

## **Cholesterol Screening in Children**

### **Case Scenario**

**K.P. is a 5 y/o male who is visiting your clinic for a well care child visit. Mom has no complaints or concerns about K.P. at this time and is switching to your clinic for insurance purposes. On obtaining a history, you find that K.P. is a healthy child in kindergarten. He has had no medical problems and never been hospitalized. However, as you ask Mom about the family history, you find out that her husband died of an MI at age 36 and she herself has hyperlipidemia with an LDL of 260 now on medication. What questions would you ask Mom and how would you proceed with care of K.P.?**

**The following concepts should be understood before continuing with this case:**

- Why is cholesterol screening important in children?**
- What is the significance of blood cholesterol levels in children and adolescents?**
- What are the basic nutrition recommendations for children and adolescents?**
- At what age should children be screened for high cholesterol? What are the screening protocols and guidelines?**
- How should you manage high cholesterol in children and adolescents?**
- What are the Step I and Step II diets?**
- What is the role of medications in management of children with high cholesterol?**

## **Cholesterol Screening in Children**

The goal of screening serum cholesterol in children is to identify and treat children with hypercholesterolemia whose elevated low-density lipoprotein cholesterol (LDL) predicts an increased adult risk of coronary heart disease (CHD).

### **Why is cholesterol screening important in children?**

#### **Diet and Atherosclerosis**

Studies in animals have demonstrated that high blood cholesterol levels promote atherosclerosis. Vascular fatty streaks and fibrous plaques develop in adolescent nonhuman primates fed diets high in saturated fatty acids and cholesterol. Total blood cholesterol levels in children vary geographically. In countries such as the Philippines, Italy, and Ghana, saturated fat constitutes about <10% of dietary intake, and the serum cholesterol level in boys 8 to 9 years old is generally below 160 mg/dL. In boys from countries such as the Netherlands, Finland, and the US, the saturated fat intake varies from 13.5-17.7% of energy intake and serum cholesterol levels are generally >160 mg/dL. The United States is in the top half of the range of serum cholesterol levels in the world.

#### **Clinical Trials**

- In adult populations, clinical trials have shown that lowering cholesterol levels reduces coronary risks and reduces fatal and non-fatal myocardial infarction.
- Recent studies show not only a decrease in the incidence of CHD but also in mortality from all causes.
- The Dietary Intervention Study in Children, a recent study of the safety and efficacy of low fat diets in pupertal children was recently reported. 663 children ages 8-10 were followed for 3 years. The intervention group receiving a diet with 28% of calories from total fat, about 10% of calories from saturated fat, and 95 mg per day of cholesterol was compared with a group that consumed 33% to 34% of calories as total fat, 12.7% of calories as saturated fat, and 112 mg per day of cholesterol. The intervention group had a significantly reduced level of LDL-cholesterol and maintained psychological well-being.

### **What is the significance of blood cholesterol levels in children and adolescents?**

- Compared with their counterparts in many other countries, US children and adolescents have higher blood cholesterol levels and higher intakes of saturated fatty acids and cholesterol. US adults have higher rates of CHD morbidity and mortality.
- Autopsy studies show that early coronary atherosclerosis often begins in childhood and adolescence and are related to high serum total cholesterol levels, LDL-cholesterol plus very low-density lipoprotein-cholesterol levels, and low high-density lipoprotein levels.

- Children and adolescents with elevated serum cholesterol levels (particularly LDL) come from families with high incidence of CHD.
- Strong familial association exists because of shared environments and genetic factors. The monogenetic factors that cause high cholesterol levels include familial hypercholesterolemia and familial-combined hypercholesterolemia.
- Children and adolescents with high cholesterol levels are more likely than the general population to have high levels as adults.

### **What are the nutrition recommendations?**

The following are the recommendations in terms of nutrients and diet:

-No dietary restriction of fat or cholesterol is recommended for infants <2 years old when rapid growth and development require high energy intakes.

-Between the ages of 2 to 5 children should adopt a diet that by 5 years of age contains  $\leq 30\%$  of calories and  $\leq 20\%$  from fat. As they begin to consume fewer calories from fat, children should replace these calories by eating more grain products, fruits, vegetables, low-fat milk products of other calcium rich foods, beans, lean meat, poultry, fish, or other protein-rich foods.

-Nutritional adequacy should be achieved by eating a wide variety of foods, caloric intake should be adequate to support growth and development and to reach and maintain desirable body weight.

-For a child or adolescent 2-18 years old, the following pattern of nutrient intake is recommended:

Saturated fatty acids  $<10\%$  of total calories

Total fat over several days of  $\leq 30\%$  of total calories and no less than  $20\%$  of total calories

Dietary cholesterol  $<300$  mg per day

### **What is the screening protocol in children and at what age should children be screened?**

- The American Academy of Pediatrics and the American Heart Association recommends screening of children who are at a high risk of coronary artery disease after the age of 2. Children less than the age of 2 have a diet high in fat so it is not recommended to screen children this early.
- In children of a parent with a serum cholesterol  $>240$  mg/dL serum total cholesterol should be measured. If the child's serum cholesterol is  $\geq 200$  mg/dL a fasting lipoprotein profile should be obtained to measure high density lipoprotein cholesterol (HDL) and LDL. If the child's serum cholesterol level is borderline (170-199 mg/dL) a second measurement should be obtained and averaged with the first. If the average is borderline or high, a fasting lipoprotein profile should be obtained.
- In children with a family history of premature cardiovascular disease, lipoprotein analysis should be performed after a 12-hour fast to measure serum HDL, LDL, total cholesterol, and triglycerides (TG). Because of the variability in some

children, the analysis should be repeated so that an average LDL-cholesterol may be calculated.

**Screening Guidelines (as recommended by AAP, National Cholesterol Education Program, AMA, and AAFP):**

- ✓ **Screen children and adolescents whose parents or grandparents at an age of 55 or younger underwent diagnostic coronary arteriography and were found to have coronary atherosclerosis (including those who have had balloon angioplasty or coronary artery bypass surgery.**
- ✓ **Screen children and adolescents whose parents or grandparents, at 55 or younger had a documented myocardial infarction, angina pectoris, peripheral vascular disease, cerebrovascular disease, or sudden cardiac death.**
- ✓ **Screen the offspring of a parent with an elevated blood cholesterol level (240 mg/dL or higher)**
- ✓ **For children and adolescents whose parental history is unobtainable, particularly those with other risk factors, physicians may choose to measure cholesterol levels to identify those in need of nutritional or medical advice. Such risk factors include smoking, obesity, DM, high blood pressure, or diets high in cholesterol and saturated fats.**

**TABLE 2**  
 Classification of Total and LDL-Cholesterol Levels in Children and Adolescents From Families With Hypercholesterolemia or Premature Cardiovascular Disease

	Total Cholesterol (mg/dL)	Category	LDL-Cholesterol (mg/dL)
Acceptable	<170		<110
Borderline	170-199		110-129
High	≥200		130

**What is the management of elevated cholesterol in children?**

1. Acceptable LDL-cholesterol level (<110 mg/dL)—Provide education on the eating pattern recommended for all children and adolescents and on other risk factors. Repeat the lipoprotein analysis in 5 years.
2. Borderline LDL-cholesterol level (110 to 129 mg/dL)—Provide advice about risk factors for cardiovascular disease. Initiate the AHA Step-One diet and other risk factor intervention. Reevaluate in one year.

3. High LDL-cholesterol (greater than or equal to 130 mg/dL)—Examine for secondary causes (thyroid, liver, and renal disorders) and familial disorders, screen all family members, initiate Step-One diet, followed by the Step-Two diet if necessary.

**Step One and Step Two Diets**—The Step-One diet calls for the same nutrient intake recommended above. What makes this diet therapeutic is prescription in the medical setting with monitoring and follow up by a health professional. The Step-Two diet requires detailed assessment of current eating patterns and instruction by a physician, registered dietician, registered nurse, nutritionist, or other trained health professional. It aims to induce an eating pattern that includes no more than 30% and no less than 20% of calories from total fat, <7 % of total calories from saturated fat, and less than or equal to 10% of calories from polyunsaturated fats, with no more than 200 mg per day of cholesterol.

### **What about drug therapy in children?**

Drug therapy should be considered only for:

- a) Children > 10 years old after an adequate trial of diet therapy (for 6 to 12 months) and whose LDL-cholesterol level remains greater than or equal to 190 mg/dL.
- b) Children > 10 years old whose LDL-cholesterol level remains greater than or equal to 160 mg/dL *and* there is a family history of premature cardiovascular disease in someone less than 55 years old of age  
*Or*  
two or more other risk factors (as mentioned above) present in the child after vigorous attempts have been made to control these risk factors.

### **Drugs of Choice**

#### **BAS (cholestyramine, colestipol)**

- Proven efficacy and safety
- Efficacy of BASs is a modest reduction in LDL <20%
- Adverse effects include GI side effects, elevation of triglycerides, unpalatability, limiting long term compliance.
- Bind bile acids in the intestinal lumen (not absorbed and lack systemic toxicity)
- Cholestyramine and colestipol (5 g colestipol = 4 g cholestyramine)
- Malabsorption of vitamins can occur (fat soluble vitamins, folate)

#### **Niacin**

- Proven efficacy and safety in short term studies
- LDL reduction 30%
- 1200-2250 mg/d

- Compliance poor given side effects of flushing (71%)

### **Statins**

- Recent studies have focused on statins
- 5 Trials
- Efficacy similar to adult patients
- Decrease in LDL by 18-35%
- Pravastatin 5-20 mg/d, Lovastatin 10-40 mg/d, Simvastatin 10 mg/d
- Compliance high but therapy brief in trials (8 weeks)
- Studies have been underpowered by safety, as effects on growth and development may not be available for years.
- High risk of myopathy.

**What are some resources for families with hyperlipidemia or high cholesterol?**

#### **National Cholesterol Education Program**

<http://www.nhlbi.nih.gov/about/ncep>

#### **American Heart Association Step I and Step II Diets**

<http://www.startwithyourheart.com/links/ahadiet.htm>

#### **American Heart Association**

[www.americanheart.org](http://www.americanheart.org)

#### **Hyperlipidemia Info from Cincinnati Children's Hospital**

<http://www.cincinnatichildrens.org/health/heart-encyclopedia/disease/hyperlipidemia.htm>

#### **MD Advice:**

<http://www.mdadvice.com/topics/hyperlipidemia/info/5.htm>

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