Type 1 diabetes: An introduction

Brian Karet, Beverley McDermott

Type 1 diabetes is a lifelong autoimmune condition characterised by sustained hyperglycaemia. There are number of factors to consider regarding its diagnosis and management, including related complications; age at diagnosis; comorbid conditions; psychological, social and occupational issues; impact on pregnancy outcomes; and implications for older people and those in residential care. This article discusses these issues and explores the fundamental aspects of care that span this long-term condition.

Type 1 diabetes only accounts for an estimated 10% of all cases of diabetes in the UK (Diabetes UK, 2009), but has serious short- and long-term implications and its incidence continues to increase worldwide. The condition has a strong genetic component, inherited mainly through the human leukocyte antigen (HLA) complex. The factors that trigger onset of clinical disease, however, remain unclear – although several theories exist (Menser et al, 1978; Rewers and Zimmet, 2004).

Management of type 1 diabetes is best undertaken in the context of a multidisciplinary healthcare team and requires continuing attention to aspects such as insulin administration, blood glucose monitoring, meal planning, as well as screening for associated conditions and diabetes-related complications – predominantly microvascular and macrovascular disease. Newer treatment approaches, such as the use of continuous subcutaneous infusion pumps, have facilitated improved outcomes both in terms of glycaemic control and reduced risk of developing complications. However, the proliferation of type 2 diabetes threatens to overwhelm healthcare services and to obscure the healthcare implications and challenges of type 1 diabetes (Stumvoll et al, 2005).

The autoimmune cause of type 1 diabetes

Type 1 diabetes is a condition in which pancreatic beta-cell destruction usually leads to absolute insulin deficiency. There are two forms: type 1A results from a cell-mediated autoimmune attack on beta-cells, whereas type 1B is far less frequent, has no known cause, and occurs mostly in individuals of Asian or African descent who have varying degrees of insulin deficiency between sporadic episodes of diabetic ketoacidosis (DKA) (Devendra et al, 2004). This article will use type 1 diabetes to refer to type 1A diabetes.

The theory is that everyone is born with a varying degree of susceptibility to develop type 1 diabetes, which is largely inherited, residing predominantly in the HLA genotypes DR and DQ. The next step requires exposure to one or more environmental triggers that alter immune function, thereby initiating beta-cell destruction; suspects include viruses such as enterovirus and congenital rubella (Menser et al, 1978), cereals and food toxins (Rewers

Supported by a grant from Merck Sharp & Dohme Limited (MSD). These modules were conceived and are delivered by the Primary Care Diabetes Society in association with *Diabetes & Primary Care*. MSD had no input into the modules and is not responsible for their content.

CPD Module 4

CPD module

New online learning opportunity
Visit the journal website to gain a certificate of continuing professional development for participating in this module. See page 236

Learning objectives

After reading this article, the participant should be able to:

1. Describe the basic pathophysiology, epidemiology and prognosis of type 1 diabetes.
2. Outline the main treatment modalities and the issues involved.
3. Explain the educational and vocational implications of type 1 diabetes, such as those related to schools and driving.
4. Define the microvascular and macrovascular complications associated with type 1 diabetes.

Key words

- Diabetic ketoacidosis
- Driving
- Macrovascular and microvascular complications
- Type 1 diabetes

Brian Karet is a GP with Special Interest in Diabetes, Bradford; Beverley McDermott is a Diabetes Specialist Nurse, Bradford.

CPD module

Page points

1. The incidence of type 1 diabetes is increasing by between 2% and 5% a year, and even in countries with the highest rates, such as Finland, there has been no levelling off since statistics records began in the 1950s.
2. Treatment of the sustained hyperglycaemia in type 1 diabetes is always with insulin, and the importance of intensive glycaemic control has come predominantly from the Diabetes Control and Complications Trial (DCCT).
3. The DCCT and its follow-up study provided evidence of a close association between the degree of sustained glycaemic control and the onset or progression of microvascular and also macrovascular complications in people with type 1 diabetes.

and Zimmet, 2004). This leads to abnormal activation of the T-cell-mediated immune system in susceptible individuals, which in turn causes an inflammatory response within the islets (insulitis) and beta-cell destruction.

Antibodies, such as those raised against islet-cells and glutamic acid decarboxylase, are easily detectable, not only in those with type 1 diabetes but in close relatives, and can precede the clinical onset of the condition by many years (Barker et al, 2004). Supportive evidence for the autoimmune pathogenesis of type 1 diabetes comes from the susceptibility of people with autoantibodies for diabetes to other autoimmune conditions, including Hashimoto's thyroiditis, Graves' disease, Addison's disease, coeliac disease, myasthenia gravis and vitiligo (Barker et al, 2005).

Epidemiology and prognosis

Traditionally, type 1 diabetes was regarded as a condition of people under the age of 20 years, often presenting with DKA. Mølbak et al (1994), however, suggest that only 50–60% of those with type 1 diabetes are younger than 16–18 years at presentation, and that type 1 occurs at a low incidence level throughout adulthood. There is, however, a significant trend towards decreasing age at presentation, particularly in children younger than 5 years (Lévy-Marchal et al, 2001), and according to the Department of Health (2007), 10–14 years is the peak age for diagnosis.

The incidence of type 1 diabetes is increasing by between 2% and 5% a year, and even in countries with the highest rates, such as Finland, there has been no levelling off since statistics records began in the 1950s (Gale, 2002). There is also huge geographical variation. Incidence rates in China, for example, are among the lowest in the world, with UK rates roughly 30 times higher, and almost 100-fold higher in Finland and Sardinia (Devendra et al, 2004). Evidence suggests that migrating populations also take on the incidence rates of their new countries in a short time. For example, incidence rates for type 1 diabetes in children of South Asian descent in the UK are similar to those of White or other ethnic populations in the same area, which are different to the very low rates reported in Asia (Raymond et al, 2001).

Aside from the risk of complications, life expectancy for children up to the age of 18 years diagnosed with type 1 diabetes is reduced by between 15–20 years compared with healthy individuals (Narayan et al, 2003).

Treatment and management

Treatment of the sustained hyperglycaemia in type 1 diabetes is always with insulin, and the importance of intensive glycaemic control has come predominantly from the Diabetes Control and Complications Trial (DCCT Research Group, 1993) and its follow-up study (Nathan et al, 2005).

The DCCT provided evidence of a close association between the degree of sustained glycaemic control and the onset or progression of microvascular complications (retinopathy, nephropathy and neuropathy; DCCT Research Group, 1993), and also macrovascular complications (cardiovascular, cerebrovascular, and peripheral vascular disease; Nathan et al, 2005), with no threshold effect, i.e. any decrease in HbA_{1c} concentrations is associated with a similar decline in relative risk of complications. There was also no HbA_{1c} level below which complications are completely prevented.

In addition the central role of smoking, obesity, hypertension and hyperlipidaemia was also uncovered, and the benefits continue to be seen years after the initial interventions have ceased (Mühlhauser et al, 1996). This legacy effect – whereby intensive control in the early years of type 1 diabetes results in significant long-term risk reductions in developing micro- and macrovascular complications – demands that intensive management be instituted as soon as diabetes is diagnosed. The downside of this is the increased risk of hypoglycaemia with increasingly tight glycaemic control. On occasions, a basal–bolus regimen is not possible, either because of patient choice, insulin administration issues or injection site problems, and less intensive regimens may have to be used, such as twice-daily premixed regimens.

Increasing numbers of adults and children, particularly those with recurrent hypoglycaemia

or difficult-to-control diabetes, are being offered insulin pumps (continuous subcutaneous insulin infusion), and primary care teams need to know how to get advice on the practical issues that people on pumps encounter (NICE, 2008).

Complications of type 1 diabetes

Microvascular complications

Diabetic nephropathy is the most common cause of renal failure in the developed world (Finne et al, 2005). It is typically defined by macroalbuminuria, the presence of which has been shown to be highly predictive of progression to advanced stages of diabetic nephropathy (DCCT/EDIC Research Group, 2003). Annual screening of people with type 1 diabetes can help to reverse the progression to end-stage renal failure if treatment with angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) is initiated early on in the disease pathway (Fioretto and Solini, 2005). NICE (2004) recommends that blood pressure should be "maintained below 130/80 mmHg by addition of other antihypertensive drugs if necessary", although the current Quality and Outcomes Framework indicator is 140/85 mmHg (NHS Employers, 2009).

Diabetic retinopathy is the most common cause of acquired blindness in people of working age in the Western world, with a prevalence rate for proliferative retinopathy of about 20–25% in type 1 diabetes (Fong et al, 2004). It progresses through recognisable stages: from early non-proliferative changes – previously called background retinopathy (microaneurysms, exudates and haemorrhages), which appear in almost all individuals with type 1 diabetes of about 20 years' duration – to proliferative retinopathy (with risk of retinal detachment and vitreous haemorrhage) and macular oedema (Fong et al, 2004). Unlike early retinopathy, the later stages can be sight-threatening. Indeed, older people with type 1 diabetes of more than 20 years' duration have a 90% chance of having diabetic retinopathy and 20% of these will progress to sight-threatening disease.

Diabetic neuropathy often begins with a loss of sensation in the extremities. Signs and symptoms of diabetic neuropathy are outlined in *Box 1*. Diabetic neuropathy may be localised, for example carpal tunnel syndrome or diabetic amyotrophy, or generalised, such as sensorimotor polyneuropathy, which often presents as a peripheral neuropathy alone, but may also affect the autonomic system (diabetic autonomic neuropathy [DAN]) with cardiac dysfunction, gastroparesis and erectile dysfunction.

One type of DAN – cardiac autonomic neuropathy (CAN) – may, at its mildest, impair exercise tolerance by impeding the reflex tachycardia associated with exercise or may cause orthostatic hypotension resulting in dizziness on standing. This may be a significant factor in the increased risk of falls in older people with type 2 diabetes (Schwartz et al, 2008). More seriously, CAN is responsible for silent myocardial infarctions in people with diabetes because of cardiac denervation. This is a particular problem during exercise when DAN can also cause decreased sweating, leading to a dangerous rise in body temperature, as well as in older people whose cardiac symptoms may present in unusual ways (epigastric pain, back pain) .

DAN may be a significant contributory factor in hypoglycaemic unawareness (Vinik et al, 2003), because the normal counter-regulatory system in which glucagon and adrenaline are secreted in response to hypoglycaemia is significantly impaired. This makes driving potentially hazardous. In addition, those with DAN may also have a problem driving at night because of a reduced or absent papillary response to light, which can easily be tested for.

Box. 1. Signs and symptoms of diabetic neuropathy.

- Tingling in the extemities.
- Weakness.
- Burning sensations.
- Loss of sensitivity to warmth or cold.
- Numbness – if the nerves are damaged enough, the patient may be unaware that a blister or minor wound has developed.
- Abnormal blood pressure.
- Problems with bowel and bladder control.
- Erectile dysfunction in men.
- Bone deformity in foot (Charcot foot).

Page points

1. Diabetic nephropathy is the most common cause of renal failure in the developed world, and is typically defined by macroalbuminuria.
2. Diabetic retinopathy is the most common cause of acquired blindness in the working age population of the Western world, with a prevalence rate for proliferative retinopathy of about 20–25% in type 1 diabetes.
3. Diabetic neuropathy may be localised, for example carpal tunnel syndrome or diabetic amyotrophy, or generalised, such as sensorimotor poly-neuropathy, which often presents as a peripheral neuropathy alone, but may also affect the autonomic system (diabetic autonomic neuropathy) with cardiac dysfunction, gastroparesis and erectile dysfunction.

CPD module

Page points

1. Peripheral neuropathy in conjunction with peripheral vascular disease can lead to neuropathic ulceration of the lower limbs (the diabetic foot), poor healing and gangrene, and amputation.
2. Cardiovascular disease accounts for about 52% of all deaths in people with type 2 diabetes and approximately 44% of deaths in type 1 diabetes.
3. Diabetic ketoacidosis results from hyperglycaemia due to absolute insulin shortage, elevating ketone levels in the blood and inducing metabolic acidosis.
4. Clinical autoimmune thyroid disease occurs in about 5% of people with type 1 diabetes, although antithyroid antibodies are found in a third of people newly diagnosed with the condition, often presenting as Hashimoto's thyroiditis.

Peripheral neuropathy in conjunction with peripheral vascular disease can lead to neuropathic ulceration of the lower limbs (the diabetic foot), poor healing and gangrene, and amputation (Perkins and Bril, 2002). If nerve damage is also a problem, then the person may not be aware of the tissue damage. This is a common problem related to individuals of increasing age, poor eyesight, and reduced awareness, particularly those in residential care.

For older individuals and those in residential care it is essential that staff and carers are aware of the importance of good foot care, and that any concerns about foot care are directed to a podiatrist. Changes in skin temperature may indicate neuropathy or infection, and if associated with a fallen arch should trigger an urgent referral to the "foot at risk" clinic.

Macrovascular complications

Cardiovascular disease (CVD) accounts for about 52% of all deaths in people with type 2 diabetes and approximately 44% of deaths in type 1 diabetes (Morrish et al, 2001). The relative risk of CVD in type 1 diabetes can be as much as 10-fold greater than that in healthy individuals, and risk factors include the presence of diabetic nephropathy, but also DAN, dyslipidaemia, hypertension, and perhaps also specific microvascular cardiac disease (Perkins and Bril, 2005).

The role of glycaemic control in type 1 diabetes has not been easy to define. The original results from the DCCT (1993) signified the importance of tight glycaemic control in terms of reducing the incidence of microvascular complications, although benefits in terms of macrovascular outcomes did not reach statistical significance. Data from the follow-up EDIC study (Nathan et al, 2005), however, did reach significance, linking intensive glycaemic control with a long-term reduction in the incidence of macrovascular complications.

Diabetic ketoacidosis

DKA is a potentially life-threatening complication of diabetes resulting from hyperglycaemia due to absolute insulin shortage, causing elevated ketone levels in the blood and inducing metabolic acidosis (Kitabchi et al, 2007).

The condition is often associated with new onset of diabetes in individuals with elevated blood glucose levels of >12 mmol/L, ketonuria and arterial blood pH less <7.35 (Singh, 1997). DKA can also occur in people with known diabetes, often as a result of intercurrent illness or poor compliance with insulin therapy. Symptoms include thirst, dry mouth, polyuria, nausea/vomiting and acetones on the breath (*Table 1*).

DKA usually presents as an acute medical emergency requiring urgent hospital treatment by continuous insulin infusion (to treat the hyperglycaemia) and electrolyte replacement (to restore acid balance). Prompt intervention by ketone testing – usually by blood test – frequent monitoring of blood glucose levels, and the use of insulin therapy can help to prevent DKA.

Comorbid conditions

Clinical autoimmune thyroid disease occurs in about 5% of people with type 1 diabetes, although antithyroid antibodies are found in a third of people newly diagnosed with the condition, often presenting as Hashimoto's thyroiditis (Kordonouri et al, 2005).

Coeliac disease occurs in 3–10% of children with type 1 diabetes within 5 years of diagnosis, although many people with autoantibody and biopsy-positive coeliac disease remain asymptomatic (Hanukoglu et al, 2003; Barker et al, 2005). All people newly diagnosed with type 1 diabetes should be tested for both.

The most common associated autoimmune condition is probably vitiligo, although accurate data are lacking (Gould et al, 1985). Other autoimmune conditions such as Addison's disease and pernicious anaemia occur with greater frequency in people with type 1 diabetes – and indeed their first degree relatives – than in healthy individuals (Hanukoglu et al, 2003).

Psychological and social factors

Children and young people

Children with type 1 diabetes from single parent families and low socioeconomic status are more likely to present with DKA at diabetes onset, have more episodes of DKA during the course

of their diabetes, attend the clinic less frequently, and are less likely to maintain good glycaemic control than those from two-parent and more affluent families (Jacobson et al, 1997).

In a study by Kovacs et al (1992), 40% of teenagers had a period of persistent non-adherance with major aspects of their diabetes routines, and these individuals were more likely to show serious psychopathology – most commonly depression – in early adulthood. Both depression and eating disorders are more common in adolescents with type 1 diabetes, often resulting in insulin omission to control body weight, resulting in poor glycaemic control and early onset of diabetes-related complications (Jones et al, 2000). In the UK, support and advocacy both for children and their carers is available through Diabetes UK (www.diabetes.org.uk), who run camps for children with type 1 diabetes, and the Insulin Dependent Diabetes Trust (www.iddtinternational.org).

Primary care teams often look after schools and young offenders institutions, and it is very important that all staff are given basic training on type 1 diabetes, in particular, how to recognise and treat hypoglycaemia and hyperglycaemia (*Table 1*), and when to get assistance. The Diabetes UK (2006) document *Children with Diabetes at School* gives advice regarding what staff need to know if there are children with diabetes in their school, including information on insulin, food and eating times, recognising and treating hyper- and hypoglycaemia, physical activity, sickness and blood glucose monitoring.

Some teenagers and adolescents will not engage with conventional diabetes services. Such individuals pose a particular challenge, and primary care teams should liaise with local paediatric services to optimise care in this often hard-to-engage-with group. Some diabetes teams have developed text-messaging-based support systems with groups of young people with type 1 diabetes as a means of improving self-care skills and confidence. One such system (Franklin et al, 2006) was associated with improved self-efficacy and treatment adherence.

Evidence suggests that there is a temptation for parents and carers of young people with type 1 diabetes to become overprotective, which can lead to depression in the person with diabetes (Wilson et al, 2009). This overprotection, often borne out of ignorance, is equally present among peers of young people with the condition (Lehmkuhl et al, 2009).

Pregnancy

Planned pregnancy and pre-conceptual care with good glycaemic control before pregnancy reduces the rate of congenital malformations and improves outcomes (Confidential Enquiry into Maternal and Child Health [CEMACH], 2007; *Box 2*). In primary care it is essential to ask women with type 1 diabetes about their intentions regarding pregnancy and to discuss and record contraception decisions. Primary care teams should highlight the risks of unplanned pregnancy both for the mother (worsening retinopathy and nephropathy, pre-eclampsia and polyhydramnios) and for the baby (malformation, growth retardation, macrosomia and death in utero) (National Collaborating Centre for Women's and Children's Health [NCCWCH], 2008).

The CEMACH (2007) report outlined a range of factors associated with poorer pregnancy outcomes, including unplanned pregnancy, no contraceptive use in the 12 months before pregnancy, no folic acid commenced prior to pregnancy, smoking, and suboptimal glycaemic control before and during pregnancy.

Page points

1. Both depression and eating disorders are more common in adolescents with type 1 diabetes, often resulting in insulin omission to control body weight, resulting in poor glycaemic control and early onset of diabetes-related complications.
2. Primary care teams often look after schools and young offenders institutions, and it is important that all staff are given basic training on type 1 diabetes, in particular, how to recognise and treat hypoglycaemia and hyperglycaemia, and when to get assistance.
3. Planned pregnancy and pre-conceptual care with good glycaemic control before pregnancy reduces the rate of congenital malformations and improves outcomes.

Table 1. Hypoglycaemia and hyperglycaemia: signs and symptoms.

Blood glucose	Symptoms	Signs
Hypoglycaemia	Shaking. Weakness. Sweating. Tingling lips/tongue. Blurring of vision. Hunger. Headache.	Slurred speech. Unsteadiness. Vacant expression. Confusion. Uncooperation. Aggression. Unusual behaviour.
Hyperglycaemia	Extreme thirst and hunger. Needing to urinate often. Tiredness/lethargy. Blurring of vision.	Unwell or infection. Nausea or vomiting. Drowsiness. Dehydration. Acetones on breath (smell of pear drops), suggests presence of ketones. Rapid breathing.

Box 2. Implications of type 1 and type 2 diabetes on pregnancy.

Compared with babies of healthy women, babies of women with either type 1 or 2 diabetes are:

- Five times as likely to be stillborn.
- Three times as likely to die in the first month of life.
- Two times as likely to have a major congenital anomaly.
- Five times as likely to be macrosomic (>4 kg) at birth.
- Ten times as likely to have Erb's palsy.

(In addition, a 70% caesarean section rate exists in pregnant women with type 1 or type 2 diabetes.)

From: Confidential Enquiry into Maternal and Child Health (2007)

Page points

1. The early onset of type 1 diabetes combined with long duration of the condition contributes to the increased probability of microvascular and macrovascular complications being present in older people, many of whom may be in residential care.
2. People with diabetes may not be unfairly discriminated against either in employment or when applying for jobs, and employers are expected to make reasonable adjustments to allow people with diabetes to work effectively alongside healthy people.
3. There are some occupations that people with type 1 diabetes are legally barred from undertaking. It is unusual for the fire service to accept people with diabetes, but the police are increasingly taking recruits with the condition.

All women with diabetes contemplating pregnancy should be advised to take 5 mg folic acid per day, and should be advised about smoking, alcohol and weight, and referred promptly to a local pre-conceptual care clinic (NCCWCH, 2008). In addition, statins, ACE inhibitors and ARBs are potentially teratogenic and should be stopped.

Older people and those in residential care

The early onset of type 1 diabetes combined with its long duration contributes to the increased probability of microvascular and macrovascular complications being present in older people, many of whom may be in residential care (*Box 3*). As a result, complications are often exacerbated in this population, particularly nephropathy, retinopathy, neuropathy, peripheral vascular disease and the diabetic foot.

For those with type 1 diabetes in residential care, a treatment plan that is tailored to the individual is essential, particularly where the staff may be unqualified carers with limited knowledge of diabetes. Administration of insulin injections may be delegated to unqualified staff (delegate) by the district nurse responsible for the person's care, providing the delegate has undertaken appropriate training and supervised practice, and has successfully completed both the theory and practice summative assessments. Staff will need to know:

- When to give injections.
- Which insulin to use.
- Where to inject the insulin.
- How to store the insulin.

It is also important that staff are aware of the importance of good foot care in residents with type 1 diabetes, as well as the referral pathway to podiatry services.

Box 3. Risk factors for vascular complications in older people with type 1 diabetes

- Poor glycaemic control.
- Length of diabetes duration.
- Genetic predisposition.
- Hypertension.
- Hyperlipidaemia.
- Smoking.
- Alcohol consumption.
- Poor diet.
- Inactive lifestyle.
- Obesity.

Adapted from: Daneman (2006)

Occupational aspects of diabetes

Diabetes is a designated disability under the *Disability Discrimination Act* (2005), and as such, people with diabetes may not be unfairly discriminated against either in employment or when applying for jobs, and employers are expected to make reasonable adjustments to allow people with diabetes to work effectively alongside healthy people.

The armed forces are exempt from this legislation and people diagnosed with diabetes in the armed forces are usually medically retired. Other than the armed forces, it is now illegal to impose a blanket recruitment ban on people with diabetes. There are some occupations, however, that people with type 1 diabetes are legally barred from undertaking (*Box 4*). It is unusual for the fire service to accept people with diabetes, but the police are increasingly taking recruits with the condition. From a safety perspective, the overwhelming issue is hypoglycaemia impairing function at work. This can often be minimised by work colleagues being familiar with the signs and treatment of hypoglycaemia, and this is particularly important with shift workers whose meal patterns and injection schedules may vary from day to day.

People with diabetes treated with insulin are barred from driving heavy goods vehicles or passenger carrying vehicles (*Box 4*); however,

changes to C1 regulations in 2001 mean that "exceptional drivers" may be allowed to drive small lorries up to 7.5 tons (see *Table 2*; Driver and Vehicle Licensing Agency [DVLA], 2009). Taxi drivers are licensed by local authorities, not the DVLA, and as such are subject to each authority's individual assessments regarding driving and diabetes.

It is anticipated, however, that impending changes following the European Commission Working Group report on diabetes in 2006 will overhaul much of this legislation.

Practical issues

Lipohypertrophy and injection sites

Lipohypertrophy is a common side-effect of subcutaneous insulin therapy, characterised by swelling of subcutaneous fat at injection sites. Causes of lipohypertrophy include repeated injections to same site and reusing needles.

Injecting into a site of lipohypertrophy, although painless, can lead to unpredictable absorption of insulin, with the potential for poor glycaemic control. People with diabetes or persons responsible for administering insulin therapy should be aware of the correct procedure for subcutaneous injecting and should use the correct needle size for the individual.

Sick day rules

Illness often stimulates increased glucose secretion, increasing the amount of insulin, fluids and blood glucose testing required. There are a number of "rules", as well as practical tips and advice, to help people with type 1 diabetes better manage their condition when ill – the "golden rule" being that they should never stop taking their insulin. A comprehensive set of rules have been developed by NHS Tayside and can be found at: http://tinyurl.com/pfbx5b. This patient information leaflet goes into depth on the areas of food and drink, blood glucose and ketone monitoring, and insulin management.

Boxes 5 and *6* provide two case studies that highlight some of the practical issues related to the management of people with type 1 diabetes.

Box 4. Employment areas that people with type 1 diabetes are legally restricted from working in.

- Airline pilot.
- Train driver.
- Air traffic controller.
- Seafarer.
- Heavy goods vehicle/passenger carrying vehicle (bus) driver. (Although there is an exception to this – see *Table 2*).

Clinical guidance

For England and Wales, NICE (2004) produced a guideline for the diagnosis and management of type 1 diabetes for children, young people and adults. The document outlines the care that should be available to adults with the condition, including recommendations on diagnosis and the options that should be offered. Equivalent

Page points

1. Injecting into a site of lipohypertrophy, although painless, can lead to unpredictable absorption of insulin, with the potential for poor glycaemic control.
2. Illness often stimulates increased glucose secretion, increasing the amount of insulin, fluids and blood glucose testing required.
3. For England and Wales, NICE (2004) produced a guideline for the diagnosis and management of type 1 diabetes for children, young people and adults.

Table 2. Driving and diabetes.

Diabetes mellitus	Group 1 entitlement Car, motorcycle	Group 2 entitlement Large goods vehicle/passenger carrying vehicle
Insulin treated. Drivers are sent a detailed letter of explanation about their licence and driving by the DVLA.	Must recognise warning symptoms of hypoglycaemia and meet required visual standards. 1, 2 or 3 year licence.	New applicants on insulin or existing drivers are barred in law from driving heavy goods vehicles or passenger carrying vehicles from 1/4/91. Drivers licensed before 1/4/91 on insulin are dealt with individually and licensed subject to satisfactory annual consultant assessment. Regulation changes in April 2001 allow "exceptional case" drivers to apply for or renew their entitlement to C1/C1E to drive small lorries with or without a trailer subject to meeting all "qualifying conditions".

Adapted from: Driver and Vehicle Licensing Agency (DVLA, 2009)

"Understanding the pathophysiology, related complications, social aspects and treatment regarding this long-term condition will ensure that people with type 1 diabetes get the help and support they need …"

recommendations regarding the diagnosis of type 1 diabetes in children and young people and about the care that should be available for them is also outlined, as well as information on transition to adult care (NICE, 2004).

For Scotland, the Scottish Intercollegiate Guidelines Network (SIGN) is currently updating its 2001 guidance. This document also explores evidence-based diabetes care in children, young people and adults, including recommendations on lifestyle management, microvascular and macrovascular complications. Both documents cover the diagnosis, care and support of people with type 1 diabetes (SIGN, 2001; NICE, 2004), and should be a benchmark for any healthcare service.

Conclusion

Type 1 diabetes is becoming increasingly common and all people with this condition will contact their primary care team at some point. Understanding the pathophysiology, related complications, social aspects and treatment regarding this long-term condition will ensure that people with type 1 diabetes get the help and support they need, and will assist in building communication between primary and secondary care. ■

Box 5. Case study 1.

Narrative

Bill is a 57-year-old self-employed builder who has had type 1 diabetes since he was 27. He is on a basal–bolus regimen of 20 units of a long-acting insulin analogue and then a rapid-acting insulin analogue whenever he eats using 1 unit for 10 g of carbohydrate. His latest results are: HbA_{1c} 7.2% (54 mmol/mol), cholesterol 3.2 mmol/L, HDL-cholesterol 2.6 mmol/L, triglycerides 3.4 mmol/L and BMI 27 kg/m^2.

His control has recently become erratic, he is having frequent hypoglycaemic events and recently had the paramedics called out to him while in his work van. His wife has recently left him, and although on the surface he appears cheerful, he is quite depressed and worried about the future. He is also complaining of being unable to sleep due to pain in his feet and legs.

Discussion

Bill has recently been under a lot of stress both in his working and personal life. He most likely has some degree of neuropathy of his feet and legs and a podiatry assessment is required to assess the severity of this. A range of analgesics may help to alleviate some of the neuropathic pain, such as amytriptyline, duloxetine, gabapentin or pregabalin. Some of these may also help to address his depression. He may benefit from some counselling.

He needs to be questioned about his drinking, particularly as this could be contributing to his hypoglycaemic episodes; his triglyceride levels indicate he is drinking more than he maybe admits to. It may be that over the many years of having diabetes and his very physically active day-to-day work he has been experiencing hypoglycaemic episodes on a regular basis and not treating them correctly, leading to some hypoglycaemic unawareness. This needs to be addressed as it will have repercussions on his driving abilities and could even lead to loss of his licence.

Barker JM, Barriga KJ, Yu L et al (2004) Prediction of autoantibody positivity and progression to type 1 diabetes: Diabetes Autoimmunity Study in the Young (DAISY). *J Clin Endocrinol Metab* **89**: 3896–902

Barker JM, Yu J, Yu L et al (2005) Autoantibody "subspecificity" in type 1 diabetes: risk for organ-specific autoimmunity clusters in distinct groups. *Diabetes Care* **28**: 850–5

Confidential Enquiry into Maternal and Child Health (2007) *Diabetes in Pregnancy: Are We Providing the Best Care? Findings of a National Enquiry: England, Wales and Northern Ireland*. CEMACH, London

Daneman D (2006) Type 1 diabetes. *Lancet* **367**: 847–58

DCCT Research Group (1993) The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. *N Engl J Med* **329**: 977–86

DCCT/EDIC Research Group (2003) Sustained effect of intensive treatment of type 1 diabetes mellitus on development and progression of diabetic nephropathy: the Epidemiology of Diabetes Interventions and Complications (EDIC) study. *JAMA* **290**: 2159–67

Department of Health (2007) *Making Every Young Person With Diabetes Matter*. DH, London

Devendra D, Liu E, Eisenbarth GS (2004) Type 1 diabetes: recent developments. *BMJ* **328**: 750–4

Diabetes UK (2006) *Children with Diabetes at School*. Diabetes UK, London

Diabetes UK (2009) Diabetes in the UK 2009: Key Statistics on Diabetes. Diabetes UK, London

Driver and Vehicle Licensing Agency (2009) *At A Glance: A Guide to the Current Medical Standards of Fitness to Drive*. DVLA, Swansea

Finne P, Reunanen A, Stenman S et al (2005) Incidence of end-stage renal disease in patients with type 1 diabetes. *JAMA* **294**: 1782–7

Fioretto P, Solini A (2005) Antihypertensive treatment and multifactorial approach for renal protection in diabetes. *J Am Soc Nephrol* **16**(Suppl 1): S18–21

Fong DS, Aiello LP, Ferris FL, III, Klein R (2004) Diabetic retinopathy. *Diabetes Care* **27**: 2540–53

Franklin VL, Waller A, Pagliari C, Greene SA (2006) A randomized controlled trial of Sweet Talk, a text-messaging system to support young people with diabetes. *Diabet Med* **23**: 1332–8

Gale EA (2002) The rise of childhood type 1 diabetes in the 20th century. *Diabetes* **51**: 3353–61

Gould IM, Gray RS, Urbaniak SJ et al (1985) Vitiligo in diabetes mellitus. *Br J Dermatol* **113**: 153–5

Hanukoglu A, Mizrachi A, Dalal I et al (2003) Extrapancreatic autoimmune manifestations in type 1 diabetes patients and their first-degree relatives: a multicenter study. *Diabetes Care* **26**: 1235–40

Jacobson AM, Hauser ST, Willett J et al (1997) Consequences of irregular versus continuous medical follow-up in children and adolescents with insulin-dependent diabetes mellitus. *J Pediatr* **131**: 727–33

Jones JM, Lawson ML, Daneman D et al (2000) Eating disorders in adolescent females with and without type 1 diabetes: cross sectional study. *BMJ* **320**: 1563–6

Kitabchi AE, Umpierrez GE, Murphy MB, Kreisberg RA (2007) Hyperglycemic crises in adult patients with diabetes: a consensus statement from the American Diabetes Association. *Diabetes Care* **29**: 2739–48

Kordonouri O, Hartmann R, Deiss D et al (2005) Natural course of autoimmune thyroiditis in type 1 diabetes: association with gender, age, diabetes duration, and puberty. *Arch Dis Child* **90**: 411–14

Kovacs M, Goldston D, Obrosky DS et al (1992) Prevalence and predictors of pervasive noncompliance with medical treatment among youths with insulin-dependent diabetes mellitus. *J Am Acad Child Adolesc Psychiatry* **31**: 1112–19

Lehmkuhl HD, Merlo LJ, Devine K et al (2009) Perceptions of type 1 diabetes among affected youth and their peers. *J Clin Psychol Med Settings* **16**: 209–15

Lévy-Marchal C, Patterson CC, Green A (2001) Geographical variation of presentation at diagnosis of type I diabetes in children: the EURODIAB study. European and Diabetes. *Diabetologia* **44**(Suppl 3): B75–80

Menser MA, Forrest JM, Bransby RD (1978) Rubella infection and diabetes mellitus. *Lancet* **1**: 57–60

Mølbak AG, Christau B, Marner B et al (1994) Incidence of insulin-dependent diabetes mellitus in age groups over 30 years in Denmark. *Diabet Med* **11**: 650–5

Morrish NJ, Wang SL, Stevens LK et al (2001) Mortality and causes of death in the WHO Multinational Study of Vascular Disease in Diabetes. *Diabetologia* **44**(Suppl 2): S14–21

Mühlhauser I, Bender R, Bott U et al (1996) Cigarette smoking and progression of retinopathy and nephropathy in type 1 diabetes. *Diabet Med* **13**: 536–43

Narayan KM, Boyle JP, Thompson TJ et al (2003) Lifetime risk for diabetes mellitus in the United States. *JAMA* **290**: 1884–90

Nathan DM, Cleary PA, Backlund JY et al (2005) Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *N Engl J Med* **353**: 2643–53

National Collaborating Centre for Women's and Children's Health (2008) *Diabetes in Pregnancy: Management of Diabetes and its Complications from Preconception to the Postnatal Period*. NICE, London. Available at: http://tinyurl.com/m4377o (accessed 17.08.09)

NHS Employers (2009) *Quality and Outcomes Framework Guidance for GMS Contract 2009/10: Delivering Investment in General Practice*. NHS Employers, London

NICE (2004) *Type 1 Diabetes: Diagnosis and Management of Type 1 Diabetes in Children, Young People and Adults. (CG15)*. NICE, London

NICE (2008) *Continuous Subcutaneous Insulin Infusion for the Treatment of Diabetes Mellitus*. NICE, London. Available at: http://tinyurl.com/mfxlst (accessed 24.08.09)

Perkins BA, Bril V (2002) Diagnosis and management of diabetic neuropathy. *Curr Diab Rep* **2**: 495–500

Perkins BA, Bril V (2005) Early vascular risk factor modification in type 1 diabetes. *N Engl J Med* **352**: 408–9

Raymond NT, Jones JR, Swift PG et al (2001) Comparative incidence of type I diabetes in children aged under 15 years from South Asian and White or other ethnic backgrounds in Leicestershire, UK, 1989 to 1998. *Diabetologia* **44**(Suppl 3): B32–B36

Box 6. Case study 2.

Narrative

Janet is 35 years old and has had type 1 diabetes since the age of 17. Her latest HbA_{1c} level is 9% (75 mmol/mol), her weight is 55 kg and her BMI is 22.6 kg/m^2. Janet often misses appointments due to her late nights and some ad-hoc illegal drug abuse, which she states is because she is feeling depressed all the time. She has an erratic lifestyle with an on/off boyfriend. Her family support is fragmented due to long periods of no contact with her.

Janet often misses injections, is unable to hold down a job and frequently does not test her blood glucose levels for days. Her confidence is low. Her normal insulin regimen is basal–bolus, but she often takes only her long-acting insulin analogue daily with maybe a small dose of rapid-acting insulin analogue with a meal if she remembers. Her eye sight is a concern as she has missed her last three retinal screening appointments, as well as podiatry appointments.

Discussion

It is difficult to get Janet her to engage or accept responsibility for her diabetes. She is still in denial regarding her diabetes and in the past has refused referral to psychology services. She has been admitted in diabetic ketoacidosis several times in the past – this has been found to be her way of weight control, so getting her to inject more frequently is almost impossible. The concerns regarding her eyesight are paramount as this is most likely going to result in her losing her sight at some point in the future.

It is difficult to assess how stable or committed her relationship is as she always attends appointments alone, but she may be dependent on her boyfriend financially or for accessing recreational drugs. The drug abuse makes her more vulnerable and she can appear to be mentally unstable with very low self-esteem. She is also at risk of a pregnancy unless she can be persuaded to use contraception and to attend for her 3-monthly injection of Depo-Provera.

Email or text-messaging may improve Janet's interactions with healthcare professionals. Some improvement in getting her to test her own blood glucose levels more frequently may be achieved by using a meter with downloadable software so the results can be viewed graphically. Providing Janet with the software to download her own results, and then asking her to email them to her healthcare team, may be a step forward in engaging Janet and promoting her self-management.

Rewers M, Zimmet P (2004) The rising tide of childhood type 1 diabetes – what is the elusive environmental trigger? *Lancet* **364**: 1645–7

Schwartz AV, Vittinghoff E, Sellmeyer DE et al (2008) Diabetes-related complications, glycemic control, and falls in older adults. *Diabetes Care* **31**: 391–6

SIGN (2001) *Management of Diabetes: A National Clinical Guideline 55*. SIGN, Edinburgh. Available at: http://tinyurl.com/m6ch8s (accessed 10.08.09)

Singh R (1997) Hospital management of ketoacidosis: are guidelines implemented efficiently? *Diabet Med* **14**: 482–6

Stumvoll M, Goldstein BJ, van Haeften TW (2005) Type 2 diabetes: principles of pathogenesis and therapy. *Lancet* **365**: 1333–46

Vinik AI, Maser RE, Mitchell BD, Freeman R (2003) Diabetic autonomic neuropathy. *Diabetes Care* **26**: 1553–79

Wilson AC, DeCourcey WM, Freeman KA (2009) The impact of managing school-aged children's diabetes: the role of child behavior problems and parental discipline strategies. *J Clin Psychol Med Settings* **16**: 216–22

CPD module

Online CPD activity

Visit www.diabetesandprimarycare.co.uk/cpd to record your answers and gain a certificate of participation

Participants should read the preceding article before answering the multiple choice questions below. There is ONE correct answer to each question. After submitting your answers online, you will be immediately notified of your score. A pass mark of 70% is required to obtain a certificate of successful participation; however, it is possible to take the test a maximum of three times. Before accessing your certificate, you will be given the opportunity to evaluate the activity and reflect on the module, stating how you will use what you have learned in practice.

1. Considering the DCCT (Diabetes Control and Complications Trial), which one of the following is true? Select ONE option only.

A. Intensive glycaemic control was associated with a higher risk of macrovascular disease.
B. Intensive glycaemic control was associated with a lower risk of microvascular disease.
C. There was a lower threshold, below which complications were completely prevented.
D. Only people with type 2 diabetes were recruited to the trial.
E. Recruited participants had either type 1 or type 2 diabetes.

2. When considering comorbidities, which of the following is not associated with type 1 diabetes? Select ONE option only.

A. Addison's disease.
B. Thyroiditis.
C. Pernicious anaemia.
D. Ulcerative colitis.
E. Coeliac disease.

3. When considering the Confidential Enquiry into Maternal and Child Health (CEMACH) report on maternal mortality and diabetes, which of the following was not associated with poorer outcomes? Select ONE option only.

A. Social class.
B. Lack of contraceptive use in the 12 months before pregnancy.
C. No folic acid intake at any time in the 12 months before pregnancy.
D. Suboptimal glycaemic control at any stage before and during pregnancy.
E. Suboptimal maternity and diabetes care during pregnancy.

4. Which one of the following jobs is open to people with type 1 diabetes? Select ONE option only.

A. Train driver.
B. Air traffic controller.
C. Armed forces.
D. Police officer.
E. Airline pilot.

5. When considering diabetic ketoacidosis (DKA), which of the following is not true? Select ONE option only.

A. Ketones and acid are by-products of body fat metabolism.
B. DKA is a microvascular complication of type 1 diabetes brought about by poor long-term glycaemic control.
C. DKA often precipitates diagnosis of type 1 diabetes as it is commonly the first symptom people with the condition will experience.
D. Symptoms include fatigue, thirst, frequent urination and acetones on the breath.
E. DKA can be a result of increased insulin requirements in people already diagnosed with type 1 diabetes.

6. A person who has had type 1 diabetes for 25 years develops lipohypertrophy. Which of the following is the cause? Select ONE option only.

A. A diet high in saturated fat.
B. A reaction to long-term use of insulin.
C. Repeated injection of insulin in the same place.
D. Using the wrong length of needle.
E. Using pork insulin.

7. A 37-year-old woman has had type 1 diabetes for 16 years. Her control has been poor to moderate during that time with an average HbA_{1c} level of 8.7% (72 mmol/mol). Her blood pressure is normal and BMI is 23 kg/m^2. She presents with sudden painless loss of vision in her left eye and is referred urgently to the ophthalmologist. What is the most likely cause of this? Select ONE option only.

A. Retinal haemorrhage.
B. Venous thrombosis.
C. Infarction of the digital nerve.
D. Glaucoma.
E. Corneal abrasion.

8. A 45-year-old man attends for a routine diabetes review. He has had type 1 diabetes for 10 years. His most recent HbA_{1c} level is 8.5% (69 mmol/mol). He is hypertensive with his blood pressure inadequately controlled at 165/100 mmHg. A recent digital retinal photograph revealed features consistent with pre-proliferative retinopathy. He has absent sensation in a stocking distribution in both legs. His recent albumin–creatinine ratio was 55 mg/mmol. His estimated glomerular filtration rate is normal. Clinical examination is unremarkable. What is the likely cause of his proteinuria and what target blood pressure (BP) should be achieved? Select ONE option only.

A. Diabetic nephropathy; BP 130/80 mmHg or less.
B. Non-specific glomerulonephritis; BP 130/80 mmHg or less.
C. Diabetic nephropathy; BP 150/90 mmHg or less.
D. Hypertensive nephropathy; BP 130/80 mmHg or less.
E. Nephrotic syndrome; BP 140/85 mmHg.

9. A 62-year-old woman presents with dystrophic toe nails and absent peripheral pulses. Examination reveals a painless ulcer underlying the head of the first metatarsal. This has a necrotic centre and is slightly offensive. What is the likely cause of this ulcer and correct plan of action? Select ONE option only.

A. Neuropathic ulcer. Treat with oral antibiotics and review in a few weeks if not healing.
B. Traumatic ulcer. Treat with oral antibiotics and arrange dressings with practice nurse.
C. Ischaemic ulcer. Urgent referral to "foot at risk" clinic.
D. Ischaemic ulcer. Outpatient referral to vascular clinic.
E. Neuropathic ulcer. Urgent referral to "foot at risk" clinic.

10. A 23-year-old woman with type 1 diabetes presents with diarrhoea and vomiting in morning surgery. You advise her to continue her normal dose of insulin and check blood glucose (BG) levels at each main meal and bedtime. Which of the following other pieces of advice would be incorrect? Select ONE option only.

A. If BG below 10 mmol/L – take usual dose of insulin.
B. If four BG readings more than 20 mmol/L and ketones present in urine – take 12 extra units of rapid-acting insulin.
C. If BG between 10 and 15 mmol/L – take six extra units of rapid-acting insulin.
D. If three BG readings between 15 and 20 mmol/L – take eight extra units of rapid-acting insulin.
E. If four BG readings more than 20 mmol/L – take 10 extra units of rapid-acting insulin.