Diabetes Mellitus

3 Clinical points

(Compiled by Carin Brent Dipl OH
Stell Expanded Functions UWC)
MDB006-MD617-0023-7-2016

The beta-cells in the pancreas produce insulin (a hormone) that helps the body to convert “food” into energy. If the pancreas does not produce enough insulin, or the body is not using the insulin correctly (or it can be a combination of both), the condition is called Diabetes Mellitus (DM)- commonly known as diabetes.

Objectives:

The reader should be able to:

- Differentiate between DM Type 1 and 2
- Recognise symptoms
- Know how to respond in an emergency situation
- Understand the link between DM and periodontitis

Cells need insulin to be able to absorb glucose from the bloodstream and burn it as energy. Should there be no insulin available or if the body is not using insulin efficiently, glucose in the blood cannot enter the cells. This leads to high glucose levels in the blood and the cells without the necessary energy to function properly.

Diabetes is classified mainly as Type I DM or Type II DM. Patients diagnosed with Type I DM are insulin dependent while Type II patients are non-insulin dependent and the patient can manage his/her sugar levels with diet, exercise and oral medication. There are other less common types of diabetes as well, but for the sake of this newsletter, we will focus only on Type I and II.

Signs and Symptoms

Blood glucose levels are measured in mg/dL or mmol/L. In South Africa we use mmol/L.

A blood glucose level between 72 mg/dL (4 mmol/L) and 108 mg/dL (6 mmol/L) is considered normal for a healthy adult.

A person with a fasting blood glucose level of 126mg/dL (7mmol/L) or higher, would be classified as diabetic. (More than one test is recommended)
The following chart indicates the variations in blood sugar levels[^11]

<table>
<thead>
<tr>
<th>Blood Sugar Levels</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 70 mg/dL (3.9 mmol/L)</td>
<td>Low fasting blood sugar</td>
</tr>
<tr>
<td>70 to 108 mg/dL (3.9 to 6 mmol/L)</td>
<td>Normal fasting blood sugar for adults</td>
</tr>
<tr>
<td>110 to 125 mg/dL (6.1 to 6.9 mmol/L)</td>
<td>Impaired fasting glucose (pre-diabetes)</td>
</tr>
<tr>
<td>126 mg/dL (7.0 mmol/L) and above in more than one test result</td>
<td>Diabetes</td>
</tr>
<tr>
<td>about 70 to 140 mg/dL (3.9 to 7.8 mmol/L)</td>
<td>Normal postprandial blood sugar</td>
</tr>
<tr>
<td>about 142 to 199 mg/dL (7.9 to 10.9 mmol/L)</td>
<td>Borderline postprandial blood sugar. May indicate pre-diabetes</td>
</tr>
<tr>
<td>Less than 70 mg/dL (3.9 mmol/L)</td>
<td>Hypoglycemia (Initial Stage)</td>
</tr>
<tr>
<td>50 mg/dL (2.8 mmol/L)</td>
<td>Hypoglycemia (Fasting)</td>
</tr>
<tr>
<td>less than 50 mg/dL (2.8 mmol/L)</td>
<td>Insulin Shock</td>
</tr>
<tr>
<td>145 – 200 mg/dL (8 – 11 mmol/L) Post meal</td>
<td>Value suggesting early diabetes</td>
</tr>
<tr>
<td>More than 200 mg/dL (11 mmol/L) Post meal</td>
<td>Value suggesting established diabetes</td>
</tr>
</tbody>
</table>

(Postprandial = after a meal)

These values are different for children.

Symptoms indicating diabetes include:

- Blurred vision
- Increased thirst
- Frequent urination
- Constant hunger
- Unexplained weight loss
- Fatigue
- Red, itchy skin
- Slow healing sores or wounds
- Swollen limbs (may be a sign of kidney damage)
- Feeling pins and needles in the feet
- Loss of feeling in the feet

Dental/oral symptoms include:

- Acetone breath (a sweet, almost fruity smell)
- Xerostomia
- Gingivitis/periodontitis
- Bone loss
- Delayed healing
Blood sugar levels are closely related to the patients’ diet. When the blood sugar levels are too high, it is called hyperglycaemia, as opposed to hypoglycaemia – where the blood sugar levels are too low.

Without enough insulin, the body breaks down fat as fuel. This process produces a build-up of acids in the bloodstream called ketones, which cause a chemical imbalance—eventually leading to diabetic ketoacidosis if untreated. Often an underlying medical problem such as heart attack, infection, or stroke may precipitate diabetic ketoacidosis even in diabetics who are normally in good control.\(^{(3)}\)

**Signs of hyperglycaemia:**\(^{(5)}\)

- excessive urination
- rapid pulse rate
- acetone breath
- excessive thirst, very dry mouth and skin
- blurred vision and headache
- lower blood pressure
- loss of consciousness

**How to respond:**

- Be thorough in checking the medical history. When last did the patient eat? Did he/she take insulin? If not, did he/she bring insulin along to the appointment? If the patient needs to take insulin - let him/her administers it.
- Delay treatment (unless absolute emergency) to another time
- Call an ambulance/medical assistance if needed
- Do CPR if the patient lose consciousness
- Monitor and record vital signs

**Signs of hypoglycaemia**\(^{(5)}\)

- Mood changes (confused, angry or restless)
- Hungry
- Perspiration
- Increased anxiety
- Possible unconsciousness

**Factors linked to a greater risk of hypoglycaemia include:**\(^{(10)}\)

- Too high a dose of medication (insulin or hypo causing tablets)
- Delayed meals
- Excessive exercise
- Alcohol

Watch this video:
How to respond:

- When last did the patient eat? Did he/she take insulin? If not, did he/she bring insulin along to the appointment? If the patient needs to take insulin let him/her administers it.
- Give a concentrated form of carbohydrate such as sugar, cake icing, Coke or concentrated orange juice. These solutions will be absorbed rapidly into the body
- Call an ambulance/ medical assistance if needed
- Do CPR if the patient become unconscious
- Monitor and record vital signs
- Reschedule appointment once patient has stabilised, and get them to visit their medical practioner.

It is best to schedule dental appointments for diabetics in the morning after breakfast. Minimise stress by keeping the appointments short. Remind the patient to eat prior to the appointment, since most hypoglycaemia is most commonly caused by skipping a meal.

Postpone treatment when:

- The patient’s sugar is not under control
- The patient is not looking/ feeling well (refer to physician if needed)
- there is previous or existing problems like diabetes related infections
- the patient is concerned about his/her own health
- the patient has recently changed medication

The following information is important to obtain before treating a diabetic patient:

a. Has the patient eaten and taken their medication as directed prior to the appointment?

b. Is there a history of trouble keeping blood glucose levels under control?

c. Were there diabetes-related problems with previous dental/dental hygiene care?

d. Are there symptoms indicative of inadequate control of blood sugar?

e. Does the patient understand and accept the need and importance of oral healthcare?

f. What medication is the patient on, including over-the-counter medications, herbals and supplements?

g. Were there any problems with previous dental/dental hygiene care?

h. Are there any problems with infections generally and specifically associated with dental/dental hygiene care?

i. How is the patient's current state of health?

j. Were there any recent changes in the patient’s health in general?
Patients with poor control of their blood sugar levels that need emergency dental work should ideally be treated in an environment where other medical assistance is at hand. (i.e. at a hospital or day clinic)

In the comprehensive article Periodontitis and diabetes: a two-way relationship[7], the authors: P. M. Preshaw, A. L. Alba, D. Herrera, S. Jepsen, A. Konstantinidis, K. Makrilakis, and R. Taylor looked at the following factors: (abstracts only)

Assessments between diabetes and periodontitis[7]

Diabetes has been unequivocally confirmed as a major risk factor for periodontitis [7–9]. The risk of periodontitis is increased by approximately threefold in diabetic individuals compared with non-diabetic individuals [10]. The level of glycaemic control is of key importance in determining increased risk. For example, in the US National Health and Nutrition Examination Survey (NHANES) III, adults with an HbA1c level of >9% had a significantly higher prevalence of severe periodontitis than those without diabetes (OR 2.90; 95% CI 1.40, 6.03) after controlling for age, ethnicity, education, sex and smoking [11].

The majority of research has focused on type 2 diabetes mellitus as a risk factor for periodontitis, probably because both diseases have historically tended to develop in patients in their 40s and 50s. However, type 1 diabetes mellitus also increases the risk of periodontitis, and all patients with diabetes (including children and young adults) should be considered to be at increased risk of periodontitis. One early study identified that around 10% of children (<18 years) with type 1 diabetes mellitus had increased attachment loss and bone loss compared with controls, despite comparable plaque scores [15]. More recently, in a study of 350 diabetic children (6–18 years old) vs 350 non-diabetic controls, the proportion of periodontal sites with evidence of periodontitis was greater in the children with diabetes (>20% vs 8% of sites, respectively) [16].

Dentists have long been aware of the importance of a diagnosis of diabetes in their patients, and various oral conditions are associated with diabetes, including xerostomia and candidal infections as well as periodontitis. In the early 1990s periodontitis was sometimes referred to as the ‘sixth complication of diabetes’ [17].

Assessments between obesity and periodontitis

Other lifestyle factors such as obesity, physical activity and diet are also likely to affect the risk of periodontitis. One of the first studies to show an effect of obesity on periodontitis identified that obese rats with periodontitis had more alveolar bone loss compared with non-obese rats [19]. Adiposity (obesity) can be regarded as a systemic disease that predisposes individuals to a variety of comorbidities and complications, and a number of studies have
reported associations between obesity and periodontitis [20]. Analysis of NHANES III data identified that individuals with a BMI of $\geq 30$ kg/m$^2$ had a significantly increased risk of periodontitis compared with individuals with a BMI of 18.5–24.9 kg/m$^2$ [21]. This relationship was potentially mediated by insulin resistance since, among those with a BMI of $\geq 27$ kg/m$^2$, those who were in the highest quartile for insulin resistance had a significantly increased risk of severe periodontitis compared with those in the lowest quartile [22]. A recent meta-analysis revealed a significant association between periodontitis and obesity (OR 1.35; 95% CI 1.23, 1.47), and concluded that a higher prevalence of periodontitis should be expected among obese adults [23].

These findings raise the question of whether increased physical activity can reduce periodontitis risk. In the US Health Professionals Follow-up Study of 39,467 health professionals, an inverse linear relationship was identified between sustained physical activity and periodontitis, independent of known risk factors [24]. Another analysis of NHANES III data revealed that adults with higher levels of physical activity had significantly lower risk of periodontitis, with associations being strongest in non-smokers (but no association in smokers, suggesting that the harmful effects of smoking outweighed any benefit of physical activity) [25]. These various studies, while interesting, are limited in that they are generally cross-sectional/observational, and the temporal sequence of events is not clear (i.e. whether obesity precedes periodontitis). Prospective cohort studies are required to evaluate this area further.

**Impact of periodontitis on diabetes**

Studies show that the incidences of macroalbuminuria and end-stage renal disease are increased twofold and threefold, respectively, in diabetic individuals who also have severe periodontitis. Furthermore, people with diabetes and severe periodontitis have a three times higher risk of cardiorenal mortality compared with those without severe periodontitis.

Microalbuminuria is when the kidney leaks small amounts of albumin into the urine- which indicates kidney malfunction

**What are the pathogenic mechanisms linking diabetes and periodontitis?**

Periodontitis is a complex chronic inflammatory disease in which inflammation in the periodontal tissues is stimulated by the long-term presence of the subgingival biofilm (dental plaque).
Inflammation is a central feature of the pathogenesis of diabetes and periodontitis

Both type 1 and type 2 diabetes mellitus are associated with elevated levels of systemic markers of inflammation [40]. The elevated inflammatory state in diabetes contributes to both microvascular and macrovascular complications, and it is clear that hyperglycaemia can result in the activation of pathways that increase inflammation, oxidative stress (the body’s inability to counteract free radicals) and apoptosis (normal and controlled death of cells as part of growth and development) [41]. Elevated serum levels of IL-6 and TNF-α have been demonstrated in diabetes and obesity [40], and serum levels of IL-6 and C-reactive protein (CRP) have been shown to predict future occurrence of type 2 diabetes mellitus [42]. Elevated levels of CRP are also associated with insulin resistance, type 2 diabetes mellitus and cardiovascular disease [43].

Interleukin-6 (IL-6) is a multifunctional cytokine that plays a central role in host defence due to its wide range of immune and hematopoietic (forming of blood cells) activities and its potent ability to induce the acute phase response. Cytokines are substances that have an effect on other cells [6].

C-reactive protein (CRP) is a substance produced by the liver in response to inflammation.

Serum levels of IL-6 and CRP are also raised in patients with periodontitis, with IL-6 levels correlating with the extent of disease [46, 47]. The systemic inflammation that is associated with periodontal disease may therefore enhance the diabetic state. Adipokines (specific type of cytokine) may also contribute to susceptibility to both periodontitis and diabetes, and the pro-inflammatory properties of leptin may be particularly important in upregulating (increasing) periodontal inflammation in people who are obese and/or have type 2 diabetes mellitus [48].

**Is there a relationship between the oral microbiota and diabetes?**

Compared with the large number of studies that have investigated the role of inflammatory mechanisms in the link between periodontitis and diabetes, relatively few have investigated relationships between the oral microbiota and diabetes. In one study, recovery of several periodontal pathogens, including Aggregatibacter actinomycetemcomitans, Campylobacter rectus, Capnocytophaga spp, Eikenella corrodens, Fusobacterium nucleatum and Prevotella intermedia, was similar in both diabetic and non-diabetic participants, but significantly more individuals with diabetes harboured *P. gingivalis* [67]. Similarly, in a study of young Japanese individuals with type 1 diabetes mellitus, a greater proportion of participants with periodontitis harboured *P. gingivalis* and *P. intermedia* than those who were periodontally healthy [68]. These studies indicate that there are probably subtle differences in the microbial composition of the subgingival biofilm between individuals with diabetes and those without, but the clinical relevance of this is not clear. Such differences may arise from the effect of diabetes in altering the local environment within the periodontal pocket such that the growth of certain bacterial species is favoured.
The contribution of oral bacteria to adiposity has also been assessed. In a study of 313 women with BMI of 27–32 kg/m² (compared with 232 healthy individuals), 98.4% of the overweight women could be identified by the presence of the periodontal pathogen *Selenomonas noxia* at levels >1.05% of the total bacterial population [69]. *S. noxia* >1.05% had a sensitivity of 98% and specificity of 80% of predicting obesity, leading to the interesting question of whether oral bacteria are involved in the pathology that leads to obesity. The tenets of ‘infectobesity’ suggest that the gut microbiota of obese individuals may be more efficient at extracting energy from a given diet than that of lean individuals [70, 71], and gut microorganisms can affect host metabolism, influencing inflammation and insulin resistance [72]. The role of swallowed periodontal bacteria in contributing to these effects has yet to be established, but it is clear from animal studies that influencing the intestinal microbiota (for example, through the use of prebiotics, specific nutrients, or natural antibiotics) could potentially change satiety and insulin resistance and be of benefit in the management of diabetes [73, 74].

**Periodontal treatment is associated with improved glycaemic control**

Several meta-analyses have confirmed that effective periodontal therapy can result in reduced HbA₁c.

**Hemoglobin A1c**, often abbreviated HbA1c, is a form of haemoglobin (a blood pigment that carries oxygen) that is bound to glucose [8].

Most recently, the Cochrane Collaboration has reported on studies that investigated the relationship between periodontal treatment and glycaemic control in people with diabetes [78]. Three studies were included in this meta-analysis which reported a significant reduction in HbA₁c of 0.40% 3–4 months after conventional periodontal therapy. The findings of these meta-analyses are supported a recent population-based study of over 5,000 individuals with diabetes [79] reporting that patients who received at least one episode of periodontal surgery (an intense form of periodontal treatment, not routinely undertaken in all patients with periodontitis) had HbA₁c levels that were 0.25% lower than patients who did not undergo periodontal surgery [80–82].

Taken collectively, the evidence supports the notion that improvements in metabolic control can be anticipated following effective treatment of periodontitis (although there are few studies available, and some studies lack power). The mechanisms by which this occurs are not yet clear, but probably relate to reduced systemic inflammation (e.g. reduced serum levels of mediators such as TNF-α and IL-6) following the treatment and resolution of periodontal inflammation. Larger randomised trials are warranted to investigate this further. These observations are important because reductions in HbA₁c are associated with a reduced risk of diabetes complications. For example, each 1% reduction in HbA₁c has been associated with reductions in risk of 21% for any endpoint related to diabetes, 21% for deaths related to diabetes, 14% for myocardial infarction and 37% for microvascular complications [83].
The management of diabetes is complex and the prevention of cardiovascular and microvascular disease, through early detection and management of complications, are key components. Lifestyle intervention, education, self-management and self-monitoring are particularly important, in addition to treatments to reduce blood glucose, blood pressure and lipids \[87\]. Similar to diabetes, current treatment philosophies for periodontitis strongly emphasise self-management through patient education. A supportive and facilitative approach by the dental team is essential, but there must be a clear understanding that patient-performed plaque control is the vehicle by which to control the inflammation which drives periodontal tissue destruction. Structured education programmes are effective in the management of diabetes \[88–90\], and similar programmes are being developed for the management of periodontitis \[91, 92\]. These education programmes all emphasise the importance of engaging with the patient and ensuring that patients develop self-efficacy in managing their disease as the means to effect the lifelong behavioural changes that are required for the successful management of both conditions. The importance of self-efficacy in the control of diabetes and oral hygiene has been demonstrated in a population of diabetic individuals in Finland. Those individuals with better tooth-brushing self-efficacy had lower plaque scores (as might be expected) and lower HbA\(_1c\) levels compared with those who had poorer self-efficacy \[93\]. Furthermore, diabetic participants who managed their gingivitis successfully also tended to report better glycaemic control and had lower mean HbA\(_1c\) levels (8.1 ± 1.5%) compared with participants who did not manage their gingivitis effectively (9.0 ± 1.9%) \[94\]. These studies suggest that there are common determinants for both dental and diabetes self-care that could be exploited for improved management of both conditions.

There is, therefore, a cogent argument for involving the dental team in the management of diabetes. Indeed, the dental team is well placed to screen patients for diabetes by virtue of the fact that many people visit their dentist regularly (e.g. every 6 months, often more frequently than they visit their medical practitioner), and the intra-oral findings may raise suspicion of undiagnosed diabetes. The dental team (particularly dental hygienists) are very adept and experienced in instituting behavioural changes in their patients, and may represent an untapped source of support for medical colleagues in this role.
You can read the full article:

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3228943/

With long term effects like blindness, amputation, kidney or heart failure the diabetic patient should ideally also see the following professionals:\[2\]

- an endocrinologist for more specialized diabetes care
- a dietitian, a nurse, or a certified diabetes educator—experts who can provide information about managing diabetes
- a counsellor or mental health professional
- a pharmacist
- an ophthalmologist or an optometrist for eye care
- a podiatrist for foot care

As dental professionals, we should stress the importance of good oral hygiene and lifestyle changes (regular exercise and diet) and refer our patients to the necessary professionals to ensure a holistic approach to managing DM

The American Academy of Periodontology has published guidelines on comprehensive periodontal examination for periodontal diseases.\[9\]
Please read this article:


To do list:

- Get a glucometer in your practice if you don’t have one.
- Ensure you keep stock of a source of concentrated carbohydrate in your practice

Question time:

1. Type 1 diabetic is:
   a. A child
   b. Insulin dependent
   c. Non-insulin dependent

2. Type 2 diabetic is:
   a. A child
   b. Insulin dependent
   c. Non-insulin dependent

3. Insulin is produced in the
   a. Pancreas
   b. Liver
   c. Kidney

4. DM develops when
   a. the body doesn’t produce enough insulin
   b. the body does not use insulin efficiently
   c. A&B

5. Which question should you ask before seeing a diabetic patient?
   a. Has the patient eaten and taken their medication as directed prior to the appointment?
   b. Is there a history of trouble keeping blood glucose levels under control?
   c. A&B

6. Hyperglycaemia is the condition where there is
   a. too much glucose in the bloodstream
   b. too little glucose in the bloodstream
   c. Not enough insulin the bloodstream

7. Hypoglycaemia is the condition where there is
   a. too much glucose in the bloodstream
   b. too little glucose in the bloodstream
   c. Not enough insulin the bloodstream

8. Hypoglycaemia can be caused by
   a. Excessive exercise
   b. Skipping a meal
   c. A&B

9. In a healthy adult, the blood sugar level (after fasting) should be:
   a. 2-3.9mmol/L
   b. 3.9 – 6mmol/L
   c. 7-11mmol/L
10. A blood glucose level of 7.5 mmol/L in an adult male (taken after a meal) indicates
   a. He is healthy  
   b. He is pre-diabetic  
   c. He is diabetic
11. Which of the following symptoms does not refer to DM?
   a. Blurred vision  
   b. Irregular heartbeat  
   c. Feeling pins and needles in the feet
12. Xerostomia refers to  
   a. Dry mouth  
   b. Dry skin  
   c. Dry eyes
13. Without enough insulin, the body breaks down fat as fuel. This process produces a build-up of acids in the bloodstream called  
   a. diabetes  
   b. hypoglycaemia  
   c. ketones
14. Ketoacidosis is  
   a. A chemical imbalance  
   b. Life threatening  
   c. A&B
15. A diabetic patient with a very dry mouth, sweet smelling breath and high pulse rate is most probably  
   a. Hypoglycaemic  
   b. Hyperglycaemic  
   c. Nervous
16. A diabetic patient that is fighting with the receptionist, confused when entering your surgery and is visibly perspiring is most probably  
   a. Hypoglycaemic  
   b. Hyperglycaemic  
   c. Nervous
17. For a hyperglycaemic patient, what should you NOT do?  
   a. Administer insulin  
   b. Give sugary drink  
   c. CPR
18. For a hypoglycaemic patient, what should you NOT do?  
   a. Administer insulin  
   b. Give sugary drink  
   c. CPR
19. Elevated serum levels of IL-6 and CRP have been seen in the development of type2 DM  
   a. True  
   b. False
20. Elevated serum levels of IL-6 and CRP have been seen in patients with periodontitis  
   a. True  
   b. False
21. There is evidence to show that bacteria commonly found in the presence of periodontitis may play a role in obesity.
   a. True
   b. False

22. Studies showed that diabetic patients who had periodontal treatment showed
   a. No improvement of control of blood glucose levels
   b. Long-term improvement of control of blood glucose levels
   c. Short-term improvement of control of blood glucose levels

23. There are no similarities between the long term management of periodontitis and diabetes
   a. True
   b. False

24. Stressing the importance and educating the patient in self-management of the disease most probably will
   a. Improve the periodontal condition of the patient
   b. Improve the glycaemic control of the patient
   c. A&B

25. Which of the following professionals does not form part of the regular team recommended to look after the diabetic patient
   a. Oral hygienist
   b. Podiatrist
   c. Physiotherapist
   d. Optometrist

26. A thorough periodontal exam includes examining the TMJ
   a. True
   b. False

27. Periodontal radiographs should be
   a. Current
   b. Of diagnostic quality
   c. A&B

28. Signs of habits like nail biting does not need to be included in a thorough periodontal exam
   a. True
   b. False

29. Which of the following statements are false?
   a. Patients should be made aware of the disease process, treatment alternatives, potential complications, expected results and their responsibility in the treatment
   b. Consequences of no treatment should be explained to the patient
   c. None

30. The dental team plays an important role in the management of both diabetes and periodontitis
   a. True
   b. False

Resources:

4. http://care.diabetesjournals.org/content/27/suppl_1/s5 [accessed 14/06/2016]
5. Modern Dental Assisting 9th Edition Bird Robinson [p467]
10. www.diabetes.co.uk [accessed 23/06/2016]