Clinical services for children with Diabetes Mellitus

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Abstract

Unlike adults, most (97%) children with Diabetes Mellitus have type 1 (T1DM) due to absolute insulin deficiency; treatment therefore requires (physiological) insulin replacement. Although the precise cause is unclear, T1DM is occurring more frequently, and is now one of the most common chronic childhood diseases, affecting more than 23,000 young people in England and Wales, a prevalence of ~ 1-in-600 children. Diabetes control directly correlates with long-term complications, morbidity and mortality, with average life expectancy at diagnosis reduced by 23 years. This review identifies the key issues faced within clinical services managing paediatric T1DM in the UK. Outcomes are recognized to be variable both within, and outside of the UK, with the UK achieving less favourable results compared to other European and developed countries. We discuss possible explanations for this and highlight local, national and international strategies to improve both clinical services and outcomes. Specifically within the UK, the introduction of paediatric diabetes networks, the introduction of the Best Practice Tariff, participation in national audit and development of national diabetes registers are discussed, in addition to the practical therapeutic changes in management such as intensification of insulin therapy.

Keywords Best Practice Tariff; child health services; diabetes complications; Diabetes Mellitus type 1; HbA1c; healthcare facilities; intensive insulin therapy; manpower and services; National Paediatric Diabetes Audit; outcome assessment; paediatric diabetes networks

Learning objectives

- that there is wide variation in the degree of diabetes control achieved in different diabetes centres both nationally and internationally
- that diabetes control is inextricably linked to long term diabetes complications
- that there continues to be wide variations in resources for diabetes units in the UK
- that the introduction of the Best Practice Tariff, along with other strategic interventions, provides an opportunity to address discrepancies in resources and improve outcomes

Introduction

Diabetes Mellitus is a condition of chronic hyperglycaemia, due to defects in insulin secretion, insulin action (or both), and is one of the most common chronic diseases of childhood, occurring in approximately 1-in-600 children.

The most recent National Paediatric Diabetes Audit (NPDA) 2010–2011 identified over 23,000 children and young people (CYP) in England and Wales with diabetes. It also confirmed that the vast majority (97%) have type 1 diabetes (T1DM). The remainder consist of:

- Type 2 diabetes (T2DM).
- Inherited forms of diabetes e.g. maturity onset diabetes of young (MODY).
- Secondary diabetes due to other chronic disease (e.g. cystic fibrosis) or as complications of therapy (steroids and/or chemotherapy).

Type 1 Diabetes Mellitus (TIDM)

This is characterized by absolute insulin deficiency secondary to autoimmune destruction of the insulin producing pancreatic β-cells. The triggers for autoimmune destruction are poorly understood, but it appears to be a process of multiple temporal sequential insults (environmental and infective) in a genetically susceptible individual.

T1DM is increasing in incidence in the UK by 4% per year especially in younger children. If this present trend continues it is estimated there will be a doubling of new cases of T1DM in European children younger than 5 years between 2005 and 2020, and a rise of 70% in cases younger than 15 years.

Type 2 Diabetes Mellitus (T2DM)

This is characterized by relative insulin deficiency, preceded by a period of resistance to, and consequently overproduction of insulin. This is most commonly associated with significant obesity, and many young people have other features of metabolic syndrome.

Despite increasing obesity levels numbers of children with T2DM remain small, and are not increasing as rapidly as has been anticipated, or from the experience in other countries.

As a result this paper will deal with the management of T1DM exclusively.

Practice points

- The vast majority (97%) of children with Diabetes Mellitus have type 1, due to auto-immune insulin deficiency.
- The incidence of T1DM is increasing by 4% a year.
- Currently ~23,000 CYP have T1DM; a prevalence of 1-in-600 children.

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Presentation

T1DM presents with classical symptoms of hyperglycaemia: polydipsia, polyuria, and nocturia, in association with weight loss and lethargy. Such symptoms warrant *"immediate (same day) referral to a multidisciplinary paediatric diabetes care team that has the competencies needed to confirm diagnosis and to provide immediate care"* where urgent expert assessment and management can be obtained (www.NICE.org.uk).

If these symptoms are overlooked, they can progress to include dehydration, abdominal pain and vomiting, which along with production of ketone bodies from lipolysis ultimately lead to diabetic ketoacidosis (DKA), a condition carrying significant morbidity and mortality.

There still, remain frequent and unacceptable delays in diagnosis: ~25% of children are diagnosed more than 24 hours after seeing a healthcare professional, substantially increasing the risks of DKA. Public health campaigns such as Diabetes UK's recent 4 T's:"*Toilet, Thirsty, Tired, Thinner*" are important in raising public awareness of the disease, but there is also a pressing need for local diabetes services to deliver regular educational updates and promotion, along with formal notification of delayed diagnosis.

Practice points

- Classic features of hyperglycaemia include polydipsia, polyuria (including nocturia), weight loss and lethargy.
- ¼ of cases are diagnosed more than 24 hours after initial presentation to a healthcare professional.
- Patients may also develop diabetic ketoacidosis due to dehydration and ketone body formation; more common if diagnosis is delayed.

Clinical management

The child with newly diagnosed T1DM requires initial stabilization and management of any life threatening complications such as DKA, followed by initiation of insulin replacement therapy. Families require education not only in practical aspects of insulin use, but also lifestyle issues, healthy eating, and carbohydrate counting; these are individually determined to maintain good control through all aspects of daily activity.

As T1DM is due to insulin deficiency, treatment must be with insulin, which as a polypeptide needs to be given by injection i.e. subcutaneously. Historical twice daily mixtures of short and medium acting insulin (BD insulin) are rarely used now, with multiple daily injections (MDI) or Continuous Subcutaneous Insulin Infusion (CSII: the "insulin pump") increasingly used, although numbers on CSII still remain low in comparison to other countries.

Assessing diabetes control

Frequent capillary blood glucose monitoring needs to be performed to ensure most readings remain within agreed target ranges throughout day and night. Whilst hypoglycaemic episodes cannot be totally abolished their frequency and severity are reduced with current regimes.

Glycated haemoglobin (HbA1c) is a reflection of how much glucose is bound to haemoglobin in the erythrocyte. Given the erythrocyte lifespan it provides an indirect measure of glycaemic control over the past 2–3 months. The HbA1c is therefore a useful tool for assessment of long-term control, providing a measure for the patient and their family to assess their individual progress, but also enabling comparison between different patient groups and diabetes centres. Measurement is now in mmol/mol, although historically it was a percentage.

Long term outcomes of childhood diabetes

TIDM is associated with an average reduction in life expectancy of 23 years in the newly diagnosed child. In addition T1DM is also associated with significant morbidity, with long term complications including:

- Microvascular disease; retinopathy, nephropathy, neuropathy (including autonomic). Many of these will manifest after 10 years of diabetes i.e. in late teenage years and early twenties, with erectile dysfunction and diabetic foot disease manifesting somewhat later.
- Macrovascular disease, manifesting as coronary vascular, cerebrovascular and peripheral vascular disease, is also significantly increased and presents at younger ages than in the general population.

There is clear association between metabolic control (assessed using HbA1c) and long term complications. The largest study of the effect of intensive diabetes management, the Diabetes Control and Complications trial (DCCT, 1993) and the follow-up Epidemiology of Diabetes Interventions and Complications Study (EDIC, 2000) both demonstrated that whilst there is no HbA1c threshold which will avoid long-term complications, maintaining HbA1c below 7.5% results in significant reduction in risk of both microvascular and macrovascular complications by between 42 and 76%. Moreover, any improvement in HbA1c, even after the onset of complications, appears to be beneficial.

The aim in effectively managing diabetes is, therefore, to reduce the risk of long term morbidity and mortality through intensive glycaemic control, improving quality of life whilst avoiding severe hypoglycaemia.

Practice points

- T1DM is currently associated with reduction in life expectancy of 23 years.
- Increased morbidity via microvascular and macrovascular complications.
- Evidence that good diabetic control substantially reduces complication risk.

Diabetes control in the UK, Europe and worldwide

As stated above, using HbA1c as a surrogate of metabolic control enables comparison between different diabetes services. In the