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Dyslipidemia in type 1 diabetes mellitus: Relation to diabetes duration, glycemic control, body habitus, dietary intake and other epidemiological risk factors

Hassan M. Mona, Sharaf A. Sahar, Soliman M. Hend *, Al-Wakeel A. Nanees

Diabetes Endocrine and Metabolism Pediatric Unit (DEMPU), New Children Hospital, Cairo University, Cairo, Egypt

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KEYWORDS

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Low density lipoprotein-cholesterol (LDL-C);
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Abstract *Background:* Diabetes is associated with a high risk of cardiovascular disease (CVD). The classic "diabetic dyslipidemia" is mostly described as hypertriglyceridemia and low levels of HDL-C. Elevated LDL-C is an established risk factor for CVD.
Objective: Identify the pattern of dyslipidemia in children and adolescents with type 1 diabetes mellitus regularly following at Diabetes Endocrine and Metabolism Pediatric Unit (DEMPU) at Children's Hospital of Cairo University; and to detect its relation to different risk factors.
Methods: Sixty children and adolescents with T1DM, (34 males and 26 females, mean age 12.5 ± 2.4 years and mean duration of diabetes 4.3 ± 2.7 years) were evaluated by full history and clinical examination including 3 day dietetic history for analysis, BMI and waist circumference. Records were revised for mean blood glucose and HbA1c. Fasting lipid profile (total cholesterol, triglycerides, HDL-C and LDL-C) was performed. Thirty-nine healthy age and sex matched children were included as control for lipid profile.
Results: Dyslipidemia significantly more frequent among T1DM children and adolescents compared to control subjects (39/60, 65% vs. 11/39, 28.2%, $p < 0.001$); and the dyslipidemic (39/60) compared to normoalbuminuric (21/60) children had significantly higher mean waist circumference. Both groups were comparable regarding age, age at onset and duration of diabetes, family history of diabetes and CVD, degree of glycemic control and dietary analysis.
Conclusion: Dyslipidemia is significantly more frequent in children and adolescents with T1DM compared to non-diabetic peers. The most frequent type of dyslipidemia was high LDL-C and low HDL-C in the dyslipidemic group.

* Corresponding author at: New Children Hospital (Abu El Reesh), Cairo University Hospitals, PO Box 2398, Cairo, Egypt. Tel.: +20 35610917, +20 1143156468 (mobile).
E-mail address: ziad.alaa@yahoo.com (S.M. Hend).

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Introduction

Children diagnosed with type 1 diabetes have a high risk of early subclinical and clinical cardiovascular disease (CVD).[1–3] The American Heart Association categorizes children with type 1 diabetes in the highest tier for cardiovascular risk and recommends both lifestyle and pharmacological treatment for those with elevated LDL cholesterol levels.[4,5]

Global IDF/ISPAD Guideline for Diabetes in Childhood and Adolescence, 2014 recommended screening for fasting blood lipids when diabetes is stabilized in children aged over 10 years. If there is a family history of hypercholesterolaemia, early CVD or if the family history is unknown, screening should start at age 2 years. If normal results are obtained, screening should be repeated every 5 years.[6]

Objectives

To study the pattern of dyslipidemia in children and adolescents with type 1 diabetes mellitus; and its relation to the duration of diabetes, degree of glycemic control, body habitus, dietary intake and epidemiological risk factors including family history and life-style.

Materials and methods

Study population

The current study included 60 children and adolescents regularly followed at the Diabetes Endocrine and Metabolism Pediatric Unit (DEMPU), Children's Hospital, Cairo University. Subjects were eligible if they were between 9 and 16 years of age and had type 1 diabetes mellitus (T1DM) for one year or more. Exclusion criteria were the presence of associated hypothyroidism and the use of thyroxin therapy or lipid lowering medications. Thirty-nine healthy age and sex matched children and adolescents were included as control.

Procedures

Detailed history was taken from included patients including the following:

- Detailed medical history including; chronological age, duration and age at onset of diabetes, type and dose of insulin, compliance to diet and insulin therapy, detailed dietetic history in addition to family history of diabetes, hypertension, coronary heart disease and stroke, and history suggestive of diabetic microvascular and macrovascular complications.
- Diet history: each patient was asked for detailed food intake for 3 consecutive days, 3 meals and snacks with emphasis on total caloric intake and fat content (three days recall). A nutritionist had analyzed all components of child's diet and calculated the mean values for total caloric intake (kcal/d), intake of fats, CHO and proteins in grams per day as well as and caloric intake derived from fats (kcal/d).
- Physical activity: type and duration (h/day) of weekly activity was classified as "mild" if regular daily activity, like walking, running, playing football, ascending and descending stairs or bicycling; and "intense" if regular sports are done, like swimming, basketball, karate or gym. Patients having sedentary life were considered "inactive".
- Thorough clinical examination including height, weight, BMI, waist circumference (WC), stage of puberty and blood pressure measurement. The latter was done on 2 separate occasions and after 10 min rests using a sphygmomanometer.
- Assessment of glycemic control by calculating the mean fasting (FBG) and 2 h postprandial blood glucose (PPBG) for one month preceding the study, and the mean glycosylated hemoglobin (HbA1c) over one year prior to the study.

Biochemical analysis

- Laboratory assessment for lipid profile was done, after a 12-h overnight fast, including: serum total cholesterol (TC) by cholesterol oxidase–peroxidase method, serum triglycerides (TG) by glycerokinase-peroxidase method, high density lipoprotein-cholesterol (HDL-C) by Stanbio HDL-C Procedure No. 0599 and low density lipoprotein-cholesterol (LDL-C) = TC-(HDL-C)-(TG/5).

Dyslipidemia was defined by the American Diabetes Association (ADA)[7] as having low density lipoprotein-cholesterol (LDL-C) $\geqslant$100 mg/dl, high density lipoprotein-cholesterol (HDL-C) $<$40 mg/dl (males) and $<$50 mg/dl (females), total cholesterol (TC) $\geqslant$200 mg/dl and triglycerides (TG) $\geqslant$150 mg/dl; and dyslipidemia was considered present if one or more of these lipid or lipoprotein levels are abnormal.[8]

Statistical analysis

Data were statistically described in terms of mean (standard deviation ($\pm$SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Mann Whitney U test for independent samples. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

The sixty cases of children and adolescents with T1DM included 34 males and the thirty-nine non-diabetic control subjects included 18 males. The mean age was 12.5 (range 9.0–19.5) years in cases and 12.0 $\pm$ 2.2 (range 9.0–16.0) years in controls, $p > 0.05$.

The mean age at onset of diabetes in the studied group was 8.2 $\pm$ 2.6 (range 2.5–14.5) years, and the mean duration of diabetes was 4.3 $\pm$ 2.7 (range 1.0–12.0) years and the mean insulin dose was 1.1 $\pm$ 0.4 (range 0.5–2.7) IU/kg/day.

The frequency of dyslipidemia in the diabetic group was 65% (39/60) compared to 28.2% (11/39) in the control group with highly significant difference ($p < 0.001$).

Within the diabetic group, comparison of the fasting serum lipid profile (mean $\pm$ SD, and median) between those with