“Hyperlipidemia---Update & Review” January 2013

So many patients are taking cholesterol medications, that it’s imperative to review this whole topic periodically. It reinforces one of the primary areas where we consult patients. The goal of this lesson is to differentiate treatment options.

The objectives of this lesson are such that upon completion the participant will be able to:

1. List the classes of cholesterol and the effects of each.
2. Discuss ATP III classification of LDL, HDL and total cholesterol blood levels.
3. Define the condition known as atherosclerosis and describe its formation and its effect on the cardiovascular system.
4. List the causes and risks of hyperlipidemia.
5. Describe the mechanism of action of statins and their adverse effects.
6. Discuss the importance of TLC in the reduction of hyperlipidemia.

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Future topics include:

- Pharmacy Law Update---Controversies Regarding Compounding
- **Review & Analysis** of Medication Errors: Pharmacy Perspective
- **Review & Prevention** of Medication Errors: Pharmacy Perspective
- Latent Tuberculosis Treatment
- Pertussis Update
- Cultural Competency & Sensitivity Pertaining to Adherence
- New Drugs of 2012/2013
- Causes, Symptoms & Treatment of Restless Leg Syndrome
- Obesity & Its Management
- STDs---Review & Update
- Treatment of Otitis Media (Swimmer’s Ear)
- Superficial Fungal Infections & Their Treatment
This lesson provides 1.25 hours (0.125 CEUs) of credit, and is intended for pharmacists in all practice settings. The program ID # for this lesson is 707-000-13-001-H01-P. Pharmacists completing this lesson by January 31, 2016 may receive full credit.

Our annual lesson that concentrates on one area of contemporary pharmacy law will be presented next month.

To obtain continuing education credit for this lesson, you must answer the questions on the quiz (70% correct required), and return the quiz. Should you score less than 70%, you will be asked to repeat the quiz. Computerized records are maintained for each participant.

If you have any comments, suggestions or questions, contact us at the above address, or call 1-847-945-8050. Please write your ID Number (the number that is on the top of the mailing label) in the indicated space on the quiz page (for continuous participants only).

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INTRODUCTION

Cholesterol is a soft waxy steroid. In spite of its seemingly bad influence on the body, it is an essential constituent of cell membranes and is crucial for normal body functions, including formation of bile acids, steroid hormones, vitamin D, sex hormones such as androgens and estrogens and metabolism of fat soluble vitamins (A, D, E, K). It plays an important role in permeability of cell membranes and in the prevention of crystallization of hydrocarbons. Furthermore, cholesterol, along with other plasma lipids such as triglycerides and phospholipids, provide energy and assist in maintenance of body temperature.

Hyperlipidemia is a condition in which blood plasma contains high levels of lipids and/or lipoproteins. This can be primary due to genetic factors or secondary which may be due to underlying things such as diabetes, hypothyroidism, nephrotic syndrome, and alcohol, as well as the dietary intake. Finally, it may occur without any specific cause (idiopathic).

The daily consumption of food provides part of the required cholesterol and 20% to 25% is manufactured by the liver. The remainder is synthesized by the intestine, adrenal glands, reproductive organs and other tissues. Cholesterol is found in abundance in egg yolk, various oils, fats, nerve tissue of the spinal cord, brain and kidneys. Normal blood values of cholesterol is healthy. However, as will be discussed, elevated blood levels are harmful and have been associated with cardiovascular diseases. Abnormally elevated lipids in the blood stream allow cholesterol, particularly low density lipoprotein cholesterol (LDL-C), to be deposited within the arterial wall of large and medium sized arteries as atherosclerotic plaques. These cause obstruction of the arteries, and depending on the extent of obstruction, may contribute to hypertension, reduction in the amount of oxygenated blood that reaches the heart and in increasing the risk of coronary heart disease (CHD), myocardium infarction and cerebral arterial diseases. Despite improvement in lifestyle (diet, exercise, weight reduction) and the use of cholesterol lowering drugs, CHD and stroke remain as major causes of death in the U.S.

The liver of an individual with average frame and weight synthesizes about 1000 mg of cholesterol daily. The total cholesterol content of the body is approximately 35 grams. The average dietary intake of an adult in the U.S. is from 200 mg to 300 mg per day. Normally, the body tends to compensate for cholesterol by reducing the manufactured quantity. Once synthesized by the liver, cholesterol is transferred via the bile into the intestinal tract. About 50% of excreted cholesterol is reabsorbed by the digestive system and pumped back into circulation. This cholesterol recycling is continuous in nature. Plant sterol, when included in the diet, tends to compete with cholesterol absorption, resulting in reducing cholesterol blood levels. Biosynthesis and regulation of cholesterol depends on cholesterol blood level. The higher the intake of cholesterol, the less endogenous production, and the opposite is true.

TYPES OF CHOLESTEROL

Lipids consist of a number of different chemicals: free fatty acids, triglycerides, sterols (cholesterol and cholesterol esters), and phospholipids (phosphoric acid esters of lipids). Triglycerides exist in nature as solids (fats) or liquids (oils). This depends on room temperature, the length of the
fatty acid chain, and the extent of their hydrogen ion saturation. Triglycerides with short fatty acids and/or unsaturated fatty acids exist as liquids at room temperature (plant oils such as olive oil, corn oil, sunflower oil, etc). Triglycerides with long fatty acid chains and/or saturated fatty acids exist in the solid form at room temperature (animal fats such as butter, fat of meat, etc.).

Lipids in blood circulation do not exist in the free form but rather as complexes (lipoproteins). To facilitate their transport, lipids bind to plasma protein such as globulin or albumin to form these complexes.

There are three main types of cholesterol:

1. **Very Low Density Lipoprotein (VLDL):** This cholesterol is produced by the liver and is made up of 50% to 65% glycerides and 20% to 30% cholesterol. It is responsible for transporting triglycerides synthesized in the liver to adipose and muscular tissue. What remains of VLDL is broken down to LDL.

2. **Low Density Lipoprotein Cholesterol (LDL):** LDL, often referred to as the “bad cholesterol,” consists of a predominantly cholesterol inner core. It forms as a result of the breakdown of the metabolites of VLDL. It is made up of 51% to 58% of cholesterol and 4% to 8% of triglycerides. It makes up about 60% to 75% of all plasma cholesterol. Its main function is to deliver cholesterol from the liver cells. If large quantities of LDL are carried and no new LDL receptors are formed, the LDL absorption will be diminished and a harmful buildup of LDL will take place which may increase the risk of CHD. A 25% reduction in plasma LDL level may reduce the occurrence of CHD by 50%.

3. **High Density Lipoprotein (HDL):** This cholesterol, which is known as “good cholesterol,” tends to prevent arterial disease from occurring as it takes cholesterol away from the cells and back to the liver. Once in the liver, it may breakdown or be excreted from the body as waste. It is the smallest and densest of lipoproteins. High density lipoprotein constituents include 18% - 25% cholesterol and 2% - 7% triglycerides. It contributes approximately 20% - 30% of total cholesterol in the blood stream. The main function of HDL is to transport cholesterol from the body tissue to the liver where it is broken down and excreted in the bile. Thus, accumulation of cholesterol is prevented. The amount of transported cholesterol is about 25% of the cholesterol in plasma. Unlike high LDL and VLDL blood levels, high HDL blood levels reduce the risk of incidence of CHD. It has been shown that healthy diet and physical exercise tend to elevate HDL blood level.

Other lipids that play a role in healthy arteries are **chylomicrons** and **triglycerides**.

**Chylomicrons** are lipoprotein particles that transport dietary lipids from the intestines to other parts of the body. It is manifested by the absorptive cells of the small intestine. Chylomicrons are composed of from 85% - 92% triglycerides, 6% - 12% phospholipids, 1% - 3% cholesterol, and 1% - 2% protein. These particles deal with the transport of dietary lipids to the liver, adipose, cardiac, and skeletomuscular tissues. The majority of chylomicrons are deactivated in the
blood by the enzyme lipoprotein lipase within 12 to 14 hours. 

**Triglycerides** are a combination of glycerol and three different fatty acids. Most fats in the blood exist as triglycerides in association with cholesterol. Since triglycerides are insoluble in water, they are transported in combination with protein. Blood triglycerides originate either from fat present in diet or may be manufactured from carbohydrates stored in the body. Excess caloric intake is converted into triglycerides and stored in fat cells until such a time when food intake is reduced or not enough to provide energy. In such circumstances and under hormonal influences, triglycerides are released from fat cells as energy sources.

**GUIDELINES FOR TREATMENT OF HYPERLIPIDEMIA**

In 1987 the National Institute of Health (NIH) established the National Cholesterol Education Program (NCEP) to be directed by the **Adult Treatment Panel (ATP)** for the purpose of issuing information for health professionals and the general public concerning testing, evaluating, monitoring and treating hyperlipidemia. An important criterion of ATP guidelines is the development of treatment goals for hyperlipidemia based on patient’s risk of CHD. ATP I established criteria for the prevention of CHD in individuals with high levels of LDL (160 mg/dl) or with borderline high LDL (130 mg – 159 mg/dl) and multiple (2+) risk factors. ATP II followed and added criteria concerning the management of LDL in persons with established CHD. For such patients, ATP II affirmed a new lower LDL goal of 100 mg/dl. An updated ATP III which was issued in 2001, included the criteria stated in ATP I and ATP II. In addition, it placed emphasis on primary prevention in persons with multiple risk factors, as well as on more intensive LDL-lowering treatment. Patients with high risk for CHD will gain benefit from more aggressive LDL-lowering therapy than recommended in ATP II. The primary goal of ATP III is to lower LDL since it has been shown that this results in reduction of the risk of CHD.

**ATP III classification of LDL blood levels, as well as total and HDL levels, is as follows:**

<table>
<thead>
<tr>
<th>LDL Cholesterol (mg/dl)</th>
<th>Total Cholesterol (mg/dl)</th>
<th>HDL Cholesterol (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 100 = Very good</td>
<td>≤ 200 = Desirable</td>
<td>&lt; 40 = Low</td>
</tr>
<tr>
<td>100 – 129 = Near optimal</td>
<td>200 – 230 = Borderline high</td>
<td></td>
</tr>
<tr>
<td>130 – 159 = Borderline high</td>
<td>240 = High</td>
<td></td>
</tr>
<tr>
<td>160 – 180 = High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>190 = Very high</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ATP III included new aspects such as consideration of diabetes without CHD as equivalent to the risk factors of CHD; use of Farmingham projection of 10-year absolute CHD risk; consideration of persons with multiple metabolic factors as candidates for intensified therapeutic lifestyle changes (TLC); recommendation for initial tests that include total LDL and HDL cholesterol and triglycerides rather than that for total cholesterol; recommendation for the use of plant sterols and soluble fiber in diet to enhance lowering of LDL cholesterol; adherence to therapeutic lifestyle changes, and treatment beyond LDL lowering in the presence of triglycerides of ≥ 200 mg/dl.
ATP III includes the following major risk factors for atherosclerotic vascular diseases:

1. cigarette smoking;
2. blood pressure ≥ 140/90 mm Hg;
3. low HDL (≤ 40 mg/dl);
4. family history of premature CHD; and,
5. age (men ≥ 45 years, women ≥ 55 years).

ATP III instituted recommendations regarding LDL levels at which to initiate (TLC) as well as LDL levels at which to consider drug therapies:

1. Persons with CHD or CHD risk equivalents (10 year risk ≥ 20%) should attain an LDL level of < 100 mg/dl. The LDL level at which to initiate (TLC) is ≥ 100 mg and the LDL level at which to consider drug therapy is ≥ 130 mg/dl.

2. For persons with 2+ risk factors (10-year risk < 20%), the LDL goal is < 130 mg/dl; the LDL levels at which to initiate (TLC) is ≥ 130 mg/dl, and the LDL at which to consider drug therapy for 1-year risk 10% - 20% is ≥ 130 and for 10-year risk is ≥ 160 mg/dl;

3. For persons with 0-1 risk factor, the LDL goal is < 160 mg/dl, and the LDL level at which to initiate TLC is ≥ 160 mg/dl and the LDL level of 160 – 189 mg/dl, drug therapy is optional. It is important to realize that when LDL lowering drugs are utilized, one should maintain TLC.

As this CE lesson is distributed, ATP IV updating is either already available, or will be soon.

RISKS OF HYPERLIPIDEMIA

I. Atherosclerosis, or hardening of the arteries, is a common disorder and occurs when fat, cholesterol and calcium deposits in the arterial linings form multiple plaques. A plaque normally consists of three components: 1) atheroma which is a fatty, soft, yellowish nodular mass located in the center of a larger plaque that consists of macrophages, which are cells that play a role in immunity; 2) a layer of cholesterol crystals; and, 3) calcified outer layer. Atherosclerosis is the leading cause of cardiovascular disease.

II. Coronary Artery Disease (CAD): Narrowing of the arteries that supply blood to the myocardium, and results in limiting blood flow and insufficient amounts of oxygen to meet the needs of the heart. The narrowing may progress to the extent that the heart muscle would sustain damage due to lack of blood supply.

III. Myocardial Infarction (MI): MI is a condition which occurs when blood and oxygen supplies are partially or completely blocked from flowing in one or more cardiac arteries, resulting in damage or death of heart cells. The blockage is usually due to the formation of a clot in an artery. This condition is commonly known as heart attack. The occlusion may be due
to ruptured atherosclerotic plaque. If the restricted flow of blood through the arteries and the resulting limited supply of oxygen are left untreated for a period of time the blockage can cause damage or death of the myocardium cells.

IV. Angina Pectoris: Currently, termed angina, this condition is not a disease but a symptom of an underlying heart condition. It is characterized by chest pain, discomfort or a squeezing pressure. The pain may also be felt in the shoulders, arms, neck and back. Angina occurs as a result of a reduction or a lack of blood supply to a part or the entire heart muscle, as well as impairment of waste removal. Poor blood circulation is usually due to CHD when partial or complete obstruction of the coronary arteries is present. Angina attacks may be due to spasm of the arteries. Angina may be a symptom of coronary microvascular disease (MVD), a condition that affects the heart’s smallest arteries.

V. Stroke or Cerebrovascular Accident (CVA) occurs when blood circulation in part of the brain is blocked or diminished. When blood supply, which carries oxygen, glucose, and other nutrients, is disrupted, brain cells die and become dysfunctional. Usually strokes occur due to blockage of an artery by a blood clot or a piece of atherosclerotic plaque that breaks loose in a small vessel within the brain.

CAUSES OF HYPERLIPIDEMIA

Hyperlipidemia is due to genetic and environmental factors, including:

1. Presence of diseases that tend to increase LDL blood levels. Such diseases include, but are not limited to: diabetes, hypertension, hypertriglyceridemia, kidney and liver diseases.

2. Family history of developing CHD or CVA early in their lives (under 55 for brother and father and under 65 years of age for mother and sister). Likewise, family history of hyperlipidemia early in life will increase the risk of developing hyperlipidemia.

3. Gender: Men have a greater chance of developing hyperlipidemia than women.

4. Age: As a person becomes older, so does the chance for developing atherosclerosis and hyperlipidemia.

5. Many foods such as eggs, butter, liver, kidneys, and certain sea foods contain cholesterol in amounts that will not drastically change cholesterol blood levels. Other foods, especially if consumed in relatively large quantities and frequently, can detrimentally affect cholesterol and triglyceride blood levels. Red meat, many cheeses, creamy cakes, ice cream, sausages and hot dogs have high contents of saturated fats and may affect the outcome of cholesterol blood concentration.

6. Sedentary lifestyle: It has been shown that non-vigorous physical activity tends to reduce LDL and elevate HDL blood levels.

7. Bodyweight: Individuals who maintain normal bodyweight which is adequate for their
frame and age are less likely to have high LDL and lower HDL levels than overweight or obese individuals. In general, overweight individuals do not follow a healthy diet.

8. Smoking: It has been reported that smoking contributes to about 400,000 deaths annually in the US. In addition to contributing to cancer and cardiovascular diseases, it detrimentally affects the levels of LDL and HDL. Cigarette smoking decreases HDL level while it elevates LDL.

9. Alcoholic Beverages: Persons who regularly consume large quantities of alcoholic beverages exhibit high LDL and low HDL levels. Cholesterol blood level is normally unaffected in people who do not drink or who drink in moderation.

TREATMENT

Since lifestyle plays a role in contributing to hyperlipidemia, it is important to realize that TLC should be instituted and followed. When lowering of blood cholesterol level cannot be achieved alone, the use of drugs becomes necessary.

ATP III recommends two methods of treatment:

1) Therapeutic lifestyle changes;

2) Drug therapy.

Additionally, consideration must be given to treating medical conditions that may contribute to hyperlipidemia.

1. Therapeutic Lifestyle Changes: Diet modification, regular physical activity, smoking cessation, and weight reduction should be tried as initial treatment, especially in mild cases of hyperlipidemia and in persons without CHD or CHD risk equivalent and < 2 risk factors. It should be kept in mind that when dieting, cholesterol intake is reduced. At the same time, production of cholesterol, especially by the liver, increases. It is recommended that the intake should be restricted to 25% - 35% of energy intake and that saturated fatty acids make up less than 7% of energy intake, and that cholesterol intake should be less than 200 mg daily. The intake of plant sterol esters and soluble fiber is advisable. Healthy diet can result in 10% to 15% reduction of cholesterol blood level.

2. Drug Therapy: High LDL, presence of risk factors, and documentation of CHD should qualify initiating drug therapy along with TLC. Mono therapy has been shown to be effective in treating hyperlipidemia, but combination therapy may be required for a comprehensive approach. Current lipid-lowering drugs include: statins, ezetimibe, bile acid sequestrants or bile binding resins, niacin, fibric acid derivatives, and plant sterols.

STATINS

Statins are the most common medications used in the treatment of hyperlipidemia. Last year
more than 20 million Americans were taking statins. They are also referred to as HMG-CoA Reductase Inhibitors because of their mechanism of action. They are well tolerated and are effective in lowering LDL. Additionally, they have the highest level of patient compliance due to their tolerable adverse effects. Statins are useful for high-risk patients such as those with CHD and diabetes. Combination therapy with a statin and another cholesterol-lowering drug may be beneficial in patients who do not respond to mono therapy.

Statins act by interfering in the biosynthesis of cholesterol in the liver. This is achieved by inhibiting the enzyme HMG-CoA reductase and reducing the rate by which it is able to produce mevalonate which is required in the biosynthesis. In addition to their cholesterol-lowering effect, statins have anti-atherosclerotic activity. They enhance the stability of atherosclerotic plaques and exert pleiotropic effect (endothelial function, inflammation, coagulation and plaque vulnerability). Clinical studies have shown that statins have significantly reduced the total cardiovascular mortality and morbidity.

Statins have a number of limitations. At the standard doses used, they are capable of reducing LDL levels by 30% - 40%. Studies have shown that when such doses are administered, LDL levels over 40% of high-risk patients failed to reach the ATP III LDL goals of 100 mg/dl. Increasing the dose of statin has its disadvantages:

1. Doubling, tripling, or quadrupling the dose will result in only 6%, 12% or 18% lowering of LDL (respectively).
2. The higher the dose of statins, the greater the potential of toxicity, the most serious of which is myopathy.
3. Some patients have low-tolerance to higher doses due to the occurrence of adverse effects such as elevation of transaminase, weakness, fatigue and muscular pain.

**Adverse Effects of Statins**

The most commonly encountered adverse effects are elevation of liver enzymes and muscle problems such as rhabdomyolysis (an acute, but may be fatal condition, characterized by destruction of skeletal muscle), myalgia, and muscle cramps. The incidents of adverse effects with statins are low. The statin, cerivastatin, was withdrawn from the market by the manufacturer due to the incidence of rhabdomyolysis. Combining any statin with a fibrate or niacin may increase the risk of rhabdomyolysis. Statins may slightly increase the risk of diabetes when given in higher doses. At one time monitoring of liver enzymes was required but this practice has been abandoned by many physicians following FDA recommendations. The intake of grapefruit or grapefruit juice may inhibit the metabolism of statins. In February 2012, the FDA required making changes to the safety information on the label of statins, especially that the intake of such medications may raise the level of blood sugar and could cause memory loss and confusion. However, the FDA indicated that such information should not prevent patients from taking statins due to the benefits to be gained. In 2012 the FDA informed health professionals that a drug interaction may occur when statins and protease inhibitors such
as ritonavir, indinavir, nelfinavir etc. are taken concurrently. Such interactions may result in elevation of statin blood levels and increase the risk of myopathy, the most serious of which is rhabdomyolysis.

**Statins in Current Use:** Currently the following are the statins in use: lovastatin, pravastatin, simvastatin, fluvastatin, atorvastatin, rosuvastatin, and pitavastatin. Comparison of efficacy of these drugs revealed that atorvastatin resulted in reduction of LDL of 42%; lovastatin and simvastatin made reductions of 36% each. Results of triglycerides reduction were atorvastatin 19%, simvastatin 13% and lovastatin 12%. Serum HDL level increased by 5% - 6% with all statins.

**Lovastatin,** which occurs naturally and is found in food such as oyster mushrooms, was the first statin to be approved by the FDA. It is partially absorbed from the GI tract and undergoes first pass extraction. Food appears to enhance the rate of absorption after oral administration. The side effects, which include abdominal pain, cramps, and dyspepsia, are usually mild and transient. As with all statins, dosage of lovastatin varies from one person to another and should be determined in accordance with the requirement and response of the patient. The usual maintenance dose is 10 – 80 mg daily given in a single or divided dose.

**Pravastatin:** The usual maintenance dose is 10 – 40 mg daily. The drug can be taken with meals, as food does not appear to affect its activity. Pravastatin side effects include nausea, vomiting, diarrhea, abdominal cramps, flatulence, headache, constipation and muscular pain.

**Simvastatin:** In 2011, the FDA announced safety label changes for simvastatin which include limiting the use of the highest approved dose of 80 mg due to increased risk of myopathy, particularly during the first 20 months. The most frequently encountered side effects include abdominal distress, constipation, flatulence, nausea, heartburn and headache. Myalgia and/or muscle weakness are rarely reported. The usual initial dose for adults is 20 mg daily. A dosage of 20 mg daily is initiated and this may be increased at intervals of no less than 4 weeks until a maximum dosage of 80 mg is reached.

**Fluvastatin:** At the recommended dosage, fluvastatin possesses a low incidence of side effects that are usually well tolerated. The most common ones are abdominal discomfort, headache, back pain and rash.

**Atorvastatin:** It is used to reduce LDL and triglycerides concentration. It is usually taken once a day with or without food. It is contraindicated in pregnancy and its intake by breastfeeding mothers is not recommended. Side effects include headache, weakness, insomnia, rash, abdominal discomfort, constipation and diarrhea. Adult dose of atorvastatin should be adjusted within 2-4 weeks after the initial dose of 10 mg daily. The maintenance daily adult dose is 10 – 80 mg daily.

**Rosuvastatin:** As with all statins, there is a concern of development of rhabdomyolysis following the use of this drug. However, the FDA indicated that the risk of this condition is greater with rosuvastatin than with other marketed statins. The FDA indicated that the risk of myopathy
during rosuvastatin therapy may be increased in Asian-Americans. Physicians should start Asian patients at the lower dose level. The starting dose for most adults is 5 mg once daily and the maximum dose is 40 mg per day.

**OTHER HYPERLIPIDEMIA LOWERING DRUGS**

**Ezetimibe**

This drug was approved by the FDA in 2002 for patients with low risk of CHD and inability to tolerate statins. Its mechanism of action differs from that of statins. It is considered a selective cholesterol absorption inhibitor. It acts by blocking the absorption of dietary and biliary cholesterol. Clinical trials showed that it did not improve clinically significant outcomes such as coronary events and actually made some outcomes, such as artery wall thickness, worse. In 2008 a panel of experts recommended that it should be used as a last resort. Recommended dose is 10 mg daily. Side effects include GI disturbances, headache, fatigue, myalgia, rash, and very rarely, myopathy.

**Bile Acid Sequestrants**

The bile acid binding resins, cholestyramine, colestipol and colesevelam, combine with bile acids present in the intestine to form an insoluble complex. This leads to an increase in LDL receptors and a reduction in plasma LDL. These medications may be used alone or in combination with statins. Because the bile acid sequestrants are not absorbed from the GI tract, they do not possess systemic adverse effects. However, they are associated with GI tract disturbances such as constipation, nausea, flatulence and indigestion.

**Cholestyramine**

This drug is taken orally as a suspension prepared from a powder. Caution should be exercised not to take the powder in the dry form as it may cause esophageal irritation or blockage. The usual initial adult dose is 3 gm, 3 times daily before meals. The maintenance dose is 4 gm, 3 times daily before meals and at bedtime.

**Colestipol Hydrochloride**

This is a high molecular weight basic anion-exchange resin. The mechanism of action, adverse effects, and mode of administration are similar to those of cholestyramine. It is dispensed in tablet and granular forms. The usual adult dose is 1 to 16 gm daily.

**Niacin**

Niacin is capable of reducing LDL (15% - 25%), VLDL (25% - 35%) and triglycerides concentration and at the same time results in elevation of HDL (15% - 25%). The mechanism of action of niacin is not fully known, but it has been postulated that niacin can partially inhibit free fatty acid release from adipose tissue and reduce the rate of synthesis of VLDL. The main adverse effects of niacin include uncomfortable and potentially dose limiting flushing of the skin, itching, skin rash, GI disturbances, hepatotoxicity and an increase in blood sugar and uric acid. The usual adult maintenance dose is 1 to 2 gm three times daily after meals.
Fibric Acid Derivatives
Gemfibrozil (Lopid®) and Fenofibrate (Tricor®) have minimal effect on lowering LDL blood level, but are effective in reducing plasma triglyceride content by increasing fatty acid oxidation in the liver, thereby reducing secretion of VLDL. Additionally, they can increase HDL levels. These drugs can be used in combination with niacin or bile acid sequestrants. The most encountered adverse effects of fibric acid derivatives include rash and GI disturbances. Statin fibrate combination therapy resulted in a 35% - 42% decrease in LDL, a 48% - 57% decrease in triglycerides and an increase of 14% - 17% in HDL.

Plant Sterols
These are capable of lowering LDL by about 10%. Their mechanism of action involves blocking cholesterol absorption from the intestines. Plant sterols are available as nonprescription drugs and should not be recommended as a primary therapy.

SUMMARY
CHD is one of the most common diseases and is considered a major health problem worldwide. The main contributing factor for CHD is high LDL and triglyceride blood levels which cause the formation of atherosclerosis and plaques that block coronary arteries. Therapeutic lifestyle changes (TLC) as well as initiation of the intake of cholesterol lowering drugs are helpful in reducing LDL blood levels and at the same time may increase HDL blood levels, thereby reducing the risk of the occurrence of cardiovascular disease and cerebrovascular accidents. Combination therapy of statins, niacin, fibrate or bile acid sequestrants are helpful in lowering LDL and triglyceride blood levels.

References
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LESSON EVALUATION

Please fill out this section as a means of evaluating this lesson. The information will aid us in improving future efforts. Either circle the appropriate evaluation answer, or rate the item from 1 to 7 (1 is the lowest rating; 7 is the highest).

1. Does the program meet the learning objectives?
   - List the classes of cholesterol YES NO
   - Discuss the ATP III classifications of LDL, HDL & total cholesterol YES NO
   - Define & describe “atherosclerosis” YES NO
   - List causes of hyperlipidemia YES NO
   - Describe MOA of statins YES NO
   - Discuss importance of TLC in treating hyperlipidemia YES NO

2. Was the program independent & non-commercial YES NO

   Poor               Average       Excellent

3. Relevance of topic
   1  2  3  4  5  6  7

4. What did you like most about this lesson?________________________________________________

5. What did you like least about this lesson?________________________________________________
Please Mark the Correct Answer(s)

1. Which one of these is not a function of cholesterol?
   A. Formation of steroid hormones  
   B. Metabolism of fat soluble vitamins  
   C. Blood pressure regulation  
   D. Manufacture of bile acids

2. Which of the following is known as “good cholesterol?”
   A. HDL  
   B. LDL  
   C. VLDL  
   D. Chylomicrons

3. The ATP III classification of LDL blood level that is near or above optimal is:
   A. 160 – 189 mg/dl  
   B. 100 – 129 mg/dl  
   C. ≤ 100 mg/dl  
   D. 130 – 159 mg/dl

4. Statins lower LDL blood levels due to:
   A. Stimulation of liver enzymes  
   B. Enhancing excretion via the kidneys  
   C. Inhibition of HMG – CoA reductase  
   D. Form an insoluble complex

5. Angina pectoris is another term for:
   A. Chest pain & pressure  
   B. Myocardial infarction  
   C. Cerebrovascular accident  
   D. Atherosclerosis

6. Family history of hyperlipidemia early in life has no effect on risk of developing hyperlipidemia.
   A. True  
   B. False

7. Cerivastatin was withdrawn from the market by the manufacturer because:
   A. Poor absorption from the GI tract  
   B. Failure to reduce LDL blood level  
   C. Caused significant elevation in BP  
   D. It caused rhabdomyolysis

8. Which of these is not a constituent of atherosclerotic plaque?
   A. Cholesterol  
   B. Keratinocytes  
   C. Calcium  
   D. Fat

9. Patients taking statins should:
   A. Not drink grapefruit juice  
   B. Take the medication on empty stomach  
   C. Not take concurrently with niacin  
   D. Have liver enzyme tested every 3 months

10. A side effect of niacin in dosage for lowering LDL level is:
    A. Urinary tract infections  
    B. Flushing of the skin  
    C. Diarrhea  
    D. Anemia
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Since May 1, 2012, we have been electronically transmitting your CE credits to CPE MONITOR.
So, if you have not signed up with CPE MONITOR, do it now.
We must have your CPE MONITOR ID# & your birthdate (day & month only).
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