International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

A Report of Two Cases Type 2 Diabetes Mellitus in Children

Vania Catleya Estina[1], I Wayan Bikin Suryawan[2], I Made Arimbawa[3]

[1, 2, 3]Udayana University, Medical Faculty, Department of Child Health, Sanglah Hospital, Denpasar, Indonesia

Abstract: ***Background: Type-2 diabetes mellitus (T2DM) was initially considered an adult entity. The case has now been reported in children in developed countries because of the increased incidence of obesity and sedentary habits associated with lifestyle changes. T2DM was diagnosed based on the absence of ketosis, good beta-cell reserve, as shown by the C-peptide assay, the absence of insulin autoantibody, and response to oral hypoglycemic agents. Objective: These case reports aim to describe clinical characteristics, management, and social aspects of T2DM in children. Case: The first case, a 12-year old female with a familial history of T2DM, presented with a history of weight loss for the past year. She also experienced vulvovaginal candidiasis. Her initial laboratory results upon admission were 14.5% HbA1C and 1.3 ng/mL C-peptide. The second case was an obese, 10- year old female who presented with frequent urination for the past six months. Her mother experienced gestational diabetes in the past. Her laboratory results upon admission were 10.7% HbA1C and 2.4 ng/mL C-peptide. Both cases were managed well by long-acting insulin and oral metformin. Systematic screening and evaluation management of T2DM is essential for clinicians. These include additional focus on lifestyle management and familial support. For patients with obesity, efforts targeting weight loss, including lifestyle modification and medication, are recommended to prevent complications.***

Keywords: type 2 diabetes mellitus, children, obese

1. Introduction

Type-2 diabetes mellitus (T2DM) was rarely reported in children, accounting for <2% of all cases of diabetes in pediatric. However, a recent increase in its incidence in children and adolescents has been documented in several populations paralleling the increase in prevalence and degree of obesity in children and adolescents [1].

Over the past three decades, the prevalence of childhood obesity has increased dramatically in Indonesia, ushering in a variety of health problems, including T2DM, which previously was not typically seen until much later in life. Currently, in Indonesia, up to 1 in 3 new cases of diabetes mellitus diagnosed in youth younger than 18 years is T2DM, with a disproportionate representation in ethnic minorities and occurring most commonly among youth between 10 and 19 years of age. There was an increasing number of children with T2DM in Indonesia (based on the Indonesia National Registry). Incidence of Indonesia children with T2DM less than T1DM. Almost all data are from Jakarta as the capital city [2], [3].

Along with the increased prevalence of obesity in children and adolescents, there is also an increase in the prevalence of various complications of obesity, including T2DM in children and adolescents. It should be a larger number of cases because of the increasing number of obese children. Obese and diabetes family history are the risk factors for Indonesia children with T2DM. The onset of T2DM in children and adolescents is most common in the second decade of life with a median age of 13.5 years and is rare before the age of puberty. T2DM in children and adolescents usually come from families with a history of T2DM [4], [5]. These case reports aim to describe clinical characteristics, management, and social aspects of T2DM in children.

2. Case Reports

First case, a 12-year old female was referred from a general hospital with suspicion of T1DM. Her mother reported she has been losing weight since a year ago. Her body weight was 65 kg and now is 50 kg, despite having a good appetite.

She has been consuming much water since three months ago after she experienced frequent urination since three months ago. She also complained about itchy, white-discharge from the vagina a week before admitted to our hospital. She reported no fatigue, prolonged wound healing, coughing, or flu symptoms. Bowel habit was normal. During admission at another hospital a year ago, her blood tests came back and showed an increased blood sugar level (376 mg/dL) with ketone +2 and glucose +2 in urine examination. Her family history that father was diagnosed with T2DM 5 years ago.

Upon presentation, she was feeling weak, with no nausea or vomiting. She appeared moderately ill and alert, pulse rate was 88 beats per minute, regular with good pulse quality, respiratory rate was 24 times per minute, regular, the axillary temperature was 36.8 °C, and reported no pain. Her body weight was 47.5 kg with 154 cm height with nutritional status was well-nourished. Laboratory findings showed increased blood glucose (292 mg/dL) and elevated HbA1c (14.5%). We prescribed subcutaneous long-acting insulin (Lantus®) dose 0-0-15 IU and oral metformin 500 mg every 12 hours. She was scheduled then to check regular blood glucose, C-peptide level, and lipid profile.

Management for this patient includes medications, nutrition support, monitoring plan, as well as patient and family education toward the disease and its long-term prognosis. We also sent her to a venereologist to be evaluated. Assessment of the quality of life of children and possible behavioral disturbances was conducted with the PedsQL

examination.

Second case, a 10-year old female came to the hospital with a high blood sugar level. She reported frequent urination for the past six months. We also noticed onychomycosis on her nails. Weight loss reported for just 1 kg in the past month, where she was 41 kg upon admission to our hospital. Her grandmother and mother suffered from diabetes mellitus. Her mother is now routinely consumed metformin and glibenclamide.

Upon presentation, her blood pressure was 100/70 mmHg, pulse rate 80 times/minutes, respiration rate 20 times/minute, axillary temperature 36.4 °C, peripheral oxygen saturation 98%, weight 41 kg, height 134 cm, and body mass index of 23.12 kg/m2. She reported no pain. Laboratory findings included fasting blood glucose (204 mg/dL), 2-hours post-prandial blood glucose (395 mg/dL), total cholesterol (179 mg/dL), high-density lipid/HDL (42 mg/dL), low-density lipid/LDL (127 mg/dL), and triglyceride (139 mg/dL). Urinalysis showed pH 5.5, urine specific gravity 1.021, no leukocytes, no protein, no erythrocytes, ketones +1, glucose +4, no crystals or cast. Other lab tests included HbA1C (10.7%), C-peptide (2.4 ng/mL), and auto-antibody insulin were 24.1.

The patient was diagnosed with T2DM and treated with Lantus 0-0-6 IU, metformin 500 mg every 12 hours, fluconazole 150 mg every 12 hours, and 8% topical ciclopirox nail lacquer every 24 hours for the nails. We provided information and education about nutrition intake for her. Calorie reduction was scheduled gradually by 200-500 calories a day with a target of 0.5 kg of weight loss per week while monitoring blood sugar regularly.

3. Discussion

Diabetes mellitus was a popular term in the world of health, and in 2007 there were around 0.02% of children from the total population diagnosed with diabetes mellitus. This means that there were around 440,000 children worldwide diagnosed with diabetes, with around 70,000 new cases per year. This also means that there were a large number of children who needed insulin to survive and avoided disabilities or complications [2].

Diabetes mellitus in children was categorized as a special diagnosis with broad types and clinical symptoms. T1DM has been accounted for 90% of all diabetes mellitus in children in developed countries, and less than half were diagnosed before the age of 15 years. T2DM was more common in teenagers, especially in the pre-puberty period. Atypical diabetes was often found in older children, adolescents, or young adults in Africa and Southeast Asia. In our cases, patients were all diagnosed with T2DM during puberty [7], [8].
T2DM is a complex metabolic disorder of heterogeneous etiology with social, behavioral, and environmental risk factors unmasking the effects of genetic susceptibility. There was a strong hereditary (likely multigenic) component to the disease, with the role of genetic determinants illustrated when differences in the prevalence of T2DM in various racial groups were considered. Recent increases in diabetes mellitus prevalence were too quick to be the result of increased gene frequency and altered gene pool, emphasizing the importance of environmental factors [9].

Puberty appeared to play a significant role in the development of T2DM in children. During puberty, there was increased resistance to the action of insulin, resulting in hyperinsulinemia. After puberty, basal and stimulated insulin responses declined. Hyperinsulinemic-euglycemic clamp studies demonstrated that insulin-mediated glucose disposal was on average 30% lower in adolescents. Increased growth hormone secretion in puberty was discussed to be responsible for the insulin resistance during puberty. Given this information, it was not surprising that the peak age at presentation of T2DM in children coincides with the usual age of mid- puberty [10].

The adverse effect of obesity on glucose metabolism was evident early in childhood. Obese children were hyperinsulinemic and had approximately 40% lower insulin-stimulated glucose metabolism compared with non-obese children. Furthermore, the inverse relationship between insulin sensitivity and abdominal fat was stronger for visceral than for subcutaneous fat. It was interesting to note that adipose tissue expanding in the obese state synthesizes and secretes metabolites and signaling proteins like leptin, adiponectin, and tumor necrosis factor-alpha. These factors were known to alter insulin secretion and sensitivity and even cause insulin resistance under experimental and clinical conditions [11].

Diabetes in children generally presents with severe symptoms, very high blood sugar levels, significant glucosuria, and ketonuria. High blood sugar levels are a confirmation of the diagnosis of diabetes mellitus. In the case of children, therapy must be started immediately, and often a life-threatening case. If ketones were found in the blood or urine, therapy was urgent, and the child must be monitored to avoid ketoacidosis. Asymptomatic children must undergo periodic blood sugar checks with various methods such as oral glucose tolerance test (OGTT) or fasting blood sugar. OGTT examination was not necessary if the diagnosis could be made through fasting blood sugar, random blood sugar, or 2 hours postprandial according to the criteria used, or if very high blood sugar levels are found. Hyperglycemia caused by other causes must be excluded, such as acute infection, trauma, circulatory stress, or stress with other causes [12].

Diagnostic criteria by the American Diabetes Association (ADA) include the following: A fasting plasma glucose (FPG) level of 126 mg/dL (7.0 mmol/L) or higher, or A 2-hour plasma glucose level of 200 mg/dL (11.1 mmol/L) or higher during a 75-g oral glucose tolerance test (OGTT), or A random plasma glucose of 200 mg/dL (11.1 mmol/L) or higher in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis. Whether a hemoglobin A1c (HbA1c) level of 6.5% or higher should be a primary diagnostic criterion or an optional criterion remains a point of controversy [13].

The classification of diabetes mellitus was made according to its etiology and was divided into type 1, type 2, other specific types, and gestational diabetes. T1DM showed damage to pancreatic beta cells caused by the presence of anti-GAD or insulin antibodies or islet cell antibodies that underlie the occurrence of an autoimmune process. T2DM was the type most commonly found in diabetes which was characterized by a disruption in the workings of insulin or insulin secretion [12], [13].

The diagnosis of diabetes mellitus in children was established by typical clinical symptoms, for T2DM requires an antibody examination because antibody involvement indicates the need for early insulin administration, an autoimmune thyroid examination or other autoimmune abnormalities was necessary. A-C- peptide examination should be performed on all children with diabetes mellitus with or the involvement of autoantibodies, especially in children over the age of 13 who are diagnosed with T2DM but with poor blood sugar control using oral therapy [14].

T2DM in children usually affected children which having nutritional status overweight or obese (body mass index ≥85th-94th and >95th based on age and sex), having a family history of diabetes mellitus, the residual secretory capacity of insulin at diagnosis (marked by normal or elevated C-peptide concentrations), sudden onset, and signs of insulin resistance (including polycystic ovary syndrome or nitric tincture), have no evidence of involvement of autoimmune diabetes (negative autoantibody examination). T2DM suffered to tend to experience hypertension or dyslipidemia compared to people with diabetes mellitus type 1 [15].

Modification of behavior and activity in children with T2DM includes a moderate-to-severe type of exercise performed at least 60 minutes a day and reducing TV viewing or screen time to less than 2 hours per day. Sports activities carried out should be fun and involve the family [15], [16].

Long-term complications in patients with diabetes mellitus include retinopathies, nephropathy, neuropathies, and other macrovascular diseases. Symptoms that could arise include visual impairment or blindness due to diabetic retinopathy, renal failure, and hypertension due to nephropathy that occurred, pain or paresthesia, muscle weakness and autonomic dysfunction due to neuropathies, heart disease, peripheral vascular disease, and stroke due to macrovascular disease [17], [18].

Diabetes could bring psychosocial problems to the patient and family. Education about the disease that diabetes mellitus was a lifetime disease, the importance of long term and routine follow up, takes time, patience, and cost. Patients with diabetes required long-term treatment and collaboration of various modalities. The smaller age of occurrence of DM would have a higher likelihood of complications if the patient has no treatment adherence. Where a child would be difficult to adjust the diet so that the complication of the disease more quickly arise due to uncontrolled blood glucose [19], [20].

Table 1. Comparison between two cases

	Case 1	Case 2
Age when diagnosed	12 yo	10 yo
Birth Weight	3200	3400
Breast milk Exclusive	6 months	3 months
Family History	Patient's father got diabetes mellitus	Patient's mother got diabetes mellitus when pregnant
First symptom and sign	Polyuria, polydipsia, polyphagy, itchy. Another symptom: White discharge and felt itchy in the vagina	Polyuria, polydipsia, polyphagy, Weight loss Another symptom: Brittle nail on hand and foot
First Laboratory result	Random BS: 292 mg/dL HbA1C: 14.5% C-Peptide 1,3 ng/mL	Random BS: 395 mg/dL HbA1C 10.7% C-Peptide 2,4 ng/mL
Personal or social history	The first child of two lived with a family, water source, and electricity as standard. The patient had a lot of friends at school.	The first child of two, lived with a family, water source and electricity as standard, the family relationship was good.Patient was a shy person but still can interact normally with her friends at school.
Growth and development history	Growth and development were appropriate for her age. Nutritional status: 108% (normal), BMI 18	Growth and development were appropriate for her age, but she was obese before. Nutritional status: 136% (obese), BMI 23,12
Treatment	Insulin Lantus 0-0-6 units subcutaneously. Metformin 500 mg twice a day intraoral. Doxycycline 100mg twice a day intraoral	Insulin Lantus 0-0-6 units subcutaneously. Metformin 500 mg twice a day intraoral. Fluconazole 150 mg twice a day intra oral Ciclopirox nail lacquer 8%
The complication and other diseases since diagnosed	No complication but had vulvovaginal candidiasis	No complication but had onychomycosis
Bio-physical environmental	Low-moderate socioeconomic level. The patient had public health insurance.	Lived in an urban area and had public health insurance.
PedsQl	Parents: 91.9 Patient: 92.3	Parents:79,06 Patient: 78,43

The natural course of T2DM in children had a broad and long spectrum. In a long-term study of patients with T2DM, children often had early complications at the age of decades three or four, both due to complications in macro or

microcirculation. During monitoring, the patient showed the course of T2DM without complications with normal growth and development. [21], [22], [23]

4. Conclusion

T2DM is being reported in obese children with a family history of DM. Systematic screening and evaluation management of T2DM is important. These cases showed that include additional focus on lifestyle management and diabetes self-management education and support. For patients with obesity, efforts targeting weight loss, including lifestyle, medication are recommended to prevent the complications.

References

[1] American Diabetes Association. Children and Adolescents: Standards of Medical Care in Diabetes-2019. Diabetes Care. 2019;42(1):148-64.
[2] Otaigbe BE, Imafidon EE. Type 2 diabetes mellitus in a Nigerian child: a case report. Afr Health Sci. 2011;11(3):454–56.
[3] Copeland KC, Silverstein J, Moore KR, et al. Management of newly diagnosed type 2 Diabetes Mellitus (T2DM) in children and adolescents. Pediatrics. 2013;131(2):364-82.
[4] Ahmad QI, Ahmad CB, Ahmad SM. Childhood obesity. Indian J Endocrinol Metab. 2010;14(1):19–25.
[5] Wilding JP. The importance of weight management in type 2 diabetes mellitus. Int J Clin Pract. 2014;68(6):682–91.
[6] Reinehr T. Type 2 diabetes mellitus in children and adolescents. World J Diabetes. 2013;4(6):270–81.
[7] Copeland KC, Zeitler P, Geffner M, et al. Characteristics of adolescents and youth with recent-onset type 2 diabetes: the TODAY cohort at baseline. J Clin Endocrinol Metab. 2011;96(1):159–67.
[8] Zeitler P, Hirst K. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Engl J Med. 2012;366(24):2247–56.
[9] Zeitler P, Arslanian S, Fu J, et al. ISPAD Clinical Practice Consensus Guidelines: Type 2 diabetes mellitus in youth. Pediatr Diabetes. 2018;19(27):28.
[10] TODAY Study Group. Safety and tolerability of the treatment of youth- onset type 2 diabetes: the TODAY experience. Diabetes Care. 2013;36(6):1765–71.
[11] Wilfley D, Berkowitz R. Binge eating, mood, and quality of life in youth with type 2 diabetes: baseline data from the today study. Diabetes Care. 2011;34(4):858–60.
[12] Walders-Abramson N, Venditti EM, Ievers-Landis CE, et al. Relationships among stressful life events and physiological markers, treatment adherence, and psychosocial functioning among youth with type 2 diabetes. J Pediatr. 2014;165(3):504–8.
[13] Springer SC, Silverstein J, Copeland K, et al. Management of type 2 diabetes mellitus in children and adolescents. Pediatrics. 2013;13(1):648–64.
[14] Kiess W, Böttner A, Raile K, et al. Type 2 diabetes mellitus in children and adolescents: a review from a European perspective. Horm Res. 2003;59(Suppl 1):77-84.
[15] Thunander M, Petersson C, Jonzon K. Incidence of type 1 and type 2 diabetes in adults and children in Kronoberg, Sweden. Diabetes Res Clin Pract. 2010;82(2):247-55
[16] Pinhas-Hamiel O, Zeitler P. The global spread of type 2 diabetes mellitus in children and adolescents. J Pediatr. 2015;146(2):693-700.
[17] Liese AD, D'Agostino RB Jr., Hamman RF, et al. The burden of diabetes mellitus among US youth: prevalence estimates from the SEARCH for diabetes in youth study. Pediatrics. 2012;118(2):1510-8.
[18] Arslanian SA. Type 2 diabetes mellitus in children: pathophysiology and risk factors. J Pediatr Endocrinol Metab. 2010;13(Suppl 6):1385–94.
[19] Roth CL, Reinehr T. Roles of gastrointestinal and adipose tissue peptides in childhood obesity and changes after weight loss due to lifestyle intervention. Arch Pediatr Adolesc Med. 2012;16(4):131–8.
[20] Copeland KC, Silverstein J, Moore KR, et al. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. Pediatrics. 2013;13(1):364-82.
[21] Herbst, A., Kapellen, T., Schober, E., Graf, C., Meissner, T., Holl, R.W. Impact of regular physical activity on blood glucose control and cardiovascular risk factors in adolescents with type 2 diabetes mellitus–a multicenter study of 578 patients from 225 centers. Pediatric Diabetes. 2015;16(3):204-10.
[22] Flint A, Arslanian S. Treatment of type 2 diabetes in youth. Diabetes Care. 2011;34(5):177-83.
[23] Gregory JM, Moore DJ, Simmons JH. Type 1 diabetes mellitus. Pediatrics. 2013;34(2):203-15.