Identifying and managing the complications of diabetes

**AUTHOR** Jillian Hill, BSc, RGN, is diabetes nurse consultant, Eastern Birmingham Primary Care Trust.

**ABSTRACT** Hill, J. (2004) Identifying and managing the complications of diabetes. Nursing Times; 100: 34, 40–44. Diabetic complications are common, costly and have a major impact on length and quality of life. There is good evidence that they can be delayed or even prevented in type 1 and type 2 diabetes by achievement of normoglycaemia, control of other risk factors, regular review and early treatment. This article discusses the type of damage that can occur in both type 1 and type 2 diabetes, which patients are particularly vulnerable and why, the costs of diabetic complications, how they can be prevented, the nursing implications of caring for patients who already have damage and helping to prevent it in others.

Diabetes is a common chronic condition that, if not adequately controlled, can lead to acute metabolic complications such as diabetic ketoacidosis (DKA) in type 1 diabetes and hyperosmolar nonketotic coma (HONK) in type 2 diabetes. The discovery of insulin and its use as a therapeutic agent in the management of type 1 diabetes in the early 1920s led to the apparent miraculous recovery of extremely sick patients with DKA, who were brought back from the brink of death (Bliss, 1982).

However, after these patients had survived for a number of years on insulin therapy, it gradually became apparent that although the acute complications of type 1 diabetes were now less life-threatening, the long-term management of the condition was a challenge. It became important to address the chronic diabetes complications that, 80 years later, are still so commonly seen in people with type 1 and type 2 diabetes attending diabetes clinics.

The long-term complications of diabetes can affect most systems of the body, including the eyes, kidneys and the nervous system. Clear evidence is now available to demonstrate that complications can be delayed or even prevented in both type 1 and type 2 diabetes. The challenge lies in supporting and educating patients to control their diabetes adequately to achieve this.

As the world faces a diabetes epidemic (King et al, 1998), with a large rise in the number of people developing type 2 diabetes in particular, the prevention of complications or at least minimising the incidence of disability these can cause, is a vital goal for all health services.

**LEARNING OBJECTIVES**

- Familiarise yourself with the different types of diabetic complication
- Be able to recognise the signs of diabetic complications in the patient
- Gain an awareness of the effects of particular diabetic complications on the patient
- Understand the methods of preventing diabetic complications

**Complications**

Diabetes complications can be categorised into those caused by damage to the microvascular system supplying nerves and organs, and those caused by macrovascular damage. Some complications involve both micro and macrovascular damage, as seen in diabetic foot problems. The duration of diabetes, the toxic effects of hyperglycaemia, dyslipidaemia, hypertension and unhealthy lifestyles are all significant factors in the development of complications.

**Microvascular**

This involves the small blood vessels of the retina (leading to diabetic retinopathy), kidneys (diabetic nephropathy) and nerves (leading to peripheral and autonomic neuropathy). The occurrence of microvascular complications is related to duration and degree of hyperglycaemia as demonstrated very clearly in a prospective study of 4,400 of patients with type 1 and type 2 diabetes who were followed for up to 25 years by Pirart. Those with a long duration of hyperglycaemia were at a much higher risk of developing complications than those with better glycaemic control (Pirart, 1978).

**Retinopathy**

Damage to the blood vessels at the back of the eye can lead to blindness, and, diabetic retinopathy is still the most common cause of blindness in people of working age in the UK (Evans, 1995) (Fig 2, p42). There are often no symptoms until advanced disease is established. Therefore, annual eye screening through dilated pupils is essential to identify the condition at an early stage so progression to sight-threatening retinopathy can be halted or slowed down by treatment (National Institute for Clinical Excellence, 2002).

In the early stages, examination of the retina will
reveal evidence of small blood vessels closing off, with compensatory dilation of other vessels. This results in microaneurisms, small haemorrhages and hard exudates (white or yellow plaques of proteins and lipids that have leaked out of damaged blood vessels). This clinical stage is termed background retinopathy. It often does not require specific treatment at this stage unless it occurs in the macula region (the central part of the retina and the section most crucial for sight).

With worsening ischaemia of the retina, there is further development of intraretinal microvascular abnormalities, with some blood vessels becoming dilated and twisted. Pale white areas where retinal vessels have become blocked causing localised nerve damage will be seen. These are commonly described as ‘cotton wool spots’. This stage is called preproliferative retinopathy. Even at this stage, the patient may have no symptoms.

Proliferative retinopathy develops through the proliferation of new blood vessels (neovascularisation) in response to growth factors released as a result of retinal ischaemia. Unfortunately, many of these vessels grow forward into the vitreous gel. As this does not provide adequate support, they bleed easily, causing the sudden devastating haemorrhages that can lead to blindness. Fibrous adhesions can develop, the traction of which can lead to retinal detachment.

Treatment by laser can prevent blindness by sealing points of vascular leakage from damaged blood vessels. It can also reduce oedema and deposition of hard exudates but will not restore sight. Improvement in glycaemic control and blood pressure are crucial for slowing down the progression of retinopathy. Sudden improvement in blood-glucose control can, however, in the short term, accelerate existing retinopathy.

**Nephropathy**
Diabetic renal disease is a major cause of morbidity and mortality in people with type 1 diabetes. Although it is not as common in people with type 2 diabetes, proportionally it is still a large problem because of the huge number of people with this type of diabetes. It progresses through five stages (Table 1, p42).

Aggressive control of blood pressure and glycaemia in the early stages of nephropathy can slow down the progression of this condition. Angiotensin-converting enzyme (ACE) inhibitors are usually the first antihypertensive agent used in patients with microalbuminuria, even in those who are normotensive. These agents reduce pressure in the glomeruli in the kidney, and reduce urinary albumin loss. To achieve normoglycaemia may require conversion to insulin therapy in patients on oral hypoglycaemic agents.

**Neuropathy**
This is the most common complication and is very difficult to treat. It is caused by damage to the microvascular system supplying the peripheral and autonomic nerves. Diabetic peripheral neuropathy commonly affects the feet, resulting in a variety of symptoms including reduced sensation, pain and paraesthesia. Painful peripheral neuropathy can be very difficult to manage, with the tricyclic antidepressants being most effective in the treatment of the nocturnal burning pain that often accompanies this condition.

Motor neuropathy causes atrophy of the small muscles of the foot, leading to deformities such as hammer toes and gait changes. This results in localised repetitive pressure in vulnerable areas, which can lead to callus formation and ulcers.

Neuropathic foot ulcers have a classic punched-out appearance with a halo of callus and exudate, and are usually painless due to the lack of sensation. Autonomic neuropathy results in dry cracked skin due to a reduction in sweating, and arteriovenous shunting, resulting in abnormal blood flow through the foot. The combination of repeated injuries to a numb foot and these changes can result in Charcot deformity, a grossly misshapen foot with a high risk of ulcer development.

Whereas the neuropathic foot is warm and numb with bounding pulses, the diabetic ischaemic foot is cold, pale or discoloured, with faint or absent pulses on palpation and Doppler scan. Ulcers are extremely painful, with little callus formation or exudate, and situated on the margins of the foot. Dry gangrene may develop, with autoamputation of the affected toe occurring eventually.

Usually, there is evidence of both neuropathic and ischaemic damage. The identification and classification

**FIG 1. COMPLICATIONS OF DIABETES**
Over time, high glucose levels can lead to the complications illustrated below

- **Stroke**
- **Eye disease**
- **Heart disease**
- **High blood pressure**
- **Kidney disease**

**Peripheral neuropathy (nerve disease)**

**Pain or loss of the lower leg(s) due to impaired blood flow**

**REFERENCES**


of people who are at risk of complications that affect their feet is essential and this is the basis for inclusion of the foot examination in the annual diabetes review. Education in self-care, regular review and rapid access to treatment if necessary are the foundations for diabetes foot complication management (NICE, 2004). Diabetic foot disease is the most common cause of non-traumatic amputation in the UK – someone with diabetes is at 15 times greater risk than someone who does not have diabetes (Williams and Pickup, 1999). Unfortunately, the number of amputations in these patients is increasing as diabetes prevalence increases (Connor et al, 2000). Autonomic neuropathy in other body areas can present as postural hypotension, erectile dysfunction, gastroparesis (delayed gastric emptying), gustatory sweating (induced by eating), diabetic diarrhoea and neuropathic bladder.

**Macrovascular damage**

This affects the large blood vessels to the heart, brain and legs leading to coronary heart disease, myocardial infarction, stroke and peripheral vascular disease. Hyperglycaemia plays a less significant role in causing macrovascular damage. Hypertension, smoking and dyslipidaemia are more important. Macrovascular complications are the major cause of death in patients with type 2 diabetes, with coronary heart disease accounting for 70 per cent of deaths (Campbell, 2001). Risk of suffering a myocardial infarction is similar in patients with diabetes without previous MI and those without diabetes who have already had an MI (Haffner et al, 1998).

**Who develops complications?**

Diabetes complications can occur in people with both type 1 and type 2 diabetes (Audit Commission, 2000). Despite being described as ‘mild diabetes’ in the past, type 2 diabetes is a complex condition with an insidious onset. This means many patients may have had the condition for several years before diagnosis. Many present with established complications at the time of diagnosis. For example, 37 per cent of newly diagnosed patients already showed signs of retinopathy in the UK Prospective Diabetes Study (UKPDS, 1994). This may have an impact on motivation to change lifestyle and concordance with medication if the patient feels it is too late as the damage has already been done.

Complications are related to duration of diabetes. In type 1 diabetes, diabetic retinopathy is rarely seen in patients who have had the condition for less than five years, but is present in 90 per cent of patients who have had the condition for over 20 years (Klein et al, 1984). Thirty per cent of these patients also have persistent proteinuria, which can indicate renal damage (Williams and Pickup, 1999).

The degree to which glycaemia was kept within normal limits over those years will also determine risk of damage development. Other factors such as smoking, self-care skills, hypertension and dyslipidaemia are also significant, particularly in the development of macrovascular damage.
Patient impact

The presence of diabetes complications can have a big impact on the person’s quality of life as well as life expectancy. The ability to work can be affected, which impacts on income, quality of housing, and the ability to take holidays or own a car. Relationships can suffer, both through financial difficulties, dependence on partners and effect on self-esteem, as well as the obvious impact of some complications, particularly erectile dysfunction.

Depression is more common in people with diabetes compared with those without (Anderson, 2001), but there is a particularly strong association between depression and the presence of complications (Lustman, 1997). Patients with complications can feel particularly vulnerable and anxious. For example, people who have lost their sight through retinopathy are especially anxious about hypoglycaemia (Cox et al, 1998).

The impact diabetes has on society has a significant financial cost. CODE-2 (Cost of Diabetes in Europe-Type 2) (Baxter et al, 2000) suggests that the annual cost of managing type 2 diabetes for someone without complications is on average £864. This cost increases to £1,339 if microvascular complications are present, to £2,124 if macrovascular complications are present, and to £2,277 for patients with both microvascular and macrovascular complications (Baxter et al, 2000).

The 2TARDIS study (Type 2 diabetes Accounting for a major Resource Demand In Society) (Bottomley, 2001) also examined the hidden costs of living with complications, such as taking time off work, transport costs to outpatient clinics, and partners taking time off work to care for the person with diabetes. This study found that the cost of treating someone with both micro and macrovascular complications was £5,332 compared with £920 for someone with type 2 diabetes with no complications. Generally, the presence of complications significantly increased costs due to the likelihood of more frequent and longer inpatient stays, and residential and nursing home care (Bottomley, 2001).

Prevention

The recognition of the devastating impact of complications, and the need for well-organised diabetes care to prevent them, resulted in a World Health Organization commitment to take effective action in the early 1990s. A number of targets were agreed, resulting in the St Vincent’s Declaration. These included a reduction in blindness by a third or more, a reduction in limb amputations by 50 per cent, and a reduction in the number of people with diabetes developing end-stage renal failure by a third by 2000 (St Vincent Joint Task Force for Diabetes, 1995). Sadly, these targets have not been achieved.

The focus for modern diabetes management is to achieve day-to-day well-being and a good quality of life, but to minimise the risk of long-term complications (without unacceptable side-effects from treatment). Two large studies have provided evidence that keeping diabetes controlled within normal parameters will reduce the risk of developing complications.

Diabetes Control and Complication Trial (DCCT)

This was a large-scale prospective study of 1,440 patients with type 1 diabetes in 29 centres in the US. Patients were randomised to either conventional therapy (daily or twice-daily insulin with three-monthly clinic appointments) or intensive treatment (three or more insulin injections a day or continuous subcutaneous insulin infusion pump, supported by monthly clinic appointments and weekly telephone calls from a diabetes specialist nurse). These patients performed frequent home blood-glucose measurements and adjusted their insulin as required to achieve tight blood-glucose control.

After nine years, microvascular complications were significantly reduced in the intensively treated group, with retinopathy, nephropathy and neuropathy being reduced from 35 to 75 per cent. Tight control was also shown to slow down the progression of existing complications, with the average risk of progression in early retinopathy reduced by about 50 per cent (Diabetes Control and Complications Trial Research Group, 1993).

UK Prospective Diabetes Study (UKPDS)

This study of more than 5,000 patients with type 2 diabetes in 23 centres looked at the effect of tight glycaemic control (and blood-pressure control) on the prevention or delay of the development of complications. The intensively treated group achieved an HbA1c that was 0.9 per cent lower than the conventionally treated group, which resulted in a 25 per cent reduction in microvascular endpoints (UK Prospective Diabetes Study (UKPDS) Group, 1998a).

Although glycaemic control is important in the prevention of microvascular damage, improvement in blood pressure was shown to reduce both microvascular and macrovascular complications (UKPDS, 1998b).

The management of dyslipidaemia also has an impact on the prevention of macrovascular complications - this has been demonstrated in trials such as the Scandinavian Simvastatin Survival Study (4S). Cholesterol lowering with simvastatin improves prognosis of diabetic patients with coronary heart disease: a sub-group analysis of the Scandinavian Simvastatin Survival Study (4S). Diabetes Care; 20: 614-620.

REFERENCES


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screening for early indicators of damage is an essential part of diabetes management. Every person with diabetes should be offered an annual review with her or his diabetes team, either in primary or secondary care. This includes examination of both feet for neuropathy and peripheral vascular disease, screening for the presence of microalbumin in urine for nephropathy, and retinopathy screening. The latter may be performed at a diabetes centre or by accredited optometrists using digital photography through dilated pupils.

The National Service Framework for Diabetes has set a target that 80 per cent of people with diabetes should be offered screening for retinopathy by 2006, rising to 100 per cent by 2007 (Department of Health, 2001).

The NSF consists of 12 standards of care to be achieved by 2013. Standards 10 and 11 are specifically about complications (Table 2, p43).

Standard 3 encourages the empowerment of people with diabetes through education, shared management planning and development of self-management skills, to achieve the best possible diabetes control. These skills should include home blood-glucose monitoring, self-adjustment of flexible insulin regimens, self-examination and care of feet. This should result in a lowering of the risk of developing complications.

Nursing implications

Diabetes can affect people of all ages, and so most nurses will come into contact with patients with this condition. No matter what area nurses are working in, everyone can be involved in opportunistic education, supporting people to manage their diabetes, identifying complications and guiding the patients to help available elsewhere as required.

This may vary from arranging access to benefits or reminders about annual eye screening, to referral to specialist clinics for erectile dysfunction or fast-tracking a patient to the foot ulcer clinic.

Supporting patients to maintain good diabetes control is essential. Many people with inadequately controlled diabetes may deny any symptoms of hyperglycaemia, and the often difficult daily task of keeping good control may not bring the patient any obvious benefits. Motivating them to persist with self-monitoring, concordance with medication (Morris et al, 1997) and maintaining a healthy lifestyle can be a challenge. This is particularly true if improving diabetes control actually makes the patient feel worse. Patients in the intensively managed group in the Diabetes Control and Complications Trial, for example, had a higher incidence of hypoglycaemia and weight gain than the patients in the conventional group.

Management of patients with established complications usually involves a multidisciplinary team approach. For example, acute foot problems should be managed in a diabetes foot clinic with access to a diabetologist for medical assessment, a diabetes nurse to advise on glycaemic control, a dietitian to advise on the required increase in calories and nutrients necessary for healing while still maintaining normoglycaemia, and a podiatrist and an orthotist for fitting of adequate footwear.

Practice and district nurses are key people in the dressing of foot ulcers and support of patients in the community, often reducing the need for hospital admission. Enabling patients to access other disciplines can improve their quality of life and help them to maintain their independence. For example, a joint appointment with the diabetes nurse and technician from the low vision clinic may result in the choice of an insulin device with a suitable magnifier, thereby helping the person to maintain their independence in terms of the self-injection of insulin.

Education in self-care is crucial in people with established complications. For example, those patients with peripheral neuropathy resulting in reduced sensation in their feet must be advised, on daily examination of their feet, how to identify problems with their feet, how to access help, and how to avoid damaging their feet (for example, by avoiding putting their feet near heat, and not walking barefoot).

As with all patient education, this should be available in the appropriate language and supported by written or taped information. The charity Diabetes UK produces a range of literature for patients with diabetic complications (www.diabetes.org.uk).

Conclusion

Diabetes is extremely common and the number of people with the condition is increasing. If not controlled, it can cause a number of disabling long-term complications, which have a devastating impact on both quality and quantity of life.

Nurses have a major role to play in educating and supporting people to manage the condition adequately and therefore preventing or delaying the development of these complications.

GUIDED REFLECTION

Each week NT publishes a guided reflection article to help you with your CPD. After reading the article use the following points to help you write your reflection:

- Outline why you read this article;
- Detail the last time you came across a patient with diabetic complications;
- List the important points made by the article;
- Write about how you could use this information next time you encounter a patient with diabetes;
- Summarise what you have learnt and how this article could have a positive effect on your practice.