Diabetes Mellitus, Type 1, in Adolescents

Description/Etiology

Diabetes mellitus, type 1 (DM1; formerly called insulin-dependent diabetes mellitus or juvenile-onset diabetes) is a chronic, life-threatening metabolic disorder characterized by severe insulin deficiency from autoimmune destruction of insulin-producing pancreatic β-cells. The destruction of β-cells usually occurs abruptly during childhood, adolescence, or young adulthood, but autoimmune destruction of β-cells can also occur later in life (e.g., latent autoimmune diabetes of adulthood). DM1 is thought to occur in genetically susceptible individuals when they are exposed to environmental factors (e.g., certain viruses) that trigger a dysfunctional immune response. In some cases DM1 can occur without evidence of autoimmunity (i.e., idiopathic DM1 or DM1, type B). Without appropriate treatment, the ensuing disruption in the normal regulation of carbohydrate, fat, and protein metabolism leads to hyperglycemia (i.e., increased blood sugar level), systemic acid-base imbalance, insufficient glucose delivery to the brain and retina, inadequate blood supply to the tissues because hyperglycemia stiffens the arteries causing a narrowing of the blood vessels, widespread vascular degeneration, and neuropathy. Severe hyperglycemia and diabetic ketoacidosis (DKA), a life threatening condition associated with insulin deficiency, can occur in children and adolescents with DM1 in response to infection or other events that increase insulin demand (for more information, see Quick Lesson About ... Diabetes Mellitus, Type 1).

Diagnosis of DM1 is based on clinical presentation and laboratory tests that demonstrate a fasting glucose level > 126 mg/dL (7.0 mmol/L) or nonfasting glucose level > 200 mg/dL (11.1 mmol/L). Management of DM1 in adolescents is complicated by a number of evolving physical and social factors, including the influence of hormonal changes on the body’s sensitivity to insulin, the need for peer acceptance, and the search for independence. These factors often interfere with adherence to the DM1 treatment regimen—50–55% of youth with DM1 are nonadherent and as many as 30–50% have poor glycemic control. Depression and eating disorders can also complicate DM1 treatment during adolescence.

Current recommendations on management of diabetes include providing diabetes self-management education (DSME) and support (DSMS), and medical nutrition therapy (MNT). The goals of treatment are to control blood glucose levels (the American Diabetes Association [ADA] recommends a target glycosylated hemoglobin [HbA1C] level of 7.5%) and reduce the risk for complications. Treatment involves lifelong administration of exogenous insulin, exercise, and diet control. Strict adherence to the treatment regimen is essential to maintain quality of life (QOL) and increase life expectancy. Patient education focuses on self-monitoring of blood glucose levels, insulin administration, and adjusting for changes in blood glucose that occur secondary to diet, exercise, acute illness, and stress. The long-term quality of blood glucose control plays an important role in preventing or delaying DM1 complications. Major long term complications of DM1 include coronary heart disease (CHD), cerebrovascular disease, and peripheral artery disease, which can lead to heart attack, stroke, end-stage kidney disease, blindness, and gangrene of the limbs.

Facts and Figures

DM1 accounts for 5–10% of all cases of diabetes. Approximately 75% of all cases of DM1 are diagnosed in children and adolescents aged < 18 years. In the United States, 1 in
400–600 children and adolescents has DM1. The peak incidence of onset is 11–13 years. DM1 onset typically occurs 1.5 years earlier in girls than in boys.

**Risk Factors**
Risk for DM1 is increased in the presence of certain human leukocyte antigen (HLA) haplotypes (e.g., HLA-DR3, HLA-DR4, HLA-DRB1, HLA-DQA1, HLA-DQB1); although these genetic variants account for 40% of genetic risk of developing DM1, only ~ 5% of persons with these alleles develop the condition. Potential environmental risk factors include viral infection (e.g., coxsackievirus, mumps virus), diets high in dairy products, and low vitamin D intake. Patients with DM1 are at increased risk of developing cardiovascular diseases and autoimmune disorders, such as Graves’ disease, celiac disease, Hashimoto thyroiditis, Addison disease, and myasthenia gravis.

**Signs and Symptoms/Clinical Presentation**
Although initiation of the disease process precedes symptoms by several years, the clinical presentation usually includes sudden polydipsia (i.e., abnormally increased thirst), polyuria (i.e., abnormally increased urine output), unexplained weight loss (10–30%), dehydration, and fatigue. Symptoms of DKA include nausea, vomiting, abdominal pain, tachycardia, hypotension, hyperventilation, fruity breath odor, and altered level of consciousness, which can be the first manifestation of DM1 (for additional information, see the Quick Lesson referenced above).

**Assessment**
› For information on assessment of DM1 see the Quick Lesson referenced above

**Treatment Goals**
› Reinforce Prescribed Treatment Regimen to Promote Optimum Physiologic Status
  • Supervise self-administration or administer insulin injections, as ordered per the treating clinician; rapid-, short-, intermediate-, and long-acting insulin preparations are available
  • Assess skin, extremities, electrolytes, lungs, heart, and renal status by physical exam, vital sign monitoring, and laboratory value review; monitor for complications of insulin therapy and report these to the treating clinician
    – Symptoms of mild hypoglycemia include sweating, tremor, tachycardia, palpitation, nervousness, and hunger
    – Moderate hypoglycemia can cause an inability to concentrate, headache, lightheadedness, confusion, memory lapses, slurred speech, emotional/behavioral changes, double vision, and drowsiness
    – Severe hypoglycemia is associated with disoriented behavior, seizures, difficulty arousing from sleep, and loss of consciousness
    – Local allergic reactions at the insulin injection site and systemic allergic reactions (immediate local reaction that gradually spreads) can also occur
  • Monitor for and treat DKA by correcting dehydration, imbalanced nutrition, electrolyte loss, and acidosis, as ordered per the treating clinician, to prevent subsequent coma and death
  • Assess for depression, eating disorders, and DM1 complication onset; immediately report abnormalities and treat, as ordered per the treating clinician
› Provide Emotional/Psychosocial Support and Educate
  • Assess the patient’s anxiety level, coping ability, and commitment to treatment regimen adherence; provide emotional support and encourage patient/family discussion about concerns with the disease process and treatment
  • Using age-appropriate language and considering the cultural background, educate the adolescent patient about the individualized treatment regimen, emphasizing that strict adherence reduces the risk for early onset complications; encourage personal choices whenever possible with components of the treatment regimen (e.g., food choices within dietary guidelines, insulin delivery methods [see Food for Thought, below])
  • Request referral to a registered dietitian to receive individualized MNT, and to a health care educator, mental health clinician, or both, for individual, group, and/or family counseling on coping with a chronic condition
  • Request referral to a social worker, if appropriate, for identification of local programs for eating disorders, substance abuse, and smoking cessation; DM1 education; and support groups appropriate for an adolescent. Encourage patient participation to become knowledgeable, reduce stress, and meet peers who face similar health challenges
Food for Thought

Many different insulin delivery devices are now available, including insulin syringes, insulin pens, and insulin pumps that allow continuous subcutaneous infusion; this gives adolescent patients the ability to choose their preferred delivery method. The transition from pediatric care to adult care in patients with DM1 is associated with worsening of glycemic control. Nevertheless, researchers in Japan studied 1,299 patients with childhood-onset DM1 and found no correlation between age at transition from pediatric to adult care and mortality risk (Onda et al., 2016). Researchers reported fewer episodes of severe hypoglycemia, diabetic ketoacidosis, and lower glycated hemoglobin levels in children, adolescents, and young adults with type 1 diabetes who use insulin pump therapy compared to those who use injection therapy following a research study in Germany, Austria, and Luxembourg (Karges et al., 2017).

Red Flags

Factors associated with poor DM1 management in adolescents include being raised in single-parent families, lower-income families, or racial/ethnic minority groups. Adolescents with DM1 should be screened annually for depression. Eating disorders (including “diabulimia,” the omission of insulin to lose weight) are associated with poor adherence to the DM1 treatment regimen and an increased risk for complications, and should be suspected when HbA1C is high and when weight loss or excessive concerns about weight are present.

What Do I Need to Tell the Patient/Patient’s Family?

Educate patient and parents regarding management of DM1, including nutrition, medication and side effects, exercise, disease progression, complication prevention strategies, blood glucose monitoring techniques, insulin storage, and the necessity of lifetime medical surveillance.

- Current recommendations advise that carbohydrates should comprise 50–55% of daily caloric intake, while fats and protein should account for 30–35% and 10–15% of calorie intake, respectively.
- Normal activity is usually encouraged; full participation in sports is possible.
- Discuss the importance of regular clinician visits to monitor weight, height, and sexual maturation; quarterly HbA1C measurement; annual retinal and foot exams; annual urinalysis for detection of microalbuminuria; and lipid profile evaluation every 5 years.
- Advise adolescents with DM1 about associated risks of alcohol use, including increased risk of DKA; advise wearing a medical bracelet indicating DM1 status.

References