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Diabetes Mellitus

A Project Submitted to Collage of Dentistry, University of Baghdad, Department of Pedodontics and Preventive Dentistry in Partial Fulfillment for the Requirement to Award the Degree of BDS.

By

Layla Abdul-Jaleel

Supervised By

Dr. Mona Abdullah

B.D.S, M.Sc

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﴿ وَيَرَى الَّذِينَ أُوتُوا الْعِلْمَ الَّذِي أُنْزِلَ إِلَيْكَ مِنْ رَبِّكَ هُوَ الْحَقَّ وَيَهْدِي إِلَى صِرَاطِ الْعَزِيزِ الْحَمِيدِ ﴾

صدق الله العظيم

DEDICATION

To my dear **father**

My first hero, teacher and great supporter for my life

To my Beloved **mother**

The owner of biggest heart and with her patience and love and prayer I reach here

ACKNOWLEDGEMENT

Thank to **Allah** for giving us the patience and strength to accomplish this work.

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Introduction

Diabetes mellitus (DM) is described as one of the most common endocrine diseases in medicine (Clark, 2006) or the most common chronic disorder (Almas et al. 2003). It has reached epidemic proportions despite the fact that not every diabetic case is reported and it is expected to rise as the ageing of the population will result in more people succumbing to it (Papadopoulos et al. 2007).

Diabetes Mellitus encompasses a heterogeneous group of disorders with the common characteristic of altered glucose tolerance and impaired lipid and carbohydrate metabolism. The disease is a growing public health proble) because its associated complications give rise to socio-economic and disease burdens that put an enormous strain on the health care systems in many countries (Wilder et al. 2009), including South Africa. Diabetes exerts a heavy economic burden on society because of health system costs incurred in managing the disease, indirect costs resulting from productivity losses and premature mortality (Kirigia et al. 2009). Diabetes mellitus accounts for 5% of all deaths worldwide and it results in morbidity and mortality in both developing and developed countries. In the United States alone about 20.8 million people are estimated to have diabetes and it continues to rise due to the increasing number of overweight and obese individuals (King, 2008). There is evidence to suggest that women are at a higher risk of mortality and morbidity from diabetes (Gucciardi et al. 2008).

The process leading to hyperglycaemia is fairly complex and it involves changes in chemical pathways and metabolic changes. An increase in cellular resistance to the action of insulin causes a series of metabolic irregularities involving carbohydrates, fats and proteins (Lamster et al. 2008), that result in micro- and macrovascular disease - the leading causes of death among diabetic patients.

It is critical therefore that oral health workers have a clear understanding of the disease in terms of its diagnosis, prevention and treatment so as to improve the quality of care offered to such patients (Taylor and Borgnakke, 2008).

Dentists can play a pivotal in identifying a diabetic patient, especially since diabetes is associated with oral complications. They can influence the diagnosis, treatment, management and prognosis of such patients by diagnosing their diabetes-associated oral complications and promptly referring the patient to a physician. There is no cure for diabetes and the dentist can play a role in glycaemic control of this disease by maintaining good oral hygiene on their diabetic patients and by motivating them to maintain good glycaemic control as this will prevent or slow down the progression of associated medical and oral diabetic complications. An elevation in blood glucose levels (hyperglycemia) affects almost all body tissues including the oral cavity although most literature focuses on the medical effects of diabetes rather than on oral health effects. The aim of the present study was to determine the prevalence of oral lesions amongst diabetic and non-diabetic patients, including periodontal deterioration; the self perceived quality of life and the prevalence of medical and oral complications closely related to diabetes. (Skamagas et al. 2008)

Aim of the study

This project was aimed to study the relation of diabetes and oral cavity disorder with it's management .

1. Classification Of Diabetes

The diabetes divided into three types as in figure 1 .

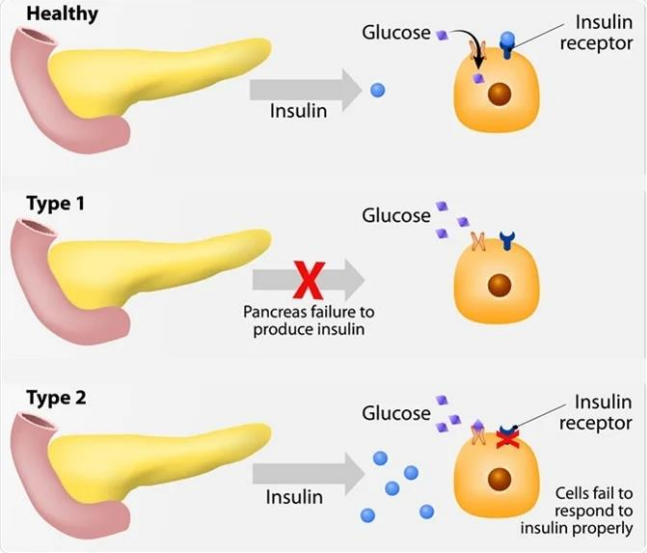

Figure 1. Types of Diabetes

A. Type 1 Diabetes

Is a slowly progressive T-cell-mediated autoimmune disease although its onset is often abrupt (Kidambi and Patel, 2008). This type of diabetes traditionally occurs in individuals younger than 30 years, mostly in adolescence or childhood, but according to recent epidemiological studies the incidence seems to be similar in both under 30s and adults. In Type 1 diabetes, the beta cells of the Islets of Langerhans in the pancreas are destroyed and are unable to produce insulin. This

results in an inexorable cascade of metabolic reactions that eventually manifest as complications associated with diabetes. Hyperglycaemia, accompanied by the classical symptoms of diabetes, occurs only when 70-90% of the beta cells have been destroyed and this, together with familial studies has served as proof that this Type of diabetes has a very slow-onset (Frier and Fisher, 2006).

Insulin is vital for glucose metabolism and the body cannot function well in its absence, as it is unable to transport glucose to the cells where it is needed. It facilitates the entry of glucose which is already absorbed in the blood stream into the cells of the body by using glucose transporters. This is the reason why exogenous insulin therapy is given to all Type 1 diabetic patients to prevent the build-up of glucose in the tissue fluids and blood stream (Mbokazi, 2006).

B. Type 2 Diabetes

Is the most common form of diabetes (King, 2008) and it refers to non-insulin –dependant diabetes mellitus. It occurs as a result of a reduced responsiveness to insulin or insulin resistance at target organs leading to a series of complications which include retinopathy, neuropathy, vascular degeneration and nephropathy. While there is still no scientific explanation why the insulin resistance occurs in Type 2 patients, it remains well accepted that excessive production of glucose in the liver accompanied by under-utilization of glucose in the skeletal muscle result from resistance to the actions of insulin. This Type has its onset above 40 years of age (Kidambi and Patel, 2008).

C. Gestational Diabetes

Is defined as either onset or first recognition of glucose intolerance during pregnancy in a woman that has not had this condition before (Dasanayake et al. 2008). It occurs in pregnancy and it usually has its onset during the third trimester.

It is a pernicious condition that is responsible for perinatal morbidity and mortality as it is closely linked to pre-eclampsia, caesarian delivery, premature rupture of membranes and preterm delivery. Its pathophysiology closely mimics that of Type 2 diabetes as it is associated with increased insulin resistance. (Dasanayake et al. 2008)

the American Diabetes Association has included other Types of diabetes classified according to specific etiology or pathophysiology (Kidambi and Patel, 2008) and these are listed in Table 1.

1	Genetic defects of beta cell function: maturity-onset diabetes of the young (MODY) e.g. MODY 1, MODY 2.
2	Pancreatic disease or injuries (e.g. Pancreatitis, pancreactomy, neoplastic disease, etc).
3	Drug induced diabetes (e.g. corticosteroids, thiazide diuretics, phenytoin and nicotinic acid).
4	Endocrine Disorders: Hyperthyroidism, Cushing's syndrome, acromegaly, pheochromocytocoma, etc.
5	Other genetic syndromes (Down's syndrome, Klinefelter's Syndrome, Turner's Syndrome, etc
6	Viral infections (e.g. Congenital rubella, mumps, Coxsackie B virus and Cytomegalovirus).
7	Rare Immune Mediated Diabetes Mellitus: stiff man syndrome and anti-insulin receptor antibodies.

Table 1: Other specific types of diabetes

2. Risk Factors

Diabetes risk factors can be broadly classified as modifiable and non-modifiable. as in figure 2 .

Those that are

A. Non-modifiable

Include factors such as genetic predisposition, increasing age and ethnicity. Diabetes Mellitus is associated with familial history, although the mode of inheritance of the susceptible genes is rather elusive (Skamagas et al. 2008). The fact that Type 1 diabetes occurs very frequently in people of Northern European descent and less commonly in Blacks, Native Americans and Asians or that Indigenous Australians have more than twice the diabetes prevalence rates compared to the prevalence found in other Australians may be an indication of how ethnicity affects diabetes prevalence.

B. Modifiable risk factors

Include obesity, sedentary lifestyles, hypertension, smoking and hyperlipidaemia, especially low-density lipoprotein hypercholesterolemia. Changing lifestyles characterized by very little exercise and a high fat diet lacking in fibre which significantly contributes to obesity (Skamagas et al. 2008). Obesity (with a body mass index >30) is a major risk factor for Type 2 diabetes as it plays a very significant role in the patho-physiology of diabetes. In fact, obesity is an integral part of metabolic syndrome X and it predisposes to Type 2 diabetes. According to one study done in South Australia 67.6% of the diabetic population were either overweight or obese. (Ogunbanjo, 2006)

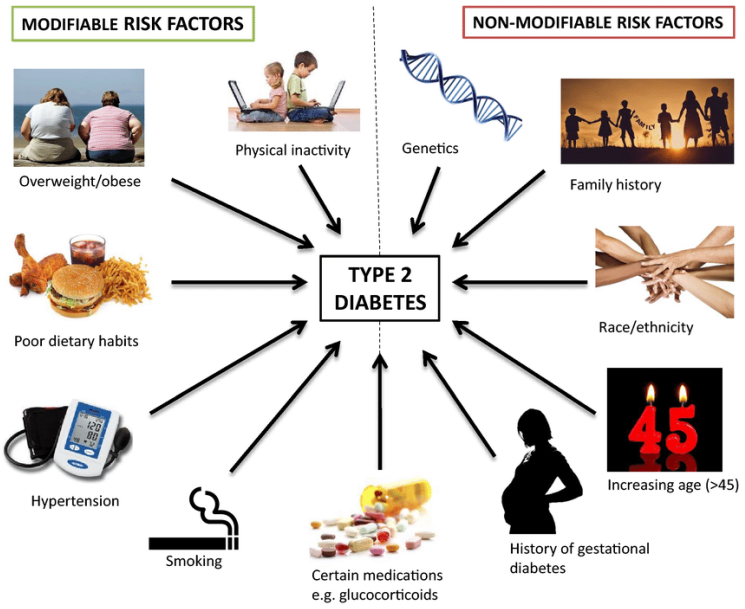

Figure 2. Diabetes Mellitus Risk Factors

3. Epidemiology

Diabetes Mellitus is a common epidemic yet its prevalence is not easy to determine because many people remain undiagnosed and many are without any clinical signs and symptoms of diabetes. The prevalence of diabetes increases with age has a strong positive correlation to obese and overweight individuals. In the year 2000 diabetes was estimated to affect more than 171 million people worldwide (Brunton, 2008). World Health Organization currently estimates that more than 180 million people have diabetes worldwide (Kirigia et al. 2009). In the United States of America (USA), it currently affects more than 12 million people.

4. Pathophysiology

In order to understand the pathophysiology of diabetes, it is crucial to have a fair knowledge of the basic carbohydrate metabolism and insulin action (Mealey, 2003). After every meal, there's an increase in the levels of glucose and insulin is

required to regulate these levels back to normal. The metabolic regulation of carbohydrates involves not only the beta cells, which secrete the insulin that reduces plasma glucose but also the alpha cells of the pancreas, the corticoadrenal hormones and the anterior pituitary hormones which increase plasma glucose (Zielinski et al. 2002). The hypothesized mechanism following ingestion of a high glycaemic carbohydrate is that blood glucose rises quickly, as does the secretion of insulin and secretion of insulin continues to bring the blood glucose level even lower than the initial glucose level leading to a hypoglycaemic state which then triggers the secretion of counterregulatory hormones like glucagon and epinephrine which will try to maintain euglyceamia (Janket et al. 2008).

Through this hypoglycaemic state, pathways like glycogenolysis and lipolysis cause an abundance release of free fatty acids which we already know to cause insulin resistance. Insulin is a hormone that is manufactured and stored in the Islets of Langerhans in the pancreas. This hormone plays a significant role in the patho-physiology of diabetes as it is the only hormone that lowers blood glucose levels (Mealey, 2003).When there is a rise in the blood glucose level the release of this hormone is triggered.

5. Diabetes And The Oral Cavity

Similar changes to those that occur in the kidney, nerves and retina also take place in the oral mucosa. Oral health complications associated with diabetes include xerostomia, tooth loss, gingivitis, periodontitis, odontogenic abscesses, caries and soft tissue lesions of the tongue and mucosa as in figure 5. Burning mouth syndrome, poor wound healing and an increased incidence of acute oral infection are all very common features in diabetic patients. Oral complications are

more pronounced and occur more readily in Type 1 uncontrolled DM than in Type 2 subjects (Vernillo, 2003).

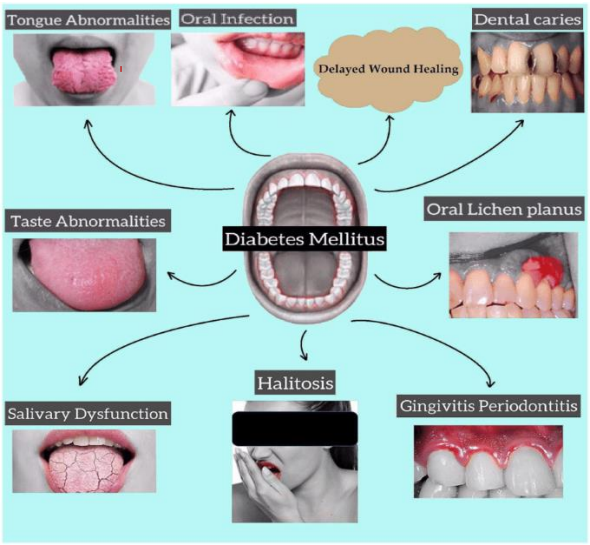

Figure 5. Complications of oral cavity in Diabetes Mellitus

5.1 Xerostomia

Xerostomia is a commonly reported oral complication in the diabetic patient and is attributed to a decrease in salivary flow. Approximately one in five adults report having xerostomia (Thomson et al. 2006). It is associated with polyuria which is also commonly experienced by diabetic patients. It is not clear whether xerostomia occurs as a result of the diabetes or due to the medication used in treatment . As in figure 6.

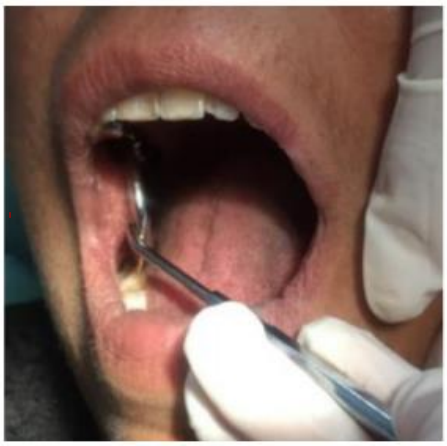

Figure 6. Xerostomia

In some patients xerostomia may present with an enlargement of the parotid glands (Mealey, 2003). The changes in the salivary secretion are believed to occur as a result of the accompanying neuropathy of the autonomic nervous system and this alters the normal oral cavity environment thus predisposing a healthy mouth to dental caries (Vernillo, 2003). Dryness of the mouth may lead to oral tissues being more susceptible to trauma and opportunistic infections such as Candida but also an increased accumulation of bacterial plaque and food debris that contributes to dental caries and periodontal disease. Xerostomia may be associated with difficulties in chewing, swallowing, tasting and speaking which leads to poor dietary intake, malnutrition and poor socialization. It has recently been shown to affect the oral health related quality of life (Soell et al. 2007).

Management Of Xerostomia

Treatment of xerostomia is essential to encourage salivary stimulation to keep the mouth moist, prevent caries and Candida infection to provide palliative relief (Vernillo, 2003). The use of saliva substitutes and stimulants is

recommended for this purpose. Artificial saliva containing methylcellulose or a mucin base can be used. Patients could also be encouraged to use sugarless chewing gum to stimulate salivary flow. Topical fluorides should be used so as to prevent caries.

5.2 Candida

Oral candidiasis is commonly found in diabetics and it is believed to occur due to the dryness of the mucosa. This opportunistic fungal infection is caused by Candida albicans and is commonly associated with hyperglyceamia. It is often associated with marginally or uncontrolled diabetes and has a positive correlation to salivary gland dysfunction (Soell et al. 2007). Its occurrence in the diabetic patient may well be attributed to the fact that diabetics have impaired immune defense mechanisms and that makes them more susceptible to infection. As in fugure 7.

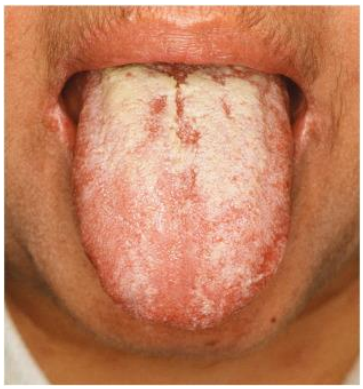

Figure 7. Oral candidiasis

Management Of Candidiasis

The following treatment options are available for these patients (Vernillo, 2003):

0.5% gentian violet aqueous solution applied topically in the mouth 3 times a day. Nystatin vaginal suppositories-although this preparation is not designed for oral use, clinicians have found it useful in treatment of oral candidiasis when the sugar content of other topical antifungal medications is a concern (Vernillo, 2003).

- **Clotrimazole** troches given as 1-10mg troche 5 times/day for 2 weeks. These troches have a very high sugar content and should be used with caution so as not to affect glycaemic control.
- **Fluconazole** 100mg/day for 2 weeks
- **Ketaconazole** 200mg/day for 2 weeks
- **Itraconazole** 200mg/day for 2 weeks. This drug is effective against resistant strains of Candida albicans.

5.3 Burning Mouth Sensation

This condition is of unknown aetiology but is closely associated with salivary gland dysfunction, candidiasis and neurological abnormalities such as depression (Vernillo, 2003). Patients experiencing a burning mouth sensation do not present with any detectable lesion except the symptoms of pain and a burning sensation on the tongue. It is also suggested with no definite proof that this condition is common in severe diabetes mellitus where diabetic neuropathy exists as a complication.

By definition, gingivitis is a condition where inflamed gingival tissues are associated with a tooth, with no attachment loss or with previous attachment and bone loss, but is not currently losing attachment or bone (Tan et al. 2006). This is the most prevalent mild form of periodontal disease which is characterized by inflammation of the gums, erythema, swelling and frequent bleeding (Kim and Amar, 2006).

This inflammation of the gingiva is caused by bacterial plaque accumulation and is reversible if treatment is initiated early enough (Soell et al. 2007). Gingival bleeding is an indicator of inflammation and it is possible that the vascular changes that take place in the diabetic patient enhance this bleeding. Apart from the microvascular changes leading to gingival bleeding, there's a correlation of gingiva with accumulation of plaque and calculus which act as local irritants to the gingival, leading to inflammation of the gums. Increased salivary glucose may also contribute to the inflammatory process by way of increased bacterial substrate and plaque formation (Orbak et al. 2008).

Management Of Burning Mouth Syndrome

Due to its association with xerostomia and Candida, some relief may be achieved through proper management of these two factors. In uncontrolled diabetes it is recommended that the glyceamic control be improved so as to prevent complications associated with hyperglyceamia. Agents such as benzodiazepines, tricyclic anti –depressants and anti-convulsants given in low dosages can be useful in treating the burning mouth syndrome however; these should be used sparingly as they can be addictive.Symptoms of burning mouth have been found in

undiagnosed cases of Type 2 diabetes, most of which have been resolved after medical diagnosis and subsequent treatment, directed at improving glycaemic control (Vernillo, 2003).

5.4 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 the periodontal ligament and alveolar bone with pocket formation, recession or both (Tan et al. 2006).

This condition is now classified as the 6th most common complication of diabetes (Kidambi and Patel, 2008) after retinopathy, nephropathy, neuropathy, peripheral vascular disease and cardiovascular disease. It is often referred to as the 6th “opathy” of diabetes (Mansour and Abd-Al-sada, 2005).

While periodontal infections have an impact on diabetic control, diabetes is a major risk factor for the development of periodontal disease (Wilder et al. 2009) and this is underpinned by epidemiological studies and case reports.This explains the reciprocal relationship that exists between diabetes and periodontitis. In fact, there’s evidence to suggest that periodontal disease may increase the risk of experiencing poor metabolic control or that periodontal disease has the potential to have adverse impact on glycaemic control in patients with diabetes mellitus (Lamster et al. 2008). As in figure 8 .

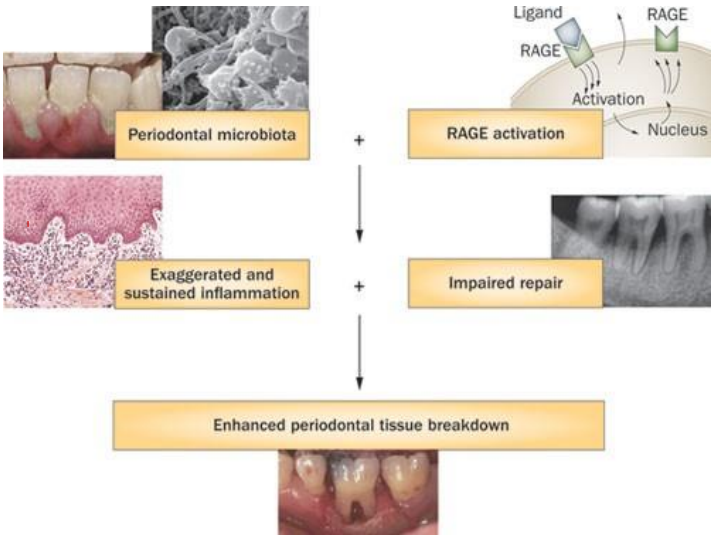

Figure 8. Diabetes Mellitus and Periodontitis

Management Of Periodontitis

A conventional approach to management of periodontitis is preferable. Patients with diabetes should receive regular scaling so as to remove plaque and calculus deposits. Local debridement with 1% povidone-iodine should be done. Sound oral hygiene practices like brushing 3 times/day and flossing should be reinforced by the dental team. The use of antibiotics is recommended and the following drugs are often used:

Amoxil 250mg three times/ day for 5 days for patients who are not allergic to penicillin **Erythromycin** 250mg three times/ day for 5 days for patients who are allergic to penicillin.

Each of the above-mentioned drugs must be accompanied by any of the following: Metronidazole 200mg three times/ day for 5 days or Clindamycin

300mg three times/day for 5 days or Clavulanic acid and Amoxil 375mg three times/ day for 5 days.

Periodontal surgical procedures can be performed on patients with advanced periodontitis but not without reservations as surgery may potentiate unwanted complications. Often there is a need to modify the patient's medication before and after surgery and there may be delayed wound healing since the patient is diabetic (Vernillo, 2003).

The use of 0.2% Chlorhexidine gluconate mouthwash has beneficial effects because it is bactericidal. This drug is rapidly absorbed to teeth and pellicle and is released slowly, thus prolonging the bactericidal effect. Phenol compounds like Listerine may also be used because they are known to be effective in preventing the development of supragingival plaque and gingivitis.

5.5 Gingivitis

Gingivitis may progress to periodontitis if it is not treated early enough. The rationale behind treatment of gingivitis is to eliminate the local irritants thereby reducing the inflammation of the gums. Plaque has to be removed through scaling and polishing because the components of microbial plaque have the potential to induce an initial infiltrate of inflammatory cells which may lead to connective tissue destruction (Vernillo, 2003). The use of a mouthwash is recommended as an adjunct to treatment. Although there are many mouthwashes to choose from, the efficacy of chlorhexidine has been shown to be very good. This drug has been shown to be the most effective antiplaque and antigingivitis chemotherapeutic agent available. (Kim and Amar, 2006).

Figure 9. Diabetes Mellitus Associated Gingivitis

5.6 Dental Caries

There seems to be no evidence linking diabetes mellitus to dental caries and information that has been published has often lacked consistency (Soell et al. 2007). Perhaps this inconsistency is as a result of different behavioural patterns among diabetic patients, where those that are compliant and motivated will engage in good oral hygiene practices and stick to regular dental appointments as opposed to those that are non-compliant. Since most diabetic patients limit their intake of fermentable carbohydrates, the less cariogenic diet may limit caries incidence. There are reports of increased incidence of dental caries among uncontrolled or marginally controlled diabetes mellitus in both animals and human studies (Rees, 2000).

Management of Dental Caries

Dental caries should be managed according to the size and depth of the lesion otherwise the caries will progress and eventually lead to tooth loss. It is important to remember the association of caries with salivary dysfunction and

xerostomia since they may well be the contributing factors to dental caries in a diabetic patient.

Apart from dental fillings, topical treatments such as fluoride-containing mouthrinses and salivary substitutes may help prevent caries. Fluoride compounds, gels, aqueous solutions and dentrifices are all possible options in treatment of dental caries. Topical fluoride can be subdivided into fluorides applied by professionals or those that can be applied at home. From the professionally-applied fluorides, stannous fluoride has been found to be 3 times more effective in inhibiting enamel dissolution by weak acids than sodium fluoride. Fluoride varnishes like Duraphat, Epoxylite and Elmex can be applied on patients by a professional. The use of fluoride-containing toothpaste for caries prevention at home should be encouraged. Sodium fluoride mouthrinses are also believed to be beneficial because of their fluid nature which allows the fluoride to reach areas which are inaccessible to the toothbrush. Oral health care workers should also reinforce sound oral hygiene practices and dietary counselling to the patient so that the patient can brush, floss and choose less cariogenic foods, all of which will enhance caries prevention. (Kim and Amar, 2006).

5.7 Altered Taste Sensation

The change in taste has been attributed to altered glucose receptors or early manifestation of diabetic neuropathy. Taste strongly influences food preference and intake and taste receptor variants have been associated with differences in taste perception. It has also been attributed to xerostomia and candidiasis; as a direct result of diabetic neuropathy or medication. Decreased taste sensation may be more pronounced for sucrose as opposed to other taste tests, and this indicates a direct effect of diabetes mellitus. The taste receptors involved are the TAS1R and

TAS2R and they are responsible for sweet and bitter taste stimuli respectively (Dotson et al. 2008). There's a belief that altered taste sensation is an age-related phenomenon. One theory is that normal ageing produces taste loss because of changes in taste cell membranes involving altered function of ion channels and receptors. This condition has been reported in diabetes patients who receive hemodialysis (Lamster et al. 2008).

Management Of Altered Taste Sensation

Since this condition has a strong correlation for Candida and xerostomia, a positive outcome may be achieved by treating the accompanying fungal infection. Improvements in altered taste sensation may occur when diabetes mellitus metabolic control is established or when xerostomia and associated candidiasis are controlled (Rees, 2000).

5.8 Acute Oral Infections

This refers to recurrent episodes of herpes simplex virus, periodontal abscesses and palatal ulcers that occur in marginally controlled diabetics. These infections are believed to occur as a result of the same pathogenic mechanism which is associated with increased susceptibility to periodontal infections (Vernillo, 2003). As in figure 10.

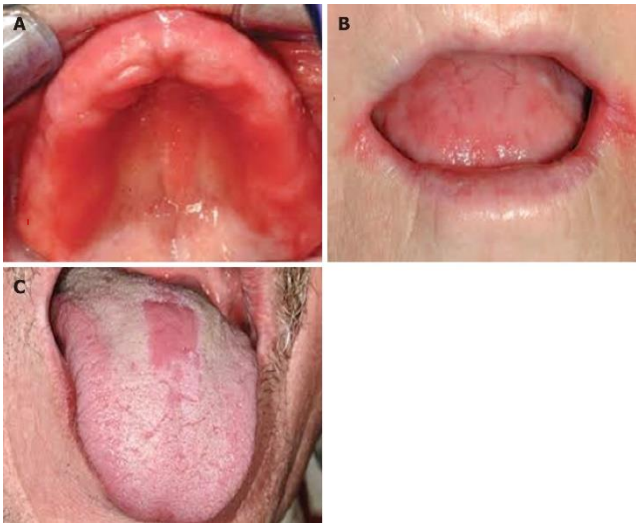

Figure 10. Candida-related lesions. A: Denture stomatitis; B: Angular chelitis; C: Median rhomboid glossitis

Management Of Acute Oral Infections

These can be managed by achieving good glycaemic control in a diabetic patient as this will reduce the impact of acute oral infections. For those diabetic patients who might have recurrent Herpes Simplex Virus infection, agents such as oral acyclovir can be used for this infection both prophylactically and therapeutically. This drug is contraindicated for patients who are diabetic and have renal insufficiency as it can lead to nephrotoxicity (Vernillo, 2003) but it is safe to use on any other diabetic patient. Other drugs of choice are Valacyclovir 100mg three times / day or Famciclovir 250mg three times/ day for 7 days.

For acute oral infections like periodontal abscesses antibiotics similar to the ones used for periodontitis management are used. A mouthwash like chlohexidine gluconate may also be used as an adjunct.

6. Diabetic Emergencies In The Dental Surgery

Dentists should be alert to hypoglycaemia, a condition that is highly dangerous as it may lead to the patient getting a seizure or even loosing consciousness (Kidambi and Patel, 2008). The classical signs and symptoms of this condition include sweating, tremors, confusion, agitation, anxiety, dizziness, tingling or numbness and tachycardia. If this condition is suspected it can be confirmed by taking a glucometer reading and the patient must be given 15g of glucose orally. In the event that a patient is unable to take this glucose orally, an intravenous line (IV) should be set up and 25-50ml of 50% dextrose solution should be administered (Kidambi and Patel, 2008). A subcutaneous injection of 1mg of glucagon should be injected in case it is not possible to set up the IV line. After the treatment, the signs and symptoms of hypoglycaemia should resolve between 10-15 minutes. As a precaution, the patient must be observed for 30-60 minutes after recovery and the blood glucose levels can then be rechecked using the glucometer.

It is not uncommon for marked hyperglycaemia patients to present with the exact symptoms as described for hypoglycaemia. Again, the important step is to confirm the glucose level with a glucometer. However, should a glucometer not be available it is safer to treat this as hypoglycaemia because the extra dose of glucose given will not have a significant or detrimental effect on the hyperglycaemia, but if the patient was not treated as hypoglycaemia, he could suffer life threatening outcomes (Mealey, 2003).

Conclusion

Diabetes Mellitus leads to multiple complications, which increase when glycemic control of the patient is inadequate. This makes management and prevention important. It has been shown that diabetes exists in a bidirectional relationship with periodontal disease and may lead to other oral pathologies. For this reason, doctors and dentists must be vigilant with regard to the various oral manifestations of diabetes in order to make an early diagnosis.

Full understanding and awareness of the pathophysiology, manifestations, and management of different types of diabetes-related orofacial infection by the endocrinologist and the dentist are essential to optimizing the care of diabetic patients.

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