



## Module 1931

# Chronic complications of diabetes

From this pharmacy CPD module you will learn about:

- The main chronic complications of diabetes
- Prevention strategies for chronic complications
- How complications are treated
- Practical advice to help patients manage these

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Diabetes mellitus is a group of metabolic diseases that can cause high blood glucose levels (hyperglycaemia) as a result of inadequate insulin secretion or the body's inability to use insulin, or both. Insulin is the hormone responsible for regulation of blood glucose levels in the body. It is secreted by beta cells in the pancreas when blood glucose levels rise; for example, after a meal.

Autoimmune destruction of the insulin-producing cells of the pancreas means that patients with type 1 diabetes cannot usually produce any insulin.

Around nine out of 10 people with diabetes have type 2.<sup>1</sup> In type 2 diabetes, insulin is produced, but is insufficient for the body's requirements. Insulin resistance can also be a problem, where the fat and muscle cells in the body become insensitive to insulin.<sup>2</sup>

Both type 1 and type 2 diabetes can result in an array of chronic complications if poorly managed. Diabetes and its complications cost the NHS over £6 billion to treat annually.<sup>1</sup>

Chronic hyperglycaemia in poorly controlled diabetes is associated with damage, dysfunction

and failure of many organ systems. Consistently raised blood glucose levels can result in damage to blood vessels throughout the body. Even mildly raised levels that do not result in symptoms can have lasting, damaging effects on blood vessels, nerves and organs.<sup>3</sup>

Most complications of diabetes are caused by damage to these blood vessels, although non-vascular complications do also occur. While the pathophysiology of type 1 and type 2 diabetes differs, the complications that present are similar for both.<sup>4</sup> Chronic complications may take years to develop and are more common in those who have poor glucose control.

Complications can be categorised as:

- microvascular – affecting small blood vessels
- macrovascular – affecting larger blood vessels
- non-vascular.

### Macrovascular complications

The central pathological mechanism of macrovascular complications in diabetes is atherosclerosis, where plaques lining the blood vessels narrow them. Atherosclerosis of large vessels can result from the altered blood levels of insulin, lipids and glucose. Plaques are

made up of lipids, inflammatory cells, smooth muscle cells and connective tissue, and cause a turbulent blood flow through the blood vessels.<sup>5</sup> Atherosclerosis can manifest as the following:

### Peripheral vascular disease (PVD)

PVD is a narrowing of the blood vessels that supply the extremities, particularly the hands and feet, resulting in claudication. This poor circulation reduces the oxygen supply to the muscles, often resulting in pain. Patients can report cramping pains in the calves when walking.

### Coronary artery disease (CAD)

CAD is a narrowing of the coronary blood vessels through atherosclerosis. Poor blood flow to the myocardium causes a build-up of lactic acid in the cardiac muscle resulting in pain on exertion – angina pectoris. CAD is the main cause of death in patients with diabetes.<sup>6</sup>

### Myocardial infarction (MI)

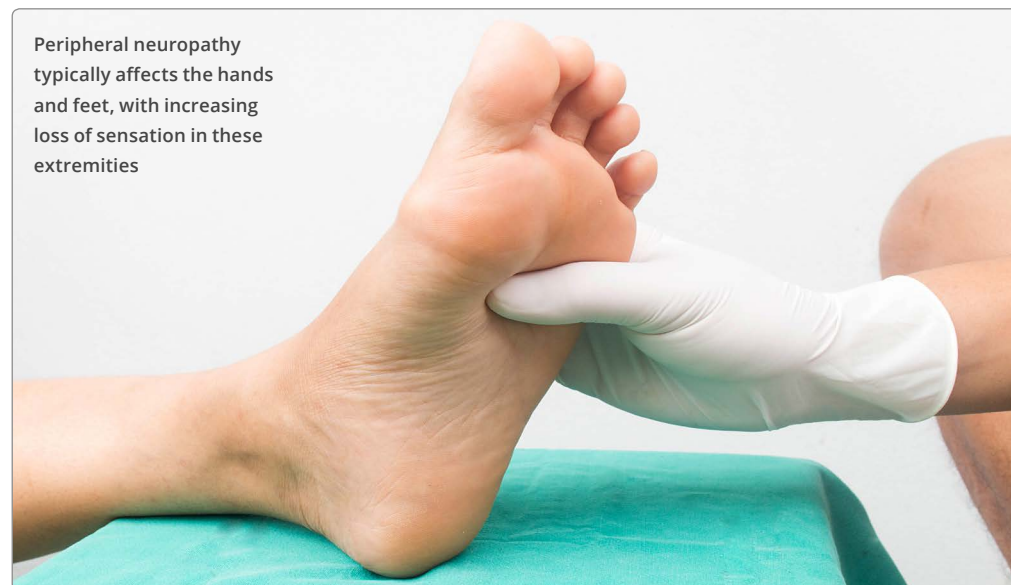
MI, commonly referred to as 'heart attack', is the irreversible death of heart muscle as a result of a prolonged lack of oxygen (ischaemia).

Patients may report pain, discomfort or malaise in the days or weeks preceding the event.<sup>7</sup> MI results from acute obstruction of a coronary artery. A coronary blood vessel can become blocked by a blood clot (thrombosis) or a ruptured plaque, blocking blood supply (infarction) and therefore oxygen to the cardiac muscle. In severe cases, the infarction can cause death.

### Cerebrovascular disease

Cerebrovascular disease is a narrowing of the two internal carotid arteries in the neck from atherosclerosis, which can increase the risk of transient ischaemic attacks (TIA). In a TIA, occlusion of the small blood vessels in the brain is caused by clots or dislodged fragments of plaque. Symptoms mimic that of a stroke and include paralysis of the face, arm or leg, slurred speech, dizziness or headache.<sup>8</sup> Symptoms subside within 24 hours and permanent brain damage does not usually occur. When the embolus is significantly large enough to completely block an artery supplying blood to the brain for a prolonged period of time, a stroke can result.

Peripheral neuropathy typically affects the hands and feet, with increasing loss of sensation in these extremities



## Microvascular complications

### Diabetic neuropathy

Diabetic neuropathy – nerve damage – is the most common complication of diabetes.<sup>9</sup> It can occur through varying mechanisms, including direct damage from hyperglycaemia and reduced blood flow to nerves from damaged small blood vessels.

### Peripheral neuropathy

Typically affects the hands and feet, with increasing loss of sensation in these extremities, and is therefore sometimes referred to as 'glove and stocking' distribution. Patients may also report numbness, tingling, pain and itchiness (paraesthesia). With loss of sensation in the lower legs and feet, ulcers are common when cuts and wounds on the feet go unnoticed. This broken skin is also an opportunity for infection to develop.

### Autonomic neuropathy

Autonomic neuropathy involves the destruction of nerves of the autonomic nervous system. Commonly this can result in a reduction of sweat from glands in the feet (eccrine glands) leading to dry, cracked skin and the possibility of infection. In severe cases, gangrene can occur. Gastroparesis is another manifestation of autonomic neuropathy. The movement of muscles in the stomach is reduced and food is therefore not adequately digested. The partially digested food may also be limited in its movement to the duodenum through reduced opening of the pyloric sphincter, causing bloating, nausea, constipation and diarrhoea.<sup>10</sup>

### Diabetic nephropathy

One in three people with diabetes go on to develop kidney disease.<sup>11</sup> The delicate filtration membranes of the nephrons become damaged from excess glucose in the blood and cause a reduction in the glomerular filtration rate (GFR). Patients usually do not experience symptoms until the disease has fully developed.

### Diabetic retinopathy

The retina is located at the back of the eye. It is a light-sensitive layer of cells that convert light into electrical signals that the brain perceives as images. The retina is supplied with a rich supply of blood through a network of tiny blood vessels. Damage to these blood vessels with leakage of blood into the eye and the development of new, weak blood vessels and scar tissue all contribute to diabetic retinopathy. Symptoms of blurred and worsening vision become more apparent as the disease progresses, while untreated cases can lead to complete loss of sight.<sup>12</sup>

### Sexual dysfunction

Damage to nerves and blood supply both contribute to erectile dysfunction in 35–75% of male patients with diabetes.<sup>13</sup> These factors can also contribute to vaginal dryness in women, leading to pain and discomfort during intercourse. Both men and women with diabetes may suffer from reduced libido.

### Periodontal disease

This is caused by the blood supply to the gums becoming restricted in diabetes. When combined with high glucose levels, bacteria can thrive and cause infection and a build-up of plaque. Patients may experience sore or bleeding gums, gingivitis (bad breath) and receding gums.

## Non-vascular complications

### Dyslipidaemia

Defects in insulin action and hyperglycaemia can lead to changes in plasma lipoproteins in patients with diabetes.<sup>14</sup> The increase of low-density lipoproteins (LDL), high plasma triglyceride concentrations and lower levels of high-density lipoproteins (HDL) can be a risk factor for cardiovascular disease (CVD).

### Infections

Patients with diabetes are more prone to infections, particularly of the skin and urinary tract. Hyperglycaemia and low blood pH can impair

humoral immunity. Poor perfusion of tissues from damage to blood vessels also increases infection risk. The fungal infection thrush caused by *Candida albicans* is commonly seen in patients with diabetes. Oral and vaginal forms of the infection are more usual, although occasionally systemic infection can occur. Infections from bacteria, such as staphylococcal, streptococcal and clostridium strains can be particularly problematic for those with peripheral neuropathy, as it can reduce the skin's ability to act as a barrier.<sup>10</sup>

### Reduced quality of life

The day-to-day management of diabetes can be overwhelming for some patients. Constant monitoring, the planning required for daily activities, such as eating and exercising, as well as managing episodes of hypoglycaemia and hyperglycaemia can all contribute to a reduced quality of life for patients with diabetes.<sup>16</sup>

### Psychological complications

Depression and anxiety are common psychological complications for those with diabetes, with approximately 25% of people with diabetes having depression.<sup>15</sup> Difficulty maintaining glucose control and decreased health-related quality of life contribute to psychological complications.

Patients with diabetes should be aware of symptoms that may indicate the development of diabetes complications. Early detection and treatment of complications will help to slow progression. Visual disturbances, slow-healing wounds, numbness or pins and needles, muscle pain and impotence can all be warning signs of diabetes complications.

Structured education programmes are available for those with type 1 and type 2 diabetes. These

are an excellent way to educate patients on the complications that may develop and how to recognise early signs and symptoms.

## Prevention strategies

There are a number of measures that can help reduce the probability of developing chronic complications:

### Managing blood glucose

Blood glucose should be kept within acceptable levels of 4-7mmol/L (this may vary slightly depending on the time of day). Hyperglycaemia is a key factor in diabetic complications, so tight glucose control is essential. Those with type 1 diabetes may have to monitor blood glucose levels on multiple occasions throughout the day.

Those with type 2 diabetes may not monitor blood glucose daily, but should have HbA1C levels checked at least every six months. HbA1C levels give a good indication of the level of glucose control over the previous three months. Good glycaemic control is indicated by readings of 48mmol/mol (6.5%) for those with type 1 and type 2 diabetes.<sup>17</sup> The lower the HbA1C reading, the lower the risk of long-term vascular complications.

### Weight loss

Being overweight or obese (with a BMI of greater than 30) can increase the risk of developing type 2 diabetes. It is thought that obese people are up to 80 times more likely to develop type 2 diabetes than those with a BMI of less than 22.<sup>18</sup>

Fat cells in the body produce proinflammatory chemicals, which contribute to insulin resistance. This is particularly relevant for those with excess abdominal fat. Diabetic complications are more pronounced in those who have a high BMI, so a 5% reduction in body weight can improve HbA1C levels and decrease the risk of cardiovascular disease.



### Exercise

Muscle contraction stimulates uptake of glucose from the blood, reducing blood glucose levels. All patients with diabetes should be encouraged to engage in mild-to-moderate exercise. This can also contribute to reduced blood pressure, therefore reducing the risk of CVD.

### Healthy diet

Patients with diabetes should follow a healthy diet to help maintain acceptable blood glucose levels. This includes wholefoods such as fruits, vegetables, pulses and wholegrains. Foods high in refined sugars and fat should be limited.

### Reduced alcohol intake

Alcohol can cause blood glucose levels to drop, increasing the risk of hypoglycaemia. It can also contribute to weight gain, another risk factor for diabetes complications. Alcohol should be limited to no more than 14 units per week.

### Smoking cessation

Smoking is a risk factor for cardiovascular disease for those with diabetes. It is also associated with premature development of microvascular complications of diabetes.<sup>19</sup>

### Cholesterol management

The QRISK2 calculator is a tool which can be used to assess 10-year CVD risk.<sup>20</sup>

### Treatment of diabetes complications

Outcomes for the treatment of diabetes complications may improve when glycaemic control is maintained, and other prevention strategies are adhered to. Individual treatment options include:

#### Peripheral neuropathy

The pain of peripheral neuropathy is not usually alleviated with traditional painkillers, such as paracetamol. Instead, amitriptyline, duloxetine, gabapentin and pregabalin are drugs used to treat neuropathic pain.



Patients should be advised on smoking cessation and reducing alcohol intake to reduce risk of complications

Capsaicin 0.075% cream is an option for those who do not wish to take, or cannot tolerate, oral treatments.<sup>21</sup>

#### Foot ulcers

A combination of measures are used to treat slow-healing foot wounds and ulcers in patients with diabetes. Treatment of infection, local wound care and mechanical offloading (reducing the pressure points on the surface of the foot) are used to varying degrees depending on the nature of the ulcer.<sup>22</sup>

#### Periodontal disease

Excellent oral hygiene is required to prevent progression of gum disease. Regular brushing, flossing and use of antiseptic mouthwashes are recommended. Intensive descaling by a dentist may be required.

#### Sexual dysfunction

Sildenafil and tadalafil are commonly prescribed medicines used to treat erectile dysfunction in men with diabetes, and are successful treatments in about two thirds of cases. Vacuum pumps that

encourage blood to flow to the penis and cause an erection can also be used.<sup>23</sup>

#### Diabetic nephropathy

Patients should reduce their salt intake to less than 6g a day. Angiotensin-converting enzyme (ACE) inhibitors help to maintain blood pressure below 130/80mmHg for those with diabetes to prevent further damage to the nephrons. Diuretics, such as furosemide, can be used to alleviate oedema.<sup>24</sup>

#### Cardiovascular disease

Statins and antihypertensives are the mainstay of treatment for cardiovascular disease.

### Practical advice to give patients

Diabetes is a complicated disease that requires management by a highly specialised network of healthcare professionals based in hospital and primary care. Although patients can focus on insulin regimens and medication adherence, there is an array of practical advice that you can provide to patients to help them manage and identify possible complications of their diabetes.

Providing support to manage the cardiovascular

complications may take the form of BMI measurements and weight loss management support. Having a weekly weight check with dietary advice may help to motivate overweight or obese patients. Education on the benefits of exercise and providing information on exercise programmes in the local area can often be a good start. You may provide blood pressure testing in your pharmacy – this could be useful for those who want to monitor their readings between hospital appointments.

Smoking cessation is another important service that many community pharmacies provide. Support your patients by introducing them to the variety of over-the-counter (OTC) options available and refer to their GP when required for prescribed therapies.

Patients with chronic complications associated with diabetes often present with a variety of complaints, which you may be able to advise on:

#### Dry skin

Suggest an emollient for those with cracked dry skin, particularly after washing. Advise patients to use warm, rather than hot, water.

#### Foot care

Remind patients to check their feet daily for redness, blisters, cuts and swelling. Patients should look between the toes, on the soles and around the heels, where cuts may not be immediately visible. Advise patients to cut their toenails straight across, wear well-fitted shoes and keep feet away from direct heat, such as hot water bottles.

#### Eyes, nose and mouth

For dry eyes, nose and mouth, patients may get relief from artificial tears, nasal spray and saliva. Remind patients that even chewing gum or rinsing their mouth can also promote saliva flow.

#### Oral hygiene

Suggest a suitable oral hygiene regimen for your patients, which includes a good quality toothbrush for twice daily brushing, dental floss and an antiseptic mouthwash.

# Complications of diabetes CPD

## What are you planning to learn?

I want to learn more about the main chronic complications of diabetes, strategies to prevent them occurring, and how they can be managed.

This learning will help me to refresh and maintain my existing skills and knowledge about diabetes and its long-term complications, and to be able to confidently provide advice to patients and carers, to spot at-risk patients and know when to refer.

## How are you planning to learn it?

- I plan to read more about diabetes on the Patient website at [tinyurl.com/diabetescomplications1](https://www.patient.co.uk/diabetescomplications1).
- I plan to find out more about the complications of diabetes from the Diabetes UK website at [tinyurl.com/diabetescomplications2](https://www.diabetes.org.uk/diabetescomplications2), which has links to individual complications and is a useful resource for patients.
- I plan to read more about essential diabetes checks for diabetic patients to reduce the risk of complications on the Diabetes UK website at [tinyurl.com/diabetescomplications3](https://www.diabetes.org.uk/diabetescomplications3).

## Give an example of how this learning has benefited the people using your services.

A patient with type 2 diabetes recently asked for advice, as they had been suffering from numbness and tingling in their fingers and toes. I was able to explain that this could be a complication of their diabetes, but there were steps they could take to manage the condition. I discussed healthy lifestyle advice and suggested some online resources they could use for information and support. I referred them to their GP for a diabetes check.

## References

1. Valabhji J (2018) Blog: Type 2 diabetes and the importance of prevention.
2. Stoppler MC (2016) Type 1 vs. Type 2 diabetes: which one is worse?
3. NHS Direct Wales (2019) Encyclopaedia: Diabetes, Type 2.
4. World Health Organisation (2019) Complications of diabetes.
5. Thanassoulis G, Afshar M (2017) Atherosclerosis. MSD Manual – Professional Version.
6. Aronson D, Eledman E. Coronary artery disease and diabetes mellitus. *Cardiol Clin* 2014;32(3):439–55.
7. Zafari AM, Abdou MH (2019) Myocardial infarction.
8. Mayo Clinic (2019) Transient ischemic attack (TIA).
9. World Health Organisation (2019) Diabetes programme. About diabetes: complications of diabetes.
10. Nursing Times Review (2017) Diabetes management 2: long-term complications due to poor control.
11. Diabetes UK (2019) Complications of diabetes – kidney disease (nephropathy).
12. NHS (2018) Diabetic retinopathy.
13. Diabetes.co.uk (2019) Diabetes and erectile dysfunction.
14. Goldberg IJ. Diabetic dyslipidemia: causes and consequences. *J Clin Endocrinol Metab* 2001;86:965–71.
15. Penckofer S, Ferrans CE, Velsor-Friedrich B, *et al*. The psychological impact of living with diabetes. *Diabetes Educ* 2007;33(4):680–90.
16. National Institute for health and Care Excellence Clinical Knowledge Summaries (CKS) (2017) Diabetes type 2.
17. National Institute for health and Care Excellence. Type 2 diabetes in adults: management. Nice guideline (NG28). London: Nice, 2017.
18. Diabetes.co.uk (2019) Diabetes and obesity.
19. American Diabetes Association: Diabetes care (2003) Smoking and diabetes.
20. National Institute for health and Care Excellence (2019) Nice recommends wider use of statins for prevention of CVD.
21. NHS (2019) Peripheral neuropathy: treatment.
22. Armstrong D, McCulloch DK, de Asla RJ (2019) Management of diabetic foot ulcers. UpToDate.
23. NHS Inform (2019) Erectile dysfunction (impotence).
24. NHS (2019) Chronic kidney disease.

# Take the 5-minute test online

1. Most complications of diabetes are caused by damage to blood vessels throughout the body.  
**True or false**
2. Although the pathophysiology of type 1 and type 2 diabetes is different, the complications are similar for both.  
**True or false**
3. Peripheral vascular disease is the most common complication of diabetes.  
**True or false**
4. Coronary artery disease is the main cause of death in patients with diabetes.  
**True or false**
5. Half of those diagnosed with diabetes go on to develop kidney disease.  
**True or false**
6. Symptoms of diabetic retinopathy include blurred and worsening vision.  
**True or false**
7. Damage to nerves and blood supply contribute to erectile dysfunction in over 90% of male patients with diabetes.  
**True or false**
8. To help prevent complications, blood glucose levels should be kept within 7-9mmol/L.  
**True or false**
9. Obese people are up to 80 times more likely to develop type 2 diabetes than those with a BMI below 22.  
**True or false**
10. Ibuprofen and paracetamol are first choice treatments for pain relief in peripheral neuropathy in patients with diabetes.  
**True or false**

**CD** Update Plus