Hyperlipidemia in Children at Risk for Coronary Heart Disease

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Abstract

High blood cholesterol in childhood associated with early development of atherosclerotic plaques has been well established. To find the prevalence of hyperlipidemia in children at risk for coronary heart disease, the authors performed cholesterol screening in children aged between 5-18 years from families with a history of premature coronary heart disease and/or parental hypercholesterolemia. All children were measured for non-fasting capillary blood total cholesterol level by Reflotron dry chemistry method, and lipoprotein analysis was done in children whose capillary blood cholesterol level was ≥ 170 mg/dl. One hundred and sixty-five children participated in this study. Eighty-seven (52.7%) of the total had a non-fasting capillary blood cholesterol level ≥ 170 mg/dl, and 75 (87.2%) of these children were measured for lipoprotein analysis. Total cholesterol level ≥ 200 mg/dl, low density lipoprotein cholesterol (LDL-C) ≥ 130 mg/dl, and high density lipoprotein cholesterol (HDL-C) < 35 mg/dl were found in 43 (57.3%), 50 (66.7%) and 9 (12.0%) children respectively. As a result of this study, Thai children at risk for coronary heart disease had a high prevalence of abnormal lipid profile, which may predict the high prevalence of premature coronary heart disease in the future.

Key word : Hyperlipidemia, Children, Coronary Heart Disease

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Coronary heart disease is a major public health problem in all industrialized countries and also in Thailand. Atherosclerosis begins in childhood and progresses further in adolescence and young adulthood. Clinically significant arterial lesions usually occur in adulthood, at which time atherosclerotic arterial lesions frequently lead to coronary heart disease. Individuals with a family history of premature coronary heart disease are at increased risk of developing coronary heart disease[1-3]. The childhood origin of atherosclerotic and the need to control atherosclerotic complications in adult have led to increased interest in the relationship of adult risk factors for coronary heart disease to early lesions of atherosclerosis in children, adolescents, and young adults[4-6], and children with high blood cholesterol levels are also more likely to have high blood cholesterol levels as adults than the general population[1,4,7-9].

Rapid socioeconomic development is causing changes in eating habits and many lifestyle patterns in Thai children and adolescents. These are related to risk factors for coronary heart disease, such as development of obesity, hypercholesterolemia, physical inactivity and cigarette smoking. To identify children at "high risk" for hypercholesterolemia, the American Academy of Pediatrics guidelines proposes targeted screening based on selected family history and individual risk factors, a positive family history of documented premature coronary disease and/or parental hypercholesterolemia[9,10]. The purpose of the present study was to analyze the prevalence of hyperlipidemia in children with coronary heart disease risk factors.

SUBJECTS AND METHOD

The protocol of the study was approved by the institutional ethic committee, Faculty of Medicine, Chulalongkorn University

Study populations

The data were collected from children between the age of 5 and 18 years who had a family history of premature coronary heart disease and/or parental hypercholesterolemia between 1999 and 2001. Children with a history of corticosteroid use, diabetes mellitus, renal, endocrine or hepatic disease were excluded. Parents were informed that coronary heart disease is now the leading cause of death in Thailand, that evidence has indicated that the disease has its origin in childhood, and that increased blood cholesterol concentration plays a major role in the disease process. The objective of the study was informed to the parents. Complete physical examination and health assessment was performed before measuring blood cholesterol level.

Premature coronary heart disease was defined as documented myocardial infarction, angiographic documentation of coronary artery disease, angina pectoris, or sudden cardiac death in parents, grandparents, aunts, or uncles at age 55 or younger. Hypercholesterolemia was defined as a documented serum cholesterol level equal to or greater than 240 mg/dl[9,11].

Lipid measurements

The initial cholesterol screening test was performed in the no fasting state. Those children whose cholesterol level ≥ 170 mg/d were evaluated at a later scheduled time, after a 12-hour fast, for total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), and triglyceride (TG). The time interval between the original cholesterol screening test and performance of lipoprotein analysis varied from 1 day to 2 weeks. A Reflotron (Boehringer Mannheim Diagnostics, Indianapolis, Inc.) machine was used for the initial cholesterol measurement which was accomplished by finger stick. Lipid profiles were obtained after venepuncture and performed by the central laboratory of King Chulalongkorn Memorial Hospital using an enzymatic system. LDL-C was calculated using the Friedwald equation [TC - HDL-C - (TG/5)].

Classification of lipid disorders

The guidelines of the the National Cholesterol Education program (NCEP) Expert Panel on Blood Cholesterol in Children and Adolescents were used[9,11] in setting the following definitions for acceptable, borderline, and high TC, LDL-C. Acceptable levels of TC and LDL-C are less than 170 mg/dl and less than 110 mg/dl, respectively; borderline levels, 170-199 mg/dl and 110-129 mg/dl; and high levels, higher than 200 mg/dl and higher than or equal to 130 mg/dl. HDL-C levels of less than 35 mg/dl are considered. For the first decade of life, a serum TG level above 100 mg/dl and above 130 mg/dl in the second decade was considered high.

RESULTS

The study population of 165 children (109 boys and 56 girls) had an age range of 5 through 18

years, with a mean age of 12.2 years. Initial cholesterol measurement was performed. A history of parental hypercholesterolemia, premature coronary heart disease or both of these risk factors were found in 114, 28 and 23 children, respectively. A paternal history of hypercholesterolemia and premature coronary heart disease was found in 54.7 and 62.8 per cent, respectively. Seventy-two (43.6%) children had a body weight ≥ 120 per cent weight for height (overweight). Blood pressure was normal for age in all of the children. A total of 87 children (52.7%) had screening TC levels of ≥ 170 mg/dl. Thirty-eight (43.7%) of these children were considered overweight, accounting for 53 per cent of all the overweight children. In the 93 children with normal body weight for height, 49 (52.6%) had a screening TC level of ≥ 170 mg/dl.

In the 87 children whose screening TC levels were ≥ 170 mg/dl, 53 (32.2%) had TC levels between 170-199 mg/dl, 24 (14.5%) and 10 (6.1%) had TC levels between 200-229 and ≥230 mg/dl respectively. Only 36 children (21.8%) had screening TC levels below 150 mg/dl, and 42 (25.5%) had TC levels between 150-169 mg/dl. Of the children whose screening TC levels were ≥ 170 mg/dl, 75 (87.2%) had lipoprotein analysis performed after a 12-hour fast. Total cholesterol, LDL-C, HDL-C and TG levels ranged from 165-311 mg/dl (210 ± 29.6 mg/dl), 96-247 mg/dl (144.5 ± 26.9 mg/dl), 30-81 mg/dl (47.2 ± 10.8 mg/dl), and 46-178 mg/dl (86.6 ± 35.6 mg/dl), respectively. Only 2 of these 75 children had a repeat TC level below 170 mg/dl, 36 (48%) children had TC levels between 200-249 mg/dl and 7 children had TC levels ≥ 250 mg/dl. Low density lipoprotein cholesterol levels of ≥ 130 mg/dl and HDL-C levels below 35 mg/dl were found in 50 and 9 subjects, respectively. Nine of the 26 children aged below 10 years and 4 of the 49 children aged above 10 years had blood TG levels exceeding 100 mg/dl and 130 mg/dl respectively (Table 1). Of the fifty children whose LDL-C levels were ≥ 130 mg/dl, 5 had LDL-C levels greater than 190 mg/dl, 13 were between 160-189 mg/dl, and 32 were 130-159 mg/dl. Twenty per cent (5/25) of the children with a family history of premature coronary heart disease and 24 of 25 (96%) of the children with parental hypercholesterolemia had blood LDL-C levels < 130 mg/dl.

Seven (4.2%) children with TC level of ≥ 250 mg/dl could be classified as heterozygous familial hypercholesterolemia. Regarding lipid related high risk of coronary heart disease[12], of these 75 children, 9 (12.0%) had a TC/HDL-C ratio > 6.0, 14 (18.7%) had an LDL-C/HDL-C ratio > 4.0 and 18 (24.0%) had an HDL-C/TC- HDL-C ratio < 0.24. Thirty of 32 (94%) children who had screening total cholesterol levels ≥ 200 mg/dl had LDL-C levels from lipoprotein analysis of ≥ 130 mg/dl, but only 50 per cent (22/43) of the children who had screening total cholesterol between 170-199 mg/dl had LDL-C levels from lipoprotein analysis of ≥ 130 mg/dl.

DISCUSSION

Coronary heart disease is the leading cause of death in Thailand. Convincing evidence has emerged that links defined risk factors in adults with an accelerated atherosclerotic process. Pathological data have also shown that atherosclerosis begins in childhood, and that the extent of atherosclerotic change in children and young adults can be correlated with the presence of the same risk factors identified in adults[2,3]. It seems reasonable to initiate healthful

Table 1. Distribution of total cholesterol, LDL-C, HDL-C, and triglyceride of 75 children who had lipid profiles studied.

Type of lipids	Level	Number	%
Cholesterol	< 170 mg/dl	2	2.7
	170-199 mg/dl	30	40.0
	≥ 200 mg/dl	43	57.3
LDL cholesterol	< 110 mg/dl	7	9.3
	110-129 mg/dl	18	24.0
	≥ 130 mg/dl	50	66.7
HDL cholesterol	< 35 mg/dl	9	12.0
	> 35 mg/dl	66	88.0
Triglyceride (>10 year-of age)	< 90 mg/dl	28	47.5
	90-129 mg/dl	17	34.7
	≥ 130 mg/dl	4	17.8

lifestyle training in childhood to promote improved cardiovascular health in adult life. Identifying at-risk children and adolescents is the first step in modifying or preventing this disease[4-6,9,12,13].

In population studies, childhood cholesterol level is a good predictor of cholesterol levels as a young adult, particularly at the high and low extremes of distribution[8-10]. Children with hypercholesterolemia, therefore, should be identified at an early age and attempts made to correct any environmental factors liable to increase the risk of coronary heart disease [8]. Cholesterol screening is an acceptable method for introducing children and families to a heart-healthy life pattern. The American Academy of Pediatrics (NCEP-Pediatrics Expert Panel) chose to recommend selective cholesterol screening, instead of universal screening. They primarily focus on children with a family history of premature coronary disease (at or below age 55), a family history of hypercholesterolemia (parental blood cholesterol levels higher than 240 mg/dl), children for whom family history is not available, and on individuals with additional screening indicators[9,14]. Although, selective screening does not effectively detect all individuals with hypercholesterolemia, universal cholesterol screening is not cost effective[15-18]. In the present study, of the 165 children who had an initial TC measurement, 87 (52.7%) children had levels exceeding 170 mg/dl and 34 of 87 children had levels exceeding 200 mg/dl. The high prevalence of hypercholesterolemia found by screening in the present study supports the prediction of the NCEP-Pediatrics Expert Panel and the Cincinnati Myocardial Infraction and Hormone Family Study (CIMIH) family population that parental hypercholesterolemia and premature coronary heart disease is particularly useful in identifying children with a high TC concentration[4,19].

Of the children in whom lipoprotein levels were studied, 43 of 75 children or at least 26.6 per cent of the 165 children had TC levels exceeding 200 mg/dl, and 50 children or at least 30.3 per cent of the 165 children had LDL-C levels exceeding 130 mg/dl. The prevalence of high TC and LDL levels in these Thai children with coronary risk factors are quite close to those found in studies in Western countries [20-22]. Driller et al[19] found 25 per cent of 232 children with a parental history of premature coronary heart disease had elevated LDL-C levels (≥ 130 mg/dl), and Sveger et al[23] found 19 children (22.6%) and 12 children (14.3%) of 84 Swedish children with a parental history of coronary heart disease had abnormal TC and LDL-C levels respectively, Chase et al [24] found 29 per cent of the children of adults with early heart attacks have elevated levels of serum cholesterol.

In a recent consensus conference regarding lowering of blood cholesterol to prevent heart disease, it was considered desirable to begin prevention in childhood because patterns of lifestyle are developed at an early age[3,11]. Rapid socioeconomic development is causing changes in eating habits and many lifestyle patterns in Thai children, leading to a higher prevalence of hyperlipidemia in children with coronary heart disease risk factors[25]. It is reasonable to attempt early identification of hypercholesterolemia by screening the children of families with documented risk factors[26]. This offers the opportunity for the physician to institute early intervention by discussing common modifiable coronary heart disease risk life style behaviors such as overeating, smoking, physical inactivity, and excessive dietary intake of cholesterol and saturated fat. Children with hypercholesterolemia require dietary instruction and controls[14,27,28]. Pediatricians have a long tradition in health maintenance and preventive medicine, and the notable frequency of hyperlipidemia in children from families with risk factors allow the pediatricians to assume a central role in the primary prevention of atherosclerosis.

SUMMARY

A considerably high proportion of children were found with elevated TC and LDL-C levels in a population of children with a family history of premature coronary heart disease and/or parental hypercholesterolemia. This may predict a high prevalence of premature coronary heart disease in adulthood. Cardiovascular health promotion linked to regular pediatric care has the potential to reduce the risk of atherosclerotic disease in both the individual child and the population at large.

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ภาวะไขมันในเลือดสูงในเด็กเสี่ยงต่อการเกิดโรคกล้ามเนื้อหัวใจขาดเลือด

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ภาวะไขมันในเลือดสูงในเด็กเป็นปัจจัยเสี่ยงต่อการเกิดโรคกล้ามเนื้อหัวใจขาดเลือดเมื่อเติบโตเป็นผู้ใหญ่ เพื่อศึกษาถึงความชุกของภาวะไขมันในเลือดสูงในเด็กและวัยรุ่นที่เสี่ยงต่อการเกิดโรคกล้ามเนื้อหัวใจขาดเลือด ผู้รายงานได้ตรวจกรองวัดระดับ total cholesterol ด้วยวิธี Reflotron dry chemistry และตรวจวัดระดับไขมันตรวจวิธี lipoprotein analysis โดยการงดอาหารก่อนการตรวจเลือด ในกรณีที่มีระดับ total cholesterol มากกว่าหรือเท่ากับ 170 มก/ดล ในเด็กและวัยรุ่นอายุ 5–18 ปี ที่มีประวัติของการมีบุคคลในครอบครัวเป็น premature coronary heart disease และ/หรือมีระดับ cholesterol ในเลือดมากกว่า 240 มก/ดล. ผลการศึกษาพบว่าเด็กและวัยรุ่นที่เข้าร่วมการศึกษา 165 ราย มีระดับ total cholesterol ≥ 170 มก/ดล จำนวน 87 ราย จากการตรวจด้วย Reflotron dry chemistry และในจำนวนนี้ 75 ราย (87.2%) ได้รับการตรวจระดับไขมันด้วยวิธี lipoprotein analysis พบว่ามีระดับ total cholesterol ≥ 200 มก/ดล, LDL cholesterol ≥ 130 มก/ดล และ HDL cholesterol < 35 มก/ดล จำนวน 43 (57.3%), 50 (66.7%) และ 9 (12.0%) ราย ตามลำดับ

สรุป : เด็กที่มีความเสี่ยงต่อการเกิดโรคหัวใจขาดเลือด มีความชุกของการมีระดับไขมันผิดปกติสูง แสดงให้เห็นว่าในอนาคตอาจมีโอกาสเกิดโรคหัวใจขาดเลือดเพิ่มขึ้นหากไม่มีมาตรการในการป้องกันตั้งแต่ในวัยเด็ก

คำสำคัญ : ไขมันในเลือดสูง, เด็ก, โรคกล้ามเนื้อหัวใจขาดเลือด

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