

## **Coronary Heart Disease**

Purpose: The purpose of this course is to provide an overview of coronary heart disease including its risk factors, signs and symptoms, diagnostic tests and interventions used in its management and treatment options.

### **Objectives**

1. Discuss the prevalence of coronary heart disease
2. List eight risk factors for coronary heart disease
3. List three diagnostic tests useful in the management of coronary heart disease
4. Discuss treatment options for hypertension and hyperlipidemia in those with coronary heart disease
5. Discuss the use of medical versus invasive versus surgical intervention in the treatment of coronary heart disease

Heart disease takes the lives of 631,636 Americans annually and it affects about 14 million Americans (1, 2). This makes it the leading cause of death in the United States. Coronary heart disease (CHD) is the main type of heart disease and it was responsible for 445,687 deaths in 2005 (3).

Heart disease is expensive, it is estimated that it will cost 304.6 billion dollars in 2009 (3). Heart disease is a major cause of disability. Among heart attack survivors, 46% of men and 22% of women are disabled to some degree with heart failure (2).

The incidence of heart disease will increase as the population ages. This is a serious concern because death rates are highest for those who have a heart attack after the age of 65. Heart attacks, a common manifestation of coronary

heart disease, affect 1.5 million people every year. Heart attacks are often associated with other diseases such as heart failure, diabetes and depression.

Heart attacks that do not result in death, may damage the heart to a point where quality of life is reduced. Heart attacks are a common cause of heart failure. Heart failure reduces the pumping power of the heart and consequently leads to reduced oxygenation to muscles. It not only leads to disability, but to a poor quality of life.

Heart disease can also cause disability before a heart attack. As atherosclerotic plaques build up, people may develop angina, shortness of breath or fatigue that limits activity.

### **Pathophysiology**

Coronary heart disease (CHD) is a blockage of the arteries that supply blood to the heart. Lipids, low-density lipoproteins (LDL) being the main fat involved in this process, accumulate in the lining of the blood vessel wall. It is believed that atherosclerosis begins when the endothelium is injured. The injured endothelium is susceptible to the build up of fats in the coronary artery (2). The LDL enters the vessel wall and causes inflammation and plaques to form.

In addition to lipid accumulation, there is also a thickening or hardening of the arterial intima (the inner layer of the coronary artery). These changes lead to a reduction in blood flow to the areas distal to the blockages.

Some of the plaques remain stable; this means they are stuck to the side of the blood vessel wall and do not move. Many of the plaques continue to grow and gradually obstruct the vessel wall leading to the typical signs and symptoms

of CHD. Some of the plaques break off and lodge in a smaller blood vessel downstream, which can result in a heart attack.

Plaques usually do not develop in isolation around the heart. If one is unfortunate enough to have plaques around the heart it is likely that plaques have developed in other areas of the body. Some other common areas of plaque development include the carotid arteries, which can lead to stroke and vessels of the legs, which can lead to peripheral vascular disease.

### **Risk Factors**

Many factors increase the risk of developing CHD. Some of the risk factors are modifiable – or ones that can be changed – some are not.

#### **Table 1: Non-modifiable risk factors**

- Family history of heart disease
- Age
- Being male (when younger)
- Race

#### **Table 2: Modifiable risk factors**

- Hyperlipidemia
- Diabetes
- Hypertension
- Physical inactivity
- Cigarette smoking
- Inflammation

- Psychological stress
- Abdominal obesity
- Diets low in fruits and vegetables

### **Non-modifiable risk factors**

Non-modifiable risk factors are factors, that if present, increase the risk for CHD and there is no intervention that will change them.

A positive family history includes having a first degree relative with heart disease. A first-degree relative is a parent, sibling or child. It is considered a particularly strong risk factor if your family member had an onset of disease before age 55 in a male relative and before 65 in a female relative.

Males have a higher risk for heart disease at a younger age. Women with diabetes have equal rates of heart disease as men (2). The risk balances out after menopause.

Age is the last non-modifiable risk factor. The older one becomes the more at risk he or she is for heart disease.

Race affects risk of heart disease. African Americans have the highest rates of heart disease (2). This may be because they have higher rates of obesity, hypertension and physical inactivity. Those who live in the Mediterranean areas have the lowest levels of heart disease.

### **Modifiable risk factors**

Modifiable risk factors are factors that can be changed to reduce the risk of heart disease.

**Cholesterol:** Controlling blood lipids reduces death, heart disease and strokes. Cholesterol and smoking are considered the top two cardiovascular risk factors. Optimizing cholesterol levels delay heart disease and reduces its complications.

Three subtypes of cholesterol are reported on a lipid panel. Total cholesterol should be less than 200 mg/dl. The low-density lipoprotein (LDL) cholesterol is the most damaging cholesterol particle. This is the one that can result in the most benefit from lowering. Most recent guidelines recommend that those with heart disease or are at high risk for heart disease that values should be less than 100 mg/dl and patients who are very high risk should have values less than 70 mg/dl (4).

The high-density lipoprotein (HDL) is considered the good cholesterol. The HDL cholesterol takes the LDL cholesterol away from the vessel where it does the most damage. Increasing HDL cholesterol reduces cardiovascular events and death rates (5).

Triglycerides are the third number reported on the lipid panel. The role of triglycerides is less clear in the development of heart disease, but elevated levels are likely related to an increased cardiovascular risk. This number on the lipid panel is most variable from day to day. Extremely high levels increase the risk of pancreatitis. Data is sparse on the benefits of lowering triglycerides independent of LDL cholesterol. None-the-less, it is recommended that the people strive to achieve triglyceride levels less than 150 mg/dl.

**Diabetes:** Having diabetes puts one at increased risk for heart disease. Those with diabetes have at least two times the risk of having a stroke or heart disease

than someone without diabetes (6). Hyperglycemia and high insulin levels noted in diabetes are two factors that increase the risk of heart disease. The risk of having a heart attack in a diabetic who has never had a heart attack is equal to the risk of someone who has established heart disease. Heart attacks in diabetics are more commonly linked to mortality (6).

**Hypertension:** High blood pressure puts one at increased risk for heart disease. Optimal goals include reducing the blood pressure to less than 120/80 mm Hg. Elevated systolic blood pressure, which is more common in the older population, is correlated more with heart disease than increases in the diastolic blood pressure.

**Physical inactivity:** Lack of exercise is a clear risk for heart disease. Exercise can affect a variety of other risk factors. Regular exercise has been shown to decrease blood pressure, raise HDL cholesterol and decrease insulin resistance (a factor associated with diabetes).

**Smoking:** Cigarette smoking is a strong risk factor for heart disease. Smoking decreases HDL cholesterol. Toxins in cigarette smoke have been shown to damage the vascular wall and may precipitate plaque formation. Nicotine narrows the blood vessels. Smoking is known to cause coronary spasm. Carbon monoxide damages the lining of the blood vessels, which increases the risk of a plaque formation. Smoking only one cigarette a day significantly increasing the risk of heart attack over a non-smoker.

**Stress:** Chronic daily stress increases the risk for heart disease.

**Abdominal obesity:** An increased waist circumference is associated with an increased risk of heart disease. Men who are in the top 20% for waist circumference have a 55% higher risk of developing heart disease than those in the bottom fifth. In women the risk is even greater. Women in the top 20% for waist circumference have a 91% increased risk of heart disease than those in the bottom 20% (7).

Weight gain negatively affects many of the other risk factors for heart diseases. The direct effect of obesity on the risk for heart disease is a question of debate but weight gain increases the risk of insulin resistance, blood pressure, diabetes and cholesterol.

**Eating few fruits and vegetables:** Fruits and vegetables have antioxidants, plant sterols, flavonoids, plant sulfur compounds and fiber that are protective against heart disease.

**Drinking too much alcohol:** Drinking 1 drink a day for the female and 1- 2 per day for men may reduce the risk of heart disease. Drinking more than this amount has the potential to increase your risk of heart disease, hypertension, strokes, obesity, breast cancer and accidents.

**Inflammation:** High levels of inflammation can increase the risk for heart disease. A test that is often run to detect this is the high sensitivity C-reactive protein (hs-CRP).

Drawing an hs-CRP level from the blood helps determine the severity of the inflammation. Those with the highest hs-CRP levels have a three times greater risk of having a heart attack (7). Those who have the highest levels of hs-CRP

responded most favorable to aspirin therapy in their ability to reduce the risk of heart attacks (2).

Those with a higher hs-CRP level may respond better to treatment. Those with the highest CRP levels have the best response to statin therapy (2) – the best way to lower hs-CRP levels. Other ways to lower CRP levels include smoking cessation and aerobic exercise.

**Infection:** Some recent attention has been placed on infection as a cause of coronary heart disease. Some agents that have been proposed as possible causes include *Chlamydia pneumoniae*, *helicobacter pylori*, *herpes simplex virus* and *cytomegalovirus*.

Trials that have looked to prevent coronary heart disease with the use of antibiotics have failed to be positive. The use of ACE inhibitors and statins are effective at reducing inflammation. Inflammation is a common factor associated with infection.

Further research is warranted on the role of infection in coronary heart disease and what treatment options are valuable.

**High level of blood homocysteine:** This is a relatively new risk factor. High levels of this chemical have been linked to vascular events. These levels can be reduced with the addition of folic acid, vitamins B6 and B12. Homocysteine levels are higher in those with cardiovascular disease and high levels may damage the vascular wall making it more likely to accumulate plaque. Despite this, recent evidence suggests that homocysteine does not independently predict

risk of heart disease and lowering homocysteine levels does not lower cardiovascular risk (2).

## **Signs and Symptoms**

Coronary heart disease often presents without symptoms. When it does present – it can present with a variety of manifestations. It can present with anything from mild chest pain to myocardial infarction to sudden cardiac death.

The most common scenario for patients with coronary heart disease is chest discomfort on exertion, which is relieved by rest. Angina is the term for chest pain and is typically described as a squeezing pain or pressure in the chest. These pains are caused by blockages in the coronary arteries. The pain can be described in a variety of ways including: pain, tightness, burning, pressure, aching, gas, indigestion or an ill-defined discomfort. Angina is often brought on by exercise, eating a heavy meal or becoming excited.

The discomfort is usually located in the chest but it can radiate to the jaw, arms or back. Angina usually last less than 3 minutes but can last up to 15-20 minutes. If the pain lasts longer than 30 minutes it could indicate a myocardial infarction.

Stable angina is chest pain that comes on with a certain level of activity and goes away with rest. Unstable angina is the term used to describe a pattern of discomfort that is noticed with less exertion or at rest and is a more ominous sign. Angina, while always a worrisome symptom, is more dangerous in someone who has not had it before or is having more episodes with less exertion or at rest. Another sign of great concern is when the pain does not go away after

rest or taking nitroglycerine. In these situations the patient should go to the emergency room.

Other symptoms of heart disease include:

- Shortness of breath
- Fatigue
- Weakness
- Dizziness
- Palpitations
- Lower leg edema

Older individuals often have significant heart disease and never have chest pain. Fatigue or shortness of breath on exertion without chest pain are common symptoms in older patients with heart disease. This is common in older individuals and diabetics. Diabetes can damage nerves, including nerves in the chest, which decreases the ability to feel chest pain.

### **Physical Exam**

There are many ways in which coronary heart disease can present on the exam. They may include:

- Hypertension
- Hypotension
- Tachycardia
- Cardiac dysrhythmia including: atrial fibrillation, ventricle tachycardia or premature ectopic beats
- Diaphoresis

- Increased breathing rate
- Syncope
- Heart murmur
- Pulmonary congestion/rales
- Abdominal obesity
- Heart failure
- Edema

## **Diagnosis**

The first step in testing for heart disease is a history and physical, which includes screening for risk factors of heart disease.

Screening for cardiac disease and risk factors includes a laboratory assessment of cholesterol (total cholesterol, LDL levels, HDL levels and triglycerides), complete blood counts, thyroid function testing, kidney and liver function, diabetes and sometimes testing for inflammation.

Special tests may include things such as: small, dense LDL-C level, lipoprotein (a) level and an apoprotein profile.

When there is an acute presentation of heart disease such as acute coronary syndrome than serum markers are run such as: troponin, creatine kinase with MB isozymes, serum aspartate aminotransferase and lactate dehydrogenase.

The next step is running a battery of diagnostic tests. The first test commonly run is an electrocardiogram (EKG), which is performed to help diagnose any arrhythmia, hypertrophy or any ischemic areas. This test does not pick up on all cases of ischemia and further testing is often required.

Stress testing, which is a more sensitive indicator of heart disease, is typically performed on patients who are at moderate risk for heart disease. High-risk patients for heart disease warrant the gold standard cardiac catheterization.

During a stress test the patient performs progressive exercise on a treadmill or bike with a continuous EKG monitoring the heart. Blockage in any of the coronary arteries can be detected. To improve the ability of this test to diagnose heart disease it is often combined with a nuclear medicine injection or an echocardiogram. When these tests are positive or inconclusive the patient is referred on for more definitive testing such as cardiac catheterization.

Cardiac catheterization involves inserting a sheath into the groin or arm and a catheter is guided to the coronary arteries with the aid of x-ray images. This test can measure the pressure in the ventricles and atriums as well as evaluate the patency of the coronary arteries. While this is the best way to diagnose disease, it is not without risk. Complications of this procedure include heart attack, stroke, bleeding or nerve damage.

Some computerized axial tomography (CAT) scans of the heart detect calcium levels in the coronary vessels. This type of testing has been shown to detect coronary heart disease, which was missed by stress testing. This test will yield a score of 0 to over 400. Zero means that there is no evidence of coronary heart disease, while over 400 indicates extensive disease.

This is not an ideal test as many people under 50 can have disease without evidence of calcification on this exam. Many insurance companies will not pay

for this test. In addition, research is sparse and there are no guidelines for what to do when a test is positive.

Stress tests are often performed on patients with multiple risk factors for heart disease even if they do not have typical signs or symptoms. Routine use of stress tests is not recommended in individuals at low risk for heart disease.

The routine use of testing on individuals who are at low risk for disease puts the patient at risk because of the high number of false positive results. Based on the positive results, patients are required to undergo more invasive and dangerous testing such as a cardiac catheterization.

For individuals with medium risk, an exercise test is warranted in men over 45 and women over 55 who are starting an exercise program or have established cardiovascular disease, diabetes, another type of vascular disease (such as peripheral vascular disease or stroke) or kidney disease.

## **Treatment**

This treatment section will focus on the management of stable coronary heart disease. It will not look at the management of acute coronary syndrome. Acute coronary syndrome is a spectrum of conditions that result from myocardial ischemia. It includes:

- Unstable angina
- ST-segment elevation myocardial infarction
- Non-ST segment elevation myocardial infarction

Treatment options for heart disease always include lifestyle modification and risk reduction. Lifestyle modification techniques to treat and prevent heart

disease are weight loss, reducing saturated fat in the diet, increasing the amount of fruits and vegetables in the diet, stopping smoking, managing stress, limiting alcohol intake and exercise.

Most people know that they need to involve themselves in lifestyle modifications but few do a good job at following this recommendation. A lifetime of habits is difficult to break even when diagnosed with a serious disease. Lifestyle modification involves starting an exercise program and changing eating habits and can be very difficult to maintain over the long haul.

Therefore, medical treatment is the mainstay of treatment for the heart patient. The method of treatment depends on the severity of disease and the patient characteristics. In older individuals with chest pain attributed to cardiovascular disease, medical treatment is as effective as surgery at reducing death and cardiovascular events in patients over 75 years old (8).

Surgery is often the treatment of choice for heart disease but some patients are not candidates. Frail, older patients who are not candidates for surgical intervention are treated with medical therapy. Patients with less severe symptoms and no evidence of severe blockage are also candidates for medical therapy. Patients who have signs and symptoms of stable angina are also candidates for medical therapy.

### **Risk Reduction**

Reducing risk factors for heart disease decreases the risk of future cardiovascular events and is a vital component to treating established heart disease. Unfortunately, it is unknown if years of exposure to risk factors for heart

disease can be reversed. Risk reduction is done through a combination of lifestyle modifications and medications. For those with established heart disease, risk factors should be treated with specific medicine known to not only treat the risk factor but also heart disease itself.

**Hypertension:** Hypertension should be treated aggressively because increased blood pressure increases the strain on the heart. Continued strain on the heart increases the risk of damage. Three major drugs used to treat hypertension in those with coronary heart disease are beta-blockers, angiotensin converting enzyme inhibitors (ACE-Is) and calcium channel blockers.

Beta-blockers, which are discussed below, are one medication that should be used to treat high blood pressure – unless there is a contraindication – in those with heart disease.

ACE-I are used to control blood pressure but also have a direct effect on the heart and blood vessels. ACE-I have positive effect on endothelial function as well as increasing the nitric oxide levels (2). ACE-I may reduce the clotting of the blood.

Individuals who take ACE-I have a lower rate of cardiac death, nonfatal heart attack, need for coronary artery bypass or percutaneous catheter angioplasty (PTCA) or death than those on placebo. This effect was independent of blood pressure lowering (9).

Calcium channel blockers are the other agents that should be strongly considered for the treatment of hypertension in those with coronary heart

disease. It has positive effects on coronary heart disease outcomes independent of its control of blood pressure (2).

**Cholesterol:** Reduction in cholesterol, specifically LDL cholesterol, decreases the progression of heart disease and may reduce established disease.

Cholesterol reduction is accomplished through lifestyle changes – mainly diet and exercise – and with certain medications. Evidence points to the possibility that reversal of plaque around the heart is possible with intensive cholesterol lowering.

Optimal management of lipid levels with statins are a mainstay in the treatment heart disease. These agents have proven to reduce cardiovascular events, stop the development of new plaques, reduce inflammation and stabilize existing plaque (2).

Triglycerides can be lowered with weight loss, reducing simple sugars, aerobic exercise, and omega-3 fatty acids. Medications are also available to lower triglycerides and include niacin and fibrates. Statins also lower triglycerides, but are not as effective as niacin and fibrates.

**Diabetes:** Anyone with established heart disease or risks for heart disease should be screened for diabetes. High levels of blood sugar and insulin damage the heart and vascular system. Aggressive management of blood sugars and other risk factors is critical for all of those with diabetes. Diabetics are at extreme risk of heart disease.

**Exercise:** Physical inactivity is major contributor to heart disease. The sedentary lifestyle increases the risk of hypertension and dyslipidemia. In addition, it

impairs coronary blood flow as well as reduces cardiovascular fitness. Engaging in a regular physical activity program has many benefits including increasing HDL cholesterol, lowering blood pressure, improving insulin sensitivity and enhancing cardiovascular function.

Individuals should perform some sort of physical activity on most days of the week.

**Smoking:** Smoking cessation should be encouraged. Smoking has many negative effects on heart disease.

### **Dietary changes**

Many dietary changes can have a beneficial effect on heart disease. Dietary changes fall in two major categories. First, weight loss – particularly loss of abdominal obesity – can have a profound effect on the heart. Second, changing the composition of the diet can reduce the risk of heart disease.

Weight loss enhances LDL and triglyceride lowering, improves functional ability, improves insulin sensitivity and reduces blood pressure.

Recommended dietary changes include (10):

- Reduce the amount of red/processed meat.
- Increase the intake of fatty fish (which are high in Omega-3 fatty acids).
- Eat a diet high in fruits and vegetables.
- Reduce saturated fats to less than 7% of the diet and cholesterol intake to less than 200 mg per day.
- Reduce the intake of trans – fatty acids
- Increase the intake of soluble fiber to 10-25 grams per day.

- Add plant stanols/sterols to the diet

## **Medical Therapy**

Medical science has found many medicines that attack the defects that are associated with heart disease.

**Nitroglycerin** is a medicine that dilates the vessels around the heart and allows more oxygen to get to the heart. It can be given in a variety of forms including oral, patch or sublingual.

The sublingual form comes in pill or spray. It is used for the relief of an acute attack of angina and should be carried by most patients with established heart disease in the event of an acute onset of chest pain. Three doses can be given five minutes apart. If three pills are unable to relieve the pain, then 911 should be called immediately.

Nitroglycerine can also be given in a long acting form – either pills, given 1-3 times a day or a patch. Side effects often limit the use of this medicine. Major side effects include headache, hypotension, light-headedness and nausea.

**Beta-Blockers**, which are pills used to control blood pressure, decrease input from the nervous system, slow down the heart rate and increase oxygenation to the heart. This class of drugs has been shown to decrease death rates in coronary heart disease (2). Side effects include fatigue, bradycardia, dizziness, depression and hypotension.

**Calcium Channel Blockers** are used in coronary heart disease to reduce ischemia and help in the treatment of angina. Calcium channel blockers are also used in the treatment of hypertension. They have not been shown to decrease

death rates in coronary disease as robustly as beta-blockers. This class of drugs should be used with caution in patients with congestive heart failure because they have the potential to decrease cardiac output.

Side effects include constipation, edema, hypotension, bradycardia and dizziness. The incidence of bradycardia and hypotension is increased when calcium channel blockers are combined with beta-blockers.

Most calcium channel blockers have some effect in reducing atherosclerosis. Most of this research was done on animal models (2). Calcium channel blockers have the potential to reduce platelet stickiness, affect cholesterol uptake and slow down growth factor release (2), all of which may reduce the risk of heart disease or heart disease progression.

**Platelet inhibitors:** Heart attacks and some types of chest pain are strongly associated with platelets sticking together. Platelet inhibitors reduce death rates and recurrent cardiac event in patients with coronary disease (2). Medicines in this class include aspirin and clopidogrel (Plavix).

**Cholesterol:** Lowering cholesterol is one of the primary goals in managing heart disease. The number one priority is to lower the LDL cholesterol to less than 100 mg/dl and less than 70 mg/dl in those at high risk. Secondary goals include raising the HDL cholesterol and lowering the triglyceride levels. If cholesterol levels are not controlled with lifestyle interventions then they are controlled with medications. The most common first line agent in the treatment of a heart disease patient with dyslipidemia are statins.

Statins inhibit an enzyme that is responsible for making cholesterol. In addition to lowering cholesterol, statins are believed to improve the stability of the plaques. Plaque stability reduces the likelihood a piece of the plaque will break off, and clog up a blood vessel – causing a heart attack.

While there are many benefits to this drug they are not without risk, but are considered generally safe. Statins have side effects including muscle weakness, liver disease, diarrhea, abdominal pain, muscle cramps and joint pain. If they are used patients should immediately report any side effects to the health care provider. Liver function tests need to be monitored on a regular basis to assess for elevated liver enzymes. Examples of statins include: rosuvastatin [Crestor], atorvastatin [Lipitor], simvastatin [Zocor], lovastatin [Mevacor], fluvastatin [Lescol] and pravastatin [Pravachol].

The addition of other cholesterol lowering agents is sometimes needed in the management of lipids. Niacin is an agent that is not as robust in its lowering of LDL, but can have significant positive effects on HDL levels and triglyceride levels. It is associated with side effects such as flushing and dyspepsia.

Fibrates are effective at lowering triglycerides. There are two commonly used drugs in this class: fenofibrate (Tricor) and gemfibrozil (Lopid). Fenofibrate can be combined with statins, but gemfibrozil should not be as it significantly increases the risk of rhabdomyolysis.

Bile acid sequestrants are used in those who need to lower LDL in addition to statin therapy. They are also often used in those who cannot tolerate statins.

They can be used in pediatric patients. Bile acid sequestrants are not as potent as the statins.

Common drugs in this class include: Colesevelam (Welchol), Cholestyramine (Questran) and Colestipol (Colestid).

### **Intervention and Surgical Treatment**

Interventional and surgical treatments used to treat heart disease are considered when medical therapy cannot control disease, disease becomes severe or quality of life is impaired on maximal medical therapy.

In 1977, the first percutaneous transluminal coronary angioplasty (PTCA) was performed on a human. It can now be used for ACS, acute ST-elevation myocardial infarction, stable angina, angina symptoms and those who have objective evidence of myocardial ischemia.

Percutaneous treatment has evolved over the years and many ways to treat atherosclerotic lesions have been developed. Some of the methods in use include stents, drug eluting stents, atherectomy devices and balloon dilation.

Balloon angioplasty is a technique where an atherosclerotic plaque is mechanically compressed. This procedure increases the luminal diameter of the coronary artery. It is often used with other devices such as stents in the treatment of coronary lesions.

Because of restenosis after PTCA other techniques were developed. Atherectomy – laser and mechanical techniques - are used to remove the plaque, calcium and other material from the site of occlusion. The long-term success of atherectomy was not much better than PTCA and is not used often.

The placement of a stent (intracoronary stents were FDA approved in 1994) in the coronary artery is used to hold open the coronary artery. Stents come as bare wire stents and stents that contain drugs called drug-eluting stents (DES). DES reduces inflammation and cell growth. It is a more successful treatment (in regard to restenosis) and is often used. The use of DES reduce restenosis when compared to bare metal stents (11).

DES work by locally delivering drugs to the site of tissue injury to reduce smooth muscle proliferation. The use of dual antiplatelet therapy is critical after placing a DES to reduce the risk of stent thrombosis. Dual therapy entails the use of aspirin and clopidogrel. Those who do not use dual antiplatelet therapy are at higher risk of stent thrombosis (11).

Antiplatelet therapy should be continued for up to one year in those at low risk for bleeding. In those individuals who are going to undergo surgery should stop clopidogrel about 5 days before surgery and restart it 2 days after surgery, with the continued use of aspirin (11).

If a patient is found to have severe disease – blockages in three vessels or a blockage in a major vessel – and is a surgical candidate, then open-heart coronary artery bypass grafting is the treatment of choice. Those patients with more localized disease – blockage in one or two vessels – are candidates for localized therapy such as angioplasty or stent placement.

In those with multivessel coronary heart disease, long-term death rates are equal in most groups of patients. Those individuals who are older than 65 with diabetes, CABG may be a better option (11).

CABG is associated with multiple risks, including infection, post-operative pneumonia, bleeding, stroke and a long recovery time. The risk of stroke during the procedure is higher than during percutaneous coronary intervention (PCI) (2, 11).

Overall, when comparing CABG to PCI the survival over the next 1-5 years was about the same (11). This statistic varied when looking at the severity of the disease. The survival statistics were better after PCI in those with single vessel disease that was not in the left anterior descending artery. Those who were afflicted with plaques in their left main artery or triple vessel disease had better survival after CABG (11).

### **Summary**

Heart disease is a problem that places much burden on American society. Every nurse should understand this disease including its signs and symptoms, risk factors and treatment options. While every nurse may not work in cardiology – the number of people with this disease means that every nurse deals with patients or people in their personal life who are afflicted with coronary heart disease.

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