

Insulin Dependent Diabetes in Children: A Literature Review

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Abstract: *Diabetes mellitus is the general name for a group of chronic metabolic diseases characterized by high blood glucose levels that result from defects in insulin secretion and/or action. The two main forms of diabetes are insulin-dependent diabetes mellitus (IDDM) or type 1 diabetes and noninsulin-dependent or type 2 diabetes. Type 1 diabetes occurs when the beta cells of the pancreatic islets of Langerhans, which are responsible for insulin production, are progressively destroyed by the immune system. The body's ability to produce insulin becomes progressively impaired until eventually no insulin is produced. The insulin deficiency results in decreased insulin utilization and increased hepatic glucose production leading to hyperglycemia. In addition, there is an increased breakdown of adipose tissue leading to ketonemia and eventual diabetic ketoacidosis (DKA) that, if left untreated, is potentially fatal. Diabetes imposes a severe socioeconomic burden on the child with diabetes as well as on their family, the community and society. Costs of diabetes comprise both direct and indirect costs. In the child, costs of diabetes are calculated in current as well as future terms. Early diagnosis, early initiation of adequate treatment and careful monitoring to avoid complications will help to maintain their health not only in childhood, but also as they grow to adulthood and become productive members of society and the economy.*

Keywords: Child, Diabetes, Diabetic ketoacidosis Insulin

1. Introduction

It is a singular tragedy that, despite the emergence in recent years of increasingly effective strategies for the metabolic/glycaemic control of type 1 and type 2 diabetes mellitus, this disease continues to exact a terrible toll. Perhaps no group better exemplifies the diabetes crisis gripping both developed and developing nations today than the child. Children and adolescents with diabetes represent society's most vulnerable population and it is indeed a tragedy that young lives continue to be lost to a disease for which adequate management tools and knowledge exist. Epidemiology describes patterns of disease by causation and geographical region, among other factors. Among developed nations, type 1 diabetes mellitus is one of the leading chronic diseases of childhood¹. Both type 1 and type 2 diabetes can occur in children and adolescents, although type 1 is in most countries still more common and in fact is still often referred to as childhood or juvenile-onset diabetes. Type 1 and type 2 diabetes present somewhat different disease patterns and require different management; people with type 1 diabetes require daily insulin, which is literally a life-saving treatment. Depending on clinical parameters and treatment success, individuals with type 2 diabetes may require insulin. Whether type 1 or type 2, all forms of diabetes pose potentially grave dangers to health.

2. History

In the 19th century, diabetes was uncommon and the incidence of childhood diabetes was relatively low and stable until the middle of the twentieth century. There has been an upturn in the incidence of type 1 diabetes in North America and northern Europe since the mid-1950s, a trend that is now observed in countries around the world. The rise has been too rapid for the explanation to be purely genetic. The causes are not yet completely understood, although

various factors have been proposed such as rapid growth in early childhood, early exposure to certain food constituents, enterovirus infection, chemicals and reduced exposure in early childhood to infective agents that contribute to development of a healthy immune system².

Type 1 diabetes is managed by insulin replacement and balancing of diet and exercise in order to maintain glycemic control and prevent the occurrence of complications. Glycemic control, which is linked directly to complication rates,¹ is monitored by the measurement of glycosylated hemoglobin, which reflects the mean blood glucose level over the previous 2 to 3 months. Lowering HbA1c has been associated with a reduction of microvascular complications of diabetes.³ In order to effectively manage diabetes, education about components of management such as blood glucose monitoring, insulin replacement, diet, exercise, and problem solving strategies must be delivered to the patient. Education is important both at diagnosis, where there is usually no knowledge base and patient and family are given the basic skills for controlling the disease,⁴ and throughout the patient's lifetime, with ongoing attention to selfmanagement skills, screening and prevention of complications, and to new developments in these areas. Since management of diabetes requires lifestyle changes, it is important that education be delivered to the whole family.

3. Onset and Symptoms

Type 1 diabetes mostly has an acute onset, with children and adolescents usually able to pinpoint when symptoms began. Onset can occur at any age. Children and adolescents may present with ketoacidosis as the first indication of type 1 diabetes.

The immunologic process that leads to type 1 diabetes can begin years before the symptoms of type 1 diabetes develop. Symptoms become apparent when most of the beta-cell

population is destroyed and usually develop over a short period of time. Early symptoms, which are mainly due to hyperglycemia, include increased thirst and urination, constant hunger, weight loss, and blurred vision. Children also may feel very tired.

Risk Factors: A combination of genetic and environmental factors put people at increased risk for type 1 diabetes. Researchers have identified many factors and continue working so that targeted treatments can be designed to stop the autoimmune process that destroys the pancreatic beta-cells.

Predicting Type 1 Diabetes: As type 1 diabetes is caused by immune destruction of the insulin-producing beta cells in the pancreatic islets, antibodies against islets' proteins are found in children and adolescents months to years before the onset of diabetes. Evidence from several studies suggests that measurement of islet autoantibodies in relatives of those with type 1 diabetes identifies new individuals who are at risk for developing type 1 diabetes. This testing may be appropriate in those who have relatives with type 1 diabetes, in the context of clinical research studies.^{6,7}

Co-morbidities: Children with type 1 diabetes are at risk for the long-term complications of diabetes. Autoimmune diseases such as celiac disease and autoimmune thyroid disease are also associated with type 1 diabetes.

4. Management

The basic elements of type 1 diabetes management are insulin administration, nutrition management, physical activity, blood glucose testing, and the development of strategies to avoid hypoglycemia and hyperglycemia that may lead to DKA. Algorithms are used for insulin dosing based on blood glucose level, food intake, physical activity, and illness, if present.

All people with diabetes are advised to avoid "liquid carbs" such as sugar-containing soda, sports or energy drinks, juices, and regular pancake syrup. These liquid carbs raise blood glucose rapidly, contain large amounts of sugars in small volumes, are hard to balance with insulin, and provide little or no nutrition.

Children receiving fixed insulin doses of intermediate- and rapid-acting insulins must have food given at the time of peak action of the insulin. Children receiving a long-acting insulin analogue or using an insulin pump receive a rapid-acting insulin analogue just before meals, with the amount of pre-meal insulin based on carb content of the meal using insulin to carb ratio and a correction scale for hyperglycemia. Further adjustment of insulin or food intake may be made based on anticipation of special circumstances such as increased exercise and intercurrent illness. Children on these regimens are expected to check their blood glucose levels routinely before meals and at bedtime.

Physical activity is a critical element of effective diabetes management. In addition to maintaining cardiovascular fitness and controlling weight, physical activity can help to lower blood glucose levels. To maintain blood glucose

levels within the target range during extra physical activity, students will need to adjust their insulin and food intake.

Families need to work with their health care team to set target blood glucose levels appropriate for the child. To control diabetes and prevent complications, the American Diabetes Association suggests blood glucose and A1C goals for type 1 diabetes by age group. For more information about managing diabetes in children, see NDEP's Helping the Student with Diabetes Succeed:

Type 1 diabetes occurs when the beta cells of the pancreatic islets of Langerhans, which are responsible for insulin production, are progressively destroyed by the immune system. The body's ability to produce insulin becomes progressively impaired until eventually no insulin is produced. The insulin deficiency results in decreased insulin utilization and increased hepatic glucose production leading to hyperglycemia. In addition, there is an increased breakdown of adipose tissue leading to ketonemia and eventual diabetic ketoacidosis (DKA) that, if left untreated, is potentially fatal.⁸

5. Acute Complications of Type 1 Diabetes

Type 1 diabetes and its treatment has two major acute complications: DKA and hypoglycemia. DKA is a metabolic state resulting from acute hyperglycemia. DKA has a mortality rate of 0.5 percent, mostly due to cerebral edema, the most frequent diabetes-related cause of death. DKA is most common at presentation, occurring in an average of 40 percent of children presenting with diabetes.

In established diabetes, the rate is 1 to 8 percent per year. Risk factors include infection, insulin omission, and equipment malfunction. DKA is treated with immediate hospitalization, insulin replacement, and rehydration. Hypoglycemia is a complication of insulin treatment. Symptoms caused by a fall in blood glucose include shakiness and emotional instability. In severe cases, there may be seizures or unconsciousness. There has been concern about possible brain dysfunction due to prolonged or repeated hypoglycemic episodes; however, there is limited evidence of permanent cognitive sequelae and they are considered minor.^{8,9} The prevalence rates for this complication vary due to potential under-reporting of minor episodes. Studies looking at the prevalence of severe hypoglycemia in children and adolescents report a range of 4 to 86 episodes per 100 patient years.^{9,10}

6. Conclusion

Diabetes imposes a severe socioeconomic burden on the child with diabetes as well as on their family, the community and society. Costs of diabetes comprise both direct and indirect costs. In the child, costs of diabetes are calculated in current as well as future terms. Early diagnosis, early initiation of adequate treatment and careful monitoring to avoid complications will help to maintain their health not only in childhood, but also as they grow to adulthood and become productive members of society and the economy.

7. Conflict of Interest

None declared.

8. Sources of Funding

Nil

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