Preventive Cardiology
in the Primary Care Setting

Management of Dyslipidemia in Children and Adolescents
DISCLOSURES

- I have no financial interests or other relationship with manufacturers of commercial products or suppliers of commercial services.
- My presentation will not include any discussion of the unlabeled use of a product or a product under investigational use.
THE PATIENT

- 15 years-old boy
- Health maintenance visit
- No complaints, but his parents are worried about his weight
- ROS: negative except he snores, has occasional nosebleeds, and he does not exercise
- PMH: allergic rhinitis
- Hospitalizations: treatment of dehydration at 2 years of age
- Surgeries: Neonatal circumcision
THE PATIENT

Medications
- Allegra for allergies

NKDA

Immunizations
- Needs Hepatitis B series, MMR, and tetanus booster

SH: lives with parents and 2 siblings; both parents smoke

FH:
- Dad has HTN and hypercholesterolemia
- Mom is obese and has DM and HTN
- PGPs have HTN and CAD
- MGPs have obesity, DM and HTN
THE PATIENT

- Physical examination
  - Wt 115 kg
  - Ht 173 cm
  - BMI 38 kg/m²
  - BP 155/86 mmHg
  - Obese
  - Cervical acanthosis nigricans
  - Axillary and abdominal striae
  - Tanner stage 4
WHAT OPPORTUNITIES HAVE YOU IDENTIFIED?

- Obesity with acanthosis – at risk for DM
- Elevated BP
- Sedentary lifestyle
- Possible sleep disordered breathing
- Second hand smoke exposure
- FH of HTN, DM, obesity, dyslipidemia, and CAD
LABORATORY STUDIES

- Hgb A1c = 5.7%
- LFTs = normal
- Total cholesterol = 257 mg/dL
- LDL = 179 mg/dL
- HDL = 34 mg/dL
- Triglycerides = 218 mg/dL
- Non-HDL = 223 mg/dL
**Why are these important?**

- Each of these is a risk factor or risk behavior associated with the development of premature cardiovascular disease
- Atherosclerotic cardiovascular disease (CVD) remains the leading cause of death in North Americans
- Risk factors and risk behaviors that accelerate the development of atherosclerosis begin in childhood
- There is increasing evidence that risk reduction delays progression towards clinical disease
2013 Leading Causes of Death in U.S.

- Heart Disease: 611,105
- Malignant Neoplasms: 584,881
- Chronic Low Respiratory Disease: 130,557
- Unintentional Injury: 128,978
- Cerebrovascular: 149,205
- Alzheimer’s Disease: 84,767
- Diabetes Mellitus: 75,578
- Influenza & Pneumonia: 56,979
- Nephritis: 47,112
- Suicide: 41,149
BACKGROUND

- Every year, over 610,000 people die of heart disease, accounting for almost 25% of deaths in the United States.
- Every year about 735,000 Americans experience a heart attack.
- Heart disease costs the United States approximately $207 billion a year. This total includes the cost of health care services, medications, and lost productivity.
BACKGROUND

- Clinical events such as myocardial infarction, stroke, peripheral arterial disease, and ruptured aortic aneurysm are the culmination of the lifelong vascular process of atherosclerosis

- Pathology
  - Accumulation of abnormal lipid in the vascular intima, a reversible stage
  - Development of a core of extracellular lipid covered by a fibromuscular cap
  - Followed by thrombosis, vascular rupture, or acute ischemic syndromes
BACKGROUND

- The presence of multiple risk factors is associated with striking evidence of an accelerated atherosclerotic process.
Background

- Risk factors and risk behaviors identified during childhood have been demonstrated to track into adulthood, especially obesity, cholesterol, and blood pressure.
BACKGROUND

- The increasing prevalence of obesity in childhood is associated with the same obesity-related risk factor clustering seen in adults and this continues into adult life.

- This high risk combination is among the reasons that the current obesity epidemic with its relationship to future CVD and DM is considered one of the most important public health challenges in contemporary society.
CARDIOVASCULAR DISEASE PREVENTION IN YOUTH

Goals
- **Primordial** - prevent the development of risk factors
- **Primary** - recognize and manage those children and adolescents at increased risk due to the presence of identified risk factors

It is well established that a population that enters adulthood with lower risk will have less atherosclerosis and will collectively have lower CVD rates
IMPLEMENTING CARDIOVASCULAR DISEASE PREVENTION IN THE PRIMARY CARE SETTING

- Pediatric care providers – pediatricians, family practitioners, nurses, nurse practitioners, physician assistants, registered dietitians - are ideally positioned to reinforce CV health behaviors as part of routine care.
IMPLEMENTING CARDIOVASCULAR DISEASE PREVENTION IN THE PRIMARY CARE SETTING

- The childhood health maintenance visit provides an ideal context for effective delivery of the CV health message.
- Pediatric care providers provide an effective team, educated to initiate behavior change to diminish risk of CVD and promote lifelong CV health in their patients, from infancy into young adult life.
IMPLEMENTING CARDIOVASCULAR DISEASE PREVENTION IN THE PRIMARY CARE SETTING

- Identify the risk factors
  - Family history of premature CVD
  - Nutrition and diet/Obesity
  - Sedentary lifestyle
  - Tobacco exposure
  - Hypertension
  - Dyslipidemia
  - Diabetes mellitus
RISK FACTOR: POSITIVE FAMILY HISTORY
**Risk Factor: Positive Family History Definition**

- Parent, grandparent, uncle, aunt, or sibling
- Male < 65 years of age
- Female < 55 years of age
- Any of the following:
  - Stroke
  - Sudden cardiac death
  - Heart attack
  - Treated angina
  - Percutaneous coronary artery intervention
  - Coronary artery bypass grafting
Risk Factor: Positive Family History Evidence

- Represents the net effect of shared genetic, biochemical, behavioral and environmental components
- A positive parental history has been consistently shown to significantly increase baseline risk for CVD
- Has been confirmed for men, women, and siblings and in different racial and ethnic groups
RISK FACTOR: POSITIVE FAMILY HISTORY RECOMMENDATIONS

- Take a detailed family history at the initial encounter and/or at age 3 years, 9-11 years, and 18 years
- Update the family history during non-urgent health encounters
- If the family history is positive, evaluate the patient for other CVD risk factors
- Educate the family about the importance of family history in assessing the risk for CVD
RISK FACTOR: NUTRITION AND DIET
**Risk Factor: Nutrition and Diet Evidence**

- There is strong and consistent evidence that good nutrition beginning at birth has profound health benefits, with the potential to decrease future risk for CVD.
- Ongoing nutrition counseling has been effective in assisting children and families to adopt and sustain recommended diets for both nutrient adequacy and reducing CV risk.
RISK FACTOR: NUTRITION AND DIET RECOMMENDATIONS

- In accordance with the Surgeon General’s Office, WHO, the AAP and the AAFP, exclusive breastfeeding is recommended for the first 6 months of life. Continued breastfeeding is recommended to at least age 12 months, with the addition of complementary foods. If breastfeeding *per se is not possible*, *feeding human milk by bottle is second best*, with formula-feeding as the third choice.
Risk Factor: Nutrition and Diet Recommendations

- In normal children and in children with hypercholesterolemia, intake of total fat can be safely limited to 30% of total calories
  - saturated fat intake limited to 7-10% of calories
  - monounsaturated and polyunsaturated fats providing up to 20% of calories
  - dietary cholesterol limited to 300 mg/d

- This dietary composition has been shown to result in lower TC and LDL-C levels, less obesity, and less insulin resistance
Risk Factor: Nutrition and Diet Recommendations

- The remaining 70% of calories should include 15-20% from protein and 50-55% from carbohydrate sources.

- Decrease sodium intake:
  - associated with lower systolic and diastolic BPs in infants, children, and adolescents.

- Increase intake of plant-based foods:
  - important low calorie sources of nutrients including vitamins and fiber in the diets of children.

- Reduce intake of sugar-sweetened beverages:
  - associated with decreased obesity.
Risk Factor: Nutrition and Diet Recommendations

- For growing children, milk provides essential nutrients, including protein, calcium, magnesium, and vitamin D, that are not readily available elsewhere in the diet.
- Consumption of fat-free milk in childhood after age 2 years and through adolescence optimizes these benefits, without compromising nutrient quality while avoiding excess saturated fat and calorie intake.
RISK FACTOR: NUTRITION AND DIET RECOMMENDATIONS

- Be specific and explicit
- Consult with a Nutritionist
- www.nhlbi.nih.gov
- www.diabetes.org
- www.healthychildren.org
RISK FACTOR: NUTRITION AND DIET RECOMMENDATIONS

Healthy Calendar
Diabetic Cooking
A full year of simple menus and easy recipes

Lara Rondinelli, RD, LD, CDE and Chef Jennifer Bucko
Risk Factor: Nutrition and Diet Recommendations
RISK FACTOR: NUTRITION AND DIET RECOMMENDATIONS
Risk Factor: Physical Activity

Physical Activity is the Best Medicine
I exercised once, but found out I was allergic to it! My skin flushed and my heart raced. I got sweaty and short of breath. Very dangerous!
**Risk Factor: Physical Activity Evidence**

- There is strong evidence for beneficial effects of physical activity and disadvantageous effects of a sedentary lifestyle on the overall health of children and adolescents across a broad array of domains.

- A sedentary lifestyle is associated with higher blood pressures/HTN, obesity, insulin resistance, and Type 2 Diabetes Mellitus.
Risk Factor: Physical Activity Evidence

There is strong evidence that increases in moderate to vigorous physical activity are associated with:

- lower systolic and diastolic blood pressure
- decreased measures of body fat; decreased BMI
- improved fitness measures
- lower total cholesterol; lower LDL cholesterol; lower triglycerides; higher HDL cholesterol
- decreased insulin resistance in childhood and adolescence
RISK FACTOR: PHYSICAL ACTIVITY EVIDENCE

- There is no evidence of harm associated with increased physical activity or limitation of sedentary activity in normal children.
- There is limited but strong and consistent evidence that physical exercise interventions improve subclinical measures of atherosclerosis.
- There is strong evidence that physical activity should be promoted in schools.
**Risk Factor: Physical Activity Recommendations**

- Encourage parents to promote and model regular physical activity
  - Unlimited active playtime in a safe and supportive environment
  - Discourage TV viewing < 2 years of age
  - Limit media time to < 2 hours a day
  - No TV in the child’s bedroom
Risk Factor: Physical Activity Recommendations

- Encourage parents to promote and model regular physical activity
  - 1 hour/day of moderate to vigorous daily activity
  - Vigorous physical activity 3 days/week
  - Encourage weekly family activity
  - Support family activity once a week and/or family support of adolescent’s physical activity program
  - Support recommendations for daily physical education in schools
RISK FACTOR: TOBACCO EXPOSURE
RISK FACTOR: TOBACCO EXPOSURE EVIDENCE

- The evidence that cigarette use is harmful and addictive is unequivocal.
- Tobacco dependence is responsible for approximately 4 million annual deaths worldwide.
- Tobacco use is probably the leading actual cause of death in the U.S.
- In utero exposure to tobacco products, involuntary tobacco smoke exposure (second hand smoke), and tobacco use directly impair health in fetuses, infants, children, and adolescents.
Risk factor: Tobacco Exposure Recommendations

- Obtain smoke exposure/smoking history
- Provide a smoke free home environment
- Provide explicit smoking abstinence/cessation message
- Provide specific smoking cessation guidance
- Reinforce at every healthcare encounter
- Advocate for school and community based smoke free interventions

Thank you for not smoking
RISK FACTOR: HYPERTENSION
In epidemiologic surveys of children and adolescents over the past 20 years, blood pressure levels are increasing, and the prevalence of hypertension and prehypertension are increasing, explained partially by the rise in obesity.

Prehypertension progresses to hypertension at a rate of approximately 7 percent per year; hypertension persists in almost one-third of boys and one-fourth of girls on 2-year longitudinal follow-up.
RISK FACTOR: HYPERTENSION EVIDENCE

- Breast-feeding and supplementation of formula with polyunsaturated fatty acids in infancy are both associated with lower blood pressure at follow-up.
- Lower dietary sodium intake is associated with lower blood pressure levels in infants, children, and adolescents.
Risk Factor: Hypertension Evidence

- A DASH-style diet, which is rich in fruits, vegetables, low-fat or fat-free dairy products, whole grains, fish, poultry, beans, seeds and nuts, and lower in sweets and added sugars, fats, and red meats is associated with lower blood pressure.
Risk Factor: Hypertension Recommendations

CONSULTING

If you’re not a part of the solution, there’s good money to be made in prolonging the problem.
RISK FACTOR: DYSLIPIDEMIA
Risk Factor: Dyslipidemia Evidence

- Atherosclerosis begins in youth and this process, from its earliest phases, is related to the presence and intensity of the known CV risk factors.
**Risk Factor: Dyslipidemia Evidence**

- This has been demonstrated in autopsy studies [Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study and the Bogalusa Heart Study]

- Risk factors for the development of atherosclerosis can be identified in childhood

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- High cholesterol
- Physical inactivity
- Family history
- High triglycerides
- High blood pressure
- Birth control
- Overweight
- Obesity
- Smoking
- Diabetes
- Prediabetes
- Unhealthy diet
- Stress
- Anemia
- Sleep apnea
- Too much alcohol
- Metabolic syndrome
- Preeclampsia
- Depression
Risk Factor: Dyslipidemia Evidence

- Risk factors correlate with noninvasive measures of subclinical atherosclerosis
  - Carotid intimal media thickness (CIMT)
  - Coronary calcium
  - Endothelial dysfunction
  - LV mass
- Combined evidence from autopsy studies, vascular studies, and cohort studies strongly indicates that abnormal lipid levels in childhood are associated with increased evidence of atherosclerosis
**Risk Factor: Dyslipidemia Evidence**

- Genetic disorders that cause elevated cholesterol levels are associated with premature CVD
- Genetic traits associated with low cholesterol are associated with longer life expectancy
- The presence of the metabolic syndrome risk factor cluster in childhood predicted clinical CVD in adult subjects at 30-48 years of age
Risk Factor: Dyslipidemia Evidence

- Obesity is commonly associated with a combined dyslipidemia pattern with mild elevation in TC and LDL, moderate to severe elevation in TG and low HDL.
- This is the most common dyslipidemic pattern seen in childhood, and lipid assessment of overweight and obese children identifies an important proportion of children with significant lipid abnormalities.
RISK FACTOR: DYSLIPIDEMIA EVIDENCE

- Cohort studies have demonstrated significant tracking of elevated lipid levels from childhood into adulthood, with lipid and lipoprotein results in childhood predictive of future adult lipoprotein profiles
- Early identification and control of dyslipidemia throughout youth and into adulthood may substantially reduce clinical CVD risk beginning in young adult life
Risk Factor: Dyslipidemia Evidence

- Significant evidence exists that using family history of premature CVD or of cholesterol disorders as the primary factor in determining lipid screening for children misses approximately 30-60% of children with dyslipidemias.

- Identification of children with lipid disorders that predispose them to accelerated atherosclerosis requires universal lipid assessment.
Risk Factor: Dyslipidemia Evidence

- Non-HDL has now been identified as a significant predictor of the presence of atherosclerosis, as powerful as any other lipoprotein cholesterol measure in children and adolescents.

- For both children and adults, non-HDL appears to be more predictive of persistent dyslipidemia and therefore atherosclerosis and future events than TC, LDL or HDL alone.
**Risk Factor: Dyslipidemia Recommendations**

- **Birth to 2 years of age**
  - No routine lipid screening

- **2-8 years of age**
  - No routine lipid screening
  - Measure lipid profile if:
    - + Family History of premature CVD
    - Parent with dyslipidemia (TC > 240 mg/dL)
    - Child has DM, HTN, BMI > 95*tile*, or smokes
    - Child has a moderate or high risk medical condition
**Risk Factor: Dyslipidemia Recommendations**

- **9-11 years of age [Universal screening]**
  - Obtain a non-fasting lipid profile (NFLP)
    - Non-HDL $\geq 145$ mg/dL or
    - HDL $< 40$ mg/dL
    - FLP $\times 2$
  - Or obtain a fasting lipid profile (FLP)
    - LDL $\geq 130$ mg/dL
    - non-HDL $\geq 145$ mg/dL
    - HDL $< 40$ mg/dL
    - TG $\geq 100$ mg/dL if $< 10$ years; $\geq 130$ mg/dL if $\geq 10$ years
    - Repeat FLP after 2 weeks but within 3 months
**Risk Factor: Dyslipidemia Recommendations**

- **12-16 years of age**
  - No routine screening
  - Obtain a FLP if new knowledge of:
    - Family history of premature CVD
    - Parent with dyslipidemia
    - Patient has DM, HTN, Obesity, or smokes
    - Patient has moderate or high risk medical condition
  - Lipid screening is not recommended for those 12–16 years of age because of significantly decreased sensitivity and specificity for predicting adult LDL–C levels and significantly increased false-negative results in this age group. Selective screening is recommended
RISK FACTOR: DYSLIPIDEMIA RECOMMENDATIONS

- 17-21 years of age [Universal screening]
  - Obtain a NFLP or FLP
    - NFLP
      - Non-HDL ≥145 mg/dL (≥190 mg/dL 20-21 years of age)
      - HDL<40 mg/dL
      - FLP × 2
    - FLP
      - LDL ≥130 mg/dL (≥160 mg/dL 20-21 years of age)
      - non-HDL ≥145 mg/dL (≥190 mg/dL 20-21 years of age)
      - HDL < 40 mg/dL
      - TG ≥130 mg/dL (≥150 mg/dL 20-21 years of age)
      - Repeat FLP
**Risk Factor: Dyslipidemia Recommendations**

- Average results of at least 2 FLPs
  - Obtained 2 weeks to 3 months apart
- TG $\geq 500$ mg/dL
  - Consult lipid specialist
- LDL $\geq 250$ mg/dL
  - Consult lipid specialist
**Risk Factor: Dyslipidemia Recommendations**

- LDL $\geq 130$ mg/dL but $< 250$ mg/dL
  - Exclude secondary causes
  - Evaluate for other risk factors
  - Initiate CHILD 1 diet (Nutrition consult)
  - Lifestyle modifications
  - Reevaluate in 3 months with FLP
  - If still abnormal, advance to CHILD 2-LDL diet
  - Reevaluate in 3 months with FLP
CAUSES OF SECONDARY DYSLIPIDEMIA

- Exogenous
  - Alcohol
  - Medications
    - Corticosteroids
    - Isoretinoin
    - Beta-blockers
    - Some oral contraceptives
    - Some chemotherapeutic agents
    - Some antiretrovirals
CAUSES OF SECONDARY DYSLIPIDEMIA

- Endocrine/Metabolic
  - Hypothyroidism
  - Hypopituitarism
  - Diabetes Mellitus
  - Pregnancy
  - Polycystic Ovary Syndrome
  - Lipodystrophy
  - Acute Intermittent Porphyria
CAUSES OF SECONDARY DYSLIPIDEMIA

- Renal
  - Chronic renal disease
  - Hemolytic Uremic Syndrome
  - Nephrotic Syndrome

- Infectious
  - Acute viral/bacterial infection
  - HIV
  - Hepatitis
CAUSES OF SECONDARY DYSLIPIDEMIA

- Hepatic
  - Obstructive liver disease/cholestasis
  - Biliary cirrhosis
  - Alagille Syndrome

- Inflammatory disease
  - Systemic Lupus Erythematosus
  - Juvenile Idiopathic Arthritis
CAUSES OF SECONDARY DYSLIPIDEMIA

- Storage disease
  - Glycogen storage disease
  - Gaucher disease
  - Cystine storage disease
  - Juvenile Tay-Sachs disease
  - Niemann-Pick disease
CAUSES OF SECONDARY DYSLIPIDEMIA

- Others
  - Kawasaki disease
  - Anorexia nervosa
  - Solid organ transplant
  - Childhood cancer survivor
  - Progeria
  - Idiopathic hypercalcemia
  - Klinefelter syndrome
  - Werner syndrome
RISK FACTOR DEFINITIONS

- + Positive Family History (+FH)
  - Myocardial infarction
  - Angina
  - Coronary artery bypass graft/stent/angioplasty
  - Sudden cardiac death in parent, grandparent, aunt, or uncle, male < 55 y, female < 65 y
RISK FACTOR DEFINITIONS

- High Level Risk Factors
  - HTN requiring medical therapy (BP > 99%’tile + 5 mmHg)
  - Current cigarette smoker
  - BMI ≥ 97 %’tile
  - Presence of high risk conditions

- Moderate Level Risk Factors
  - HTN not requiring medical therapy
  - BMI ≥ 95 %’tile and < 97 %’tile
  - HDL-C < 40 mg/dL
  - Presence of moderate risk conditions
Special Risk Conditions

- **High Risk**
  - Diabetes Mellitus
  - Chronic kidney disease/ESRD/Renal transplant
  - Orthotopic heart transplant
  - Kawasaki disease with current aneurysms

- **Moderate Risk**
  - Kawasaki disease with regressed aneurysms
  - Chronic inflammatory disease (SLE or IJA)
  - HIV infection
  - Nephrotic syndrome
RISK FACTOR: DYSLIPIDEMIA
RECOMMENDATIONS

- LDL < 130 mg/dL, continue diet and reevaluate annually
- LDL 130-189 mg/dL and no risk factors, continue diet and reevaluate every 6 months with FLP and update of FH and RFs
- LDL ≥ 190 mg/dL, initiate Statin therapy
RISK FACTOR: DYSLIPIDEMIA RECOMMENDATIONS

- LDL $\geq 160$ mg/dL but $< 189$ mg/dL
  - Plus positive Family History
  - Or one high level risk factor
  - Or 2 or more moderate level risk factors
  - Initiate Statin therapy

- LDL $\geq 130$ mg/dL but $< 160$ mg/dL
  - Plus two high level risk factors
  - Or one high level and 2 or more moderate level RFs
  - Or clinical CVD
  - Initiate Statin therapy
**Risk Factor: Dyslipidemia Recommendations**

- TG $\geq 100$ mg/dL but $< 500$ mg/dL (< 10 years)
- TG $\geq 130$ mg/dL but $< 500$ mg/dL (10-19 years)
- CHILD 1 diet with lifestyle modifications and weight loss
- Reevaluate in 3 months
- If still abnormal, CHILD 2-TG diet
- Reevaluate in 3 months
- If normal, reevaluate annually with FLP and update FH and RFs
**Risk Factor: Dyslipidemia Recommendations**

- After six months of diet and lifestyle modifications
  - TG < 100 mg/dL (<10 y); TG < 130 mg/dL (10-19 y)
    - Continue diet and lifestyle changes and recheck annually
  - TG ≥ 100, < 200 mg/dL (<10 y) or ≥ 130, < 200 mg/dL (10-19 y)
    - Intensify CHILD2-TG diet and weight loss
    - Increase dietary fish intake
    - Reevaluate every 6 months
RISK FACTOR: DYSLIPIDEMIA
RECOMMENDATIONS

- TG ≥ 200, < 500 mg/dL
  - CHILD 2-TG Diet and weight loss
  - Consider Omega-3 fish oil supplementation

- If LDL target achieved and non-HDL ≥ 145 mg/dL, consult lipid specialist for drug therapy (statin+/-fibrate+/-nicotinic acid)
# Apolipoprotein Concentrations in Children and Adolescents

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<th>Category</th>
<th>Acceptable</th>
<th>Borderline</th>
<th>High</th>
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<tbody>
<tr>
<td>Total Cholesterol</td>
<td>&lt; 170 mg/dL</td>
<td>170-199 mg/dL</td>
<td>≥ 200 mg/dL</td>
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<tr>
<td>LDL</td>
<td>&lt; 110 mg/dL</td>
<td>110-129 mg/dL</td>
<td>≥ 130 mg/dL</td>
</tr>
<tr>
<td>Non-HDL</td>
<td>&lt; 120 mg/dL</td>
<td>120-144 mg/dL</td>
<td>≥ 145 mg/dL</td>
</tr>
<tr>
<td>ApoB</td>
<td>&lt; 90 mg/dL</td>
<td>90-109 mg/dL</td>
<td>≥ 110 mg/dL</td>
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<tr>
<td>TG</td>
<td></td>
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<tr>
<td>0-9 years</td>
<td>&lt; 75 mg/dL</td>
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<tr>
<td>HDL</td>
<td>&gt; 45 mg/dL</td>
<td>40-45 mg/dL</td>
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<tr>
<td>ApoA-1</td>
<td>&gt; 120 mg/dL</td>
<td>115-120 mg/dL</td>
<td>&lt; 115 mg/dL</td>
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</table>
TREATMENT OF DYSLIPIDEMIA
TREATMENT OF DYSLIPIDEMIA
CHILD 1 DIET

- Birth to 12 months
  - In accordance with the Surgeon General’s Office, WHO, the AAP and the AAFP, exclusive breastfeeding is recommended for the first 6 months of life. Continued breastfeeding is recommended to at least age 12 months, with the addition of complementary foods after 6 months. If breastfeeding per se is not possible, feeding human milk by bottle is second best, with iron fortified formula-feeding as the third choice.
TREATMENT OF DYSLIPIDEMIA
CHILD 1 DIET

12-24 months
- Continued breast feeding is acceptable
- Reduced fat unflavored cow’s milk
- Limit/avoid sugar sweetened beverages
- Limit 100% fruit juice (cup) to 4 oz/day
- 30% of kcal from fat
  - 8-10% saturated fats
  - 20% monounsaturated and polyunsaturated fats
- Cholesterol < 300 mg/day
TREATMENT OF DYSLIPIDEMIA
CHILD 1 DIET

Greater than 2 years of age

- Intake of total fat limited to 30% of total calories
  - saturated fat intake limited to 7-10% of calories
  - monounsaturated and polyunsaturated fats providing up to 20% of calories
  - dietary cholesterol limited to 300 mg/d
- The remaining 70% of calories should include
  - 15-20% from protein
  - 50-55% from carbohydrate sources
- Primary beverage = fat-free unflavored milk
- Limit/avoid sugar sweetened beverages
- Limit 100% fruit juice to 4-6 oz/day
- Increase dietary fiber (age + 5 g/day; 14 g/1,000 kcal)
TREATMENT OF DYSLIPIDEMIA
CHILD 2-LDL DIET

- 25-30% of calories from fat
  - ≤ 7% from saturated fat
  - ~10% from monounsaturated fats
  - Cholesterol < 200 mg/day
  - Avoid trans fat
  - Plant sterol/stanol esters up to 2 g/day may be used

- The water-soluble fiber psyllium can be added to a low-fat, low saturated fat diet as cereal enriched with psyllium
  - 6 g/d for children 2–12 years
  - 12 g/d for those ≥12 years
TREATMENT OF DYSLIPIDEMIA
CHILD 2 – TG DIET

- 25–30% of calories from fat
  - <7% from saturated fat
  - ~10% from monounsaturated fat
  - <200 mg/d of cholesterol
  - Avoid trans fats

- Decrease sugar intake
  - No sugar sweetened beverages
  - Replace simple with complex carbohydrates

- Increase Omega-3 fatty acids
  - Dietary fish
  - Fish oil supplements
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- Children < age 10 years should not be treated with a medication unless they have a severe primary hyperlipidemia or a high-risk condition that is associated with serious medical morbidity
  - homozygous hypercholesterolemia/LDL > 400 mg/dL
  - primary hypertriglyceridemia with TG > 500 mg/dL
  - evident CVD in the first two decades of life
  - cardiac transplantation
TREATMENT OF DYSLIPIDEMIA

MEDICATIONS

- Consult a lipid specialist if:
  - The average LDL is ≥ 250 mg/dl
  - The average TG is ≥ 500 mg/dL

- Consider medications if the lipid profile remains abnormal after at least 6 months of compliance with dietary and lifestyle modifications

- Consider family history, associated medical conditions, and risk factors when deciding to initiate medical therapy
TREATMENT OF DYSLIPIDEMIA
MEDICATIONS

- Bile acid sequestrants
  - Colesevelam (FDA approved > 10 years of age)
  - Cholestyramine (not FDA approved for children)
  - Colestipol (not FDA approved for children)

- Clinical effects
  - Lowers LDL (10-20%)
  - Raises HDL (2-8%)
  - May increase TG (5-10%)

- Adverse effects
  - Abdominal distention, bloating, gas, constipation
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- Cholesterol absorption inhibitors
  - Ezetimibe (not FDA approved in children)
- Clinical effects
  - Lowers LDL
- Adverse effects
  - Gastrointestinal upset, myopathy, headaches
TREATMENT OF DYSLIPIDEMIA

MEDICATIONS

- Fibric acid derivatives
  - Fenofibrate (not FDA approved in children)
  - Gemfibrozil (not FDA approved in children)

- Clinical effects
  - Lowers TG
  - Raises HDL

- Adverse effects
  - Dyspepsia
  - Constipation
  - Myositis
  - Anemia
TREATMENT OF DYSLIPIDEMIA

MEDICATIONS

- HMG CoA-Reductase Inhibitors (statins)
  - Atorvastatin (FDA approved > 10 years of age)
  - Rosuvastatin (FDA approved > 10 years of age)
  - Fluvastatin (FDA approved > 10 years of age)
  - Lovastatin (FDA approved > 10 years of age)
  - Pravastatin (FDA approved > 8 years of age)
  - Simvastatin (FDA approved > 10 years of age)

- Clinical effects
  - Lowers LDL, increases HDL, lowers TG

- Adverse effects
  - Elevated LFTs, elevated CK, myopathy
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- Nicotinic acid
  - Niacin extended release (not recommended < 2 y)
- Clinical effects
  - Raises HDL
  - Lowers TG and LDL
- Adverse effects
  - Flushing
  - Hepatic toxicity
  - Pruritis
  - Elevated blood glucose and uric acid
TREATMENT OF DYSLIPIDEMIA

MEDICATIONS

- Omega-3 Fatty Acids
  - Lovaza (not FDA approved for children)
  - Multiple OTC preparations

- Clinical effects
  - Lowers TG
  - Raises HDL
  - Increases LDL and LDL particle size

- Adverse effects
  - GI complaints
  - May prolong bleeding time
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- Start with lowest dose and titrate to desired effect based upon FLP
- Monitor for adverse effects and drug interactions
- Emphasize importance of continued compliance with diet and exercise recommendations
- Consult lipid specialist if patient fails single drug therapy
TREATMENT OF DYSLIPIDEMIA

Guidelines for use of Statins

- Measure baseline FLP, AST, ALT, and CK
- Educate patient about potential side effects and drug interactions
- Advise female patients regarding pregnancy concerns and the need for adequate contraception
- Start with lowest dose administered once a day at bedtime
- Repeat FLP in 4 weeks
  - Goal LDL is < 130 mg/dL (< 110 mg/dL is ideal)
- Monitor CK, AST, and ALT when clinically indicated
  - Threshold for worrisome AST/ALT is 3 x ULN
  - Threshold for CK is 10 x ULN
**Treatment of Dyslipidemia Medications**

- **Guidelines for the use of Statins**
  - If LDL goal is not achieved, increase dose and repeat FLP in 4 weeks
  - Continue this process until LDL goal is achieved or maximum tolerated dose is reached
  - Once LDL goal is achieved, repeat FLP in 2 months, then every 3-4 months for the first year and then biannually.
  - If the LDL goal is not achieved, consult lipid specialist.
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- Guidelines for the use of Statins
  - If signs or symptoms of myopathy develop, discontinue the medication and check CK level
    - Threshold for worrisome CK is 10 x ULN
  - Monitor symptoms and CK until normalized
  - May consider restarting medication once symptoms have resolved and CK has normalized
  - If AST/ALT become elevated, stop the medication and monitor until laboratory values return to normal and then consider restarting medication
TREATMENT OF DYSLIPIDEMIA MEDICATIONS

- **Monitoring Liver Enzymes**
  - Labels have been revised to remove the need for routine periodic monitoring of liver enzymes in patients taking statins. The labels now recommend that liver enzyme tests should be performed before starting statin therapy and as clinically indicated thereafter. FDA has concluded that serious liver injury with statins is rare and unpredictable in individual patients, and that routine periodic monitoring of liver enzymes does not appear to be effective in detecting or preventing serious liver injury.
REFERENCES

- http://circ.ahajournals.org/content/125/1/e2.full.pdf
- http://www.heart.org/HEARTORG/GettingHealthy/Dietary-Recommendations-for-Healthy-Children_UCM_303886_Article.jsp
- http://www.fda.gov/default.htm
Questions?