetes). In addition to the disease itself, diabetes also includes various complications and, above all, creates a supportive environment for the development of further disorders and pathologies. Certain alterations favor oral pathologies in diabetic patients.
This narrative review aims to focus on diabetic patients and the possible oral complications that can occur in oral surgery sessions.
The MEDLINE database (NCBI PubMed and PMC) was employed to obtain sources of information. An online search was performed to select articles regarding complications in oral surgery for diabetic patients.
The search considered 52 articles using the following keywords: "diabetic patient," "complications," and "oral surgery."
Although it is not possible to establish with certainty what the predisposing factors are, the scientific literature shows that the altered composition of saliva, together with the reduced immune response against bacteria, determines a lower antibacterial capacity in diabetic patients and thus a higher frequency of inflammatory diseases caused by the accumulation of plaque and tartar; in particular, gingivitis, periodontitis, caries, aphthae or aphthous stomatitis, map tongue (benign migratory glossitis), xerostomia, tongue inflammation, and candidiasis.
In conclusion, the dentist must always take due account of all the needs of diabetic patients, trying to operate above all at the level of prevention and being aware of all the possible complications that diabetic patients could face during an oral surgery session.

Keywords: diabetes mellitus, oral surgery, complications, systemic diseases, dental implants.

Introduction

Diabetes mellitus refers to a cluster of metabolic disorders characterized by chronic hyperglycemia resulting from the body's inability to produce or effectively use insulin (Petersmann A. et al., 2019). In 2015, it was estimated that there were 415 million individuals aged between 20 and 79 with diabetes, a figure projected to reach 642 million by 2040 (Ogurtsova K. et al., 2017).
There are four main types of diabetes: type 1, type 2, gestational diabetes, and other types caused by various factors. Type 1 diabetes, an autoimmune condition, is marked by an absolute insulin deficiency due to the destruction of pancreatic beta-cells, commonly occurring in young individuals. In contrast, type 2 diabetes is characterized by insulin resistance and inadequate insulin secretion, typically affecting individuals in lat-

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er stages of life. Gestational diabetes involves impaired glucose regulation during pregnancy in previously unaffected individuals. Additionally, diabetes can arise from syndromes, diseases of the exocrine pancreas, or as a result of certain medications or chemicals (American Diabetes Association, 2020).

Diabetes diagnosis is based on glycemic criteria, including A1C levels, fasting plasma glucose (FPG), and 2-hour plasma glucose values (2-hour PG) during an oral glucose tolerance test (OGTT). Classic hyperglycemia or hyperglycemic crisis symptoms may also prompt diagnostic testing, with plasma glucose > 200 mg/dL considered causative. Confirmatory testing is necessary without definitive hyperglycemia (American Diabetes Association, 2015).

Management of type 1 diabetes involves insulin therapy, dietary adjustments, lifestyle modifications, and regular glucose monitoring to minimize the risk of serious complications (Haak T. et al., 2019). Type 2 diabetes treatment can be pharmacologic or nonpharmacologic, with weight loss, diet, and exercise being cornerstones of nonpharmacologic therapy. Metformin is often the first-line pharmacologic treatment due to its favorable effects on mortality, hypoglycemia risk, weight loss, and lipid profiles (Pfeiffer AF. Et al., 2014).

Microvascular and macrovascular complications are prevalent in type 2 diabetes, increasing the risk of retinopathy, cataracts, and glaucoma, which can lead to potential blindness (Chatterjee S. et al., 2017). Gestational diabetes management primarily focuses on nonpharmacologic interventions like physical activity and dietary modifications, with pharmacologic therapy reserved for cases unresponsive to lifestyle changes (Johns EC. et al., 2018).

Women with gestational diabetes face increased risks of complications during pregnancy and childbirth, including pre-eclampsia, cesarean delivery, and neonatal complications such as respiratory distress syndrome and hypoglycemia (HAPO Study Cooperative Research Group, 2008).

Diabetes management in the dental context is becoming more pertinent due to the aging population, necessitating dentists to address systemic conditions (Tetè et al., 2021). While oral surgery and implantology are feasible in diabetic patients (Ferrari Cagidiaco et al., 2018; Gherlone et al., 2022), intra- and post-operative complications remain possible. Therefore, this study aims to delineate potential complications in oral surgery and their management in type 1 diabetic patients.

Materials and methods

The MEDLINE database (NCBI PubMed and PMC) was employed to obtain sources of information. An online search was performed to select articles regarding complications in oral surgery for diabetic patients.

Randomized controlled trials (RCTs), prospective, observational, reviews, and retrospective studies were considered. Textbooks relevant to the topic were then examined, and the citations of each retrieved article and those of reviews and expert opinions were examined to include as much knowledge as possible, applying the keywords “diabetic patient,” “complications,” AND “oral surgery, 52 articles responded to the research topic.

Literature review on possible complications in oral surgery and their management in patients affected by type i diabetes

Clinical Manifestations of Diabetes in Oral Cavity

Diabetes mellitus presents a range of complications and manifestations within the oral cavity, including periodontal disease, periapical lesions, xerostomia, poor wound healing, glossitis, and taste changes (Mauri-Obradors E et al., 2017). The severity of these oral manifestations appears to be correlated with the duration of diabetes, its management approach, and the overall impact of the disease on the individual patient.

The relationship between diabetes and oral health is closely intertwined, as the pathophysiology of diabetes can lead to various oral manifestations. Improving the oral health status of patients with diabetes has been shown to contribute to better blood glucose control and prevent other potential complications (Ternois M., 2017).

Complications in the oral cavity can be linked to two possible mechanisms. The first mechanism involves the polyol pathway, where glucose is converted to sorbitol by aldose reductase, utilizing NADPH and leading to highly toxic oxidative stress. Sorbitol is subsequently converted to fructose, which accumulates and causes tissue damage. The second mechanism involves the accumulation of advanced glycosylation end products (AGEs), formed by the binding of glucose with proteins, lipids, and nucleic acids, resulting in structural and functional alterations (Mealey BL., 2000).

A. Diabetes and Periodontal Disease

Diabetes and periodontal disease share a close and bidirectional relationship. Extensive evidence in the literature demonstrates a significant association between diabetes and periodontitis, with greater severity of diabetes corresponding to a worsened course of periodontal disease and vice versa. Elevated levels of HbA1c, a marker of glycemic control, are correlated with an increased risk of periodontal disease and its characteristic signs (Borgnakke WS, 2019).

Diabetes is recognized as a risk factor for periodontal disease, as hyperglycemia exerts adverse effects on both the hard and soft tissues of the periodontium (Demmer RT, 2012). Conversely, periodontal disease is considered a risk factor for diabetes. In 1993, Löe designated periodontal disease as the “sixth complication of diabetes” (Löe H, 1993 - Hasuike A et al., 2017).

Periodontal disease triggers the production of various pro-inflammatory cytokines, such as IL-1β, IL-6, and TNF-α, contributing to insulin resistance. Individuals with diabetes are three times more likely to develop periodontitis compared to healthy individuals (Preshaw PM et al., 2011).

The prevalence of severe periodontitis among diabetic patients is reported to be 59.6%, significantly higher than the prevalence among non-diabetic individuals, which stands at 39% (López-López J. Et al., 2011).

B. Diabetes and Xerostomia

Diabetic patients commonly experience xerostomia, a condition characterized by decreased saliva production and altered saliva composition. This salivary dysfunction results in reduced saliva flow and changes in saliva composition, including increased salivary glucose levels and

decreased pH. These alterations create an environment conducive to bacterial growth. Xerostomia can adversely affect quality of life by causing difficulties in speech, swallowing, and nutrition (Al-Maskari AY et al., 2011).

C. Diabetes and Oral Infections

Fungal and bacterial infections are common in diabetic patients, primarily due to reduced salivary flow, which diminishes saliva's antimicrobial effects (Mohammed L et al., 2021).

The primary oral infection encountered in diabetic patients is oral candidiasis, an opportunistic fungal infection resulting from the uncontrolled proliferation of Candida albicans within the oropharyngeal tract. This condition arises due to dysbiosis of the fungus, which usually colonizes the oral cavity but can overgrow under conditions of immunosuppression, diabetes mellitus, or inappropriate antibiotic use. Clinically, oral candidiasis manifests as a white coating on the mucous membranes of the oral cavity and/or throat, often accompanied by symptoms such as mouth burning, pain during chewing and/or swallowing, abnormal taste sensations, and loss of taste perception. Diagnosis is typically straightforward through a thorough physical examination and patient history, with occasional use of a pharyngeal swab for confirmation (Richardson R et al., 2010).

Candida-related lesions encompass conditions like denture stomatitis, angular cheilitis, and median rhomboid glossitis and are more prevalent in diabetic patients who smoke, wear dentures, have poorly controlled blood sugar levels, and use steroids or broad-spectrum antibiotics (Rodrigues CF et al., 2019).

D. Diabetes and Periapical Injuries

The link between diabetes and periapical lesions is more pronounced in patients with poorly controlled diabetes. In such individuals, the dental pulp may experience limited collateral circulation and a diminished immune response, increasing the likelihood of pulpal infection or necrosis. Therefore, meticulous attention is essential when managing these lesions, ensuring proper treatment and utmost care to achieve predictable outcomes (Segura-Egea JJ et al., 2012).

Possible complications of diabetes in oral surgery and their management

When performing dental extractions in diabetic patients, several principles should be followed:

1. Determine whether the patient's diabetes is controlled through pharmacological or nonpharmacological means.
2. Treat any infections promptly, especially if the extraction is required in an immunocompromised diabetic patient (Gazal G. 2019).
3. Controlled diabetic patients typically do not require antibiotic prophylaxis for standard dental extractions. However, in cases of uncontrolled diabetes, antibiotic prophylaxis is recommended (ZehaniA. et al. 2017).
4. The maximum allowable fasting blood glucose level for dental extraction is 180mg/dl or 200 mg/dl for casual blood glucose (de Bedout T. et al., 2018).
5. Emergency dental extractions may be performed if the blood glucose level is below 234 mg/dl, provided that a local anesthetic without adrenaline and a course of amoxicillin 500 mg for 5 days post-extraction are administered (Byakodi S. et al., 2017).
6. A fasting blood glucose level of 240 mg/dl is a critical threshold for dental treatment. Symptoms such as tingling in the extremities, nausea, vomiting, diarrhea, and dizziness may occur at this level. Emergency dental extractions in patients with elevated glucose levels can lead to severe infections due to delayed socket healing, as blood accumulates ketones (Estrich CG. Et al., 2019).

A. Mycotic Infections

Dental extractions in patients with poorly controlled diabetes can pose a risk for fungal infections. Cases of fulminant mucormycosis of the maxillary sinuses have been reported following dental extractions in such individuals (Gholinejad Ghadi N. et al., 2018). This underscores the importance of proper management and vigilant monitoring, particularly in diabetic patients with compromised glycemic control, to prevent such severe complications.

B. Osteonecrosis

The literature indicates that dental extraction in elderly patients with uncontrolled diabetes is recognized as one of the triggers for osteonecrosis of the maxillae (ONJ) (Wan Q. et al., 2018). This highlights the need for careful consideration and personalized management strategies, particularly in this patient population, to minimize the risk of such complications during dental procedures.

C. Cardiovascular Emergency

Diabetes mellitus is associated with a heightened risk of cardiovascular emergencies, attributed to accelerated and more extensive coronary atherosclerotic damage compared to non-diabetic individuals. Moreover, when diabetes coexists with hypertension, the risk of cardiovascular disease escalates significantly. Diabetic patients with concomitant hypertension face a fourfold higher risk of developing angina, elevated blood pressure, and myocardial infarction during or after surgical procedures conducted in dental offices (Hu G. et al., 2007).

Considering these risks, the literature recommends that patients with uncontrolled diabetes and hypertension should undergo treatment in a hospital setting equipped with a cardiology unit. This ensures prompt access to specialized care and timely intervention if necessary (Jadhav AN et al., 2019). Such precautionary measures aim to mitigate the potential cardiovascular complications associated with dental procedures in high-risk patient populations.

Possible complications of diabetes in implant surgery and their management

Implant surgery has become a prevalent option for rehabilitating partially or edentulous patients. However, various factors can influence implant survival intra- and postoperatively, and it depends on the operator and patient. These factors can affect implant success at different stages, including placement, loading, and beyond (Ferrari Cagidiaco E., 2018; Gherlone E.F., 2022).

Patients with type I and II diabetes mellitus often require implant-prosthetic rehabilitation. However, careful evaluation of the patient's medical history is essential to deter-

mine their suitability for oral surgery (D'Orto et al., 2022). Controlled or uncontrolled diabetes significantly impacts implant therapy outcomes, with uncontrolled hyperglycemia posing risks such as compromised osseointegration and increased incidence of peri-implantitis (Oates TW et al., 2013; Chang et al., 2013; Javed et al., 2018).

The risk of peri-implantitis is notably higher in diabetic patients, emphasizing the importance of early diagnosis and prevention (Shi Y. et al., 2014). While the association between diabetes and peri-implant mucositis remains inconclusive (Diz P. et al., 2013), diabetic patients face a 50% higher risk of peri-implantitis compared to non-diabetic individuals (Monje A. et al., 2017).

Diabetes also correlates with increased complications in dental implant surgery, including delayed wound healing and heightened infection risk (Marchand F. et al., 2012). Chronic hyperglycemia contributes to soft tissue inflammation and crestal bone loss around implants, primarily through the increased production of pro-inflammatory cytokines and glycation end products (Javed F. et al., 2011; Abduljabbar T. et al., 2017).

Overall, controlled diabetes allows for successful implant-prosthetic rehabilitation, albeit with longer osseointegration periods than healthy individuals (Naujokat et al., 2016). However, patients with diabetes, especially those with uncontrolled hyperglycemia, require meticulous management and monitoring to minimize implant-related complications.

Conclusion

Within the limitation of this study, although it is not possible to establish with certainty what the predisposing factors are, the scientific literature shows that the altered composition of saliva, together with the reduced immune response against bacteria, is dependent on a lower antibacterial capacity in the diabetic patient and therefore a higher frequency of inflammatory diseases caused by the accumulation of plaque and tartar; in particular, gingivitis, periodontitis, caries, aphthae or aphthous stomatitis, map-like tongue (benign migratory glossitis), xerostomia, inflammation of the tongue and candidiasis.

In conclusion, the dental surgeon should always take due account of all the needs of the diabetic patient, trying to operate above all at the level of prevention and being aware of all the possible complications that the diabetic patient could face during an oral surgery session.

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