CORONARY ARTERY DISEASE

Coronary artery disease and atherosclerosis involve a chronic disease state characterized by stiff and rigid coronary arteries, and coronary plaques. Unhealthy levels of blood cholesterol and fats, poor lifestyle factors and certain modifiable and genetic risk factors cause atherosclerosis. Hypertension, and cigarette smoking are leading causes of atherosclerosis and coronary heart disease. Gender, genetics, and modifiable lifestyle choices can contribute to coronary artery disease, a progressive disease where the affected individual can suffer from angina and be at higher risk of a sudden coronary event, including death. Certified nursing assistants can participate in the prevention and treatment of coronary artery disease by monitoring patient vital sign trends and any physical signs of distress, and by reporting serious concerns to an immediate supervisor when they are observed.

Learning Goals:

1. Identify the causes and risk factors for coronary artery disease.
2. Identify the signs or symptoms of coronary artery disease that should be brought to a supervisor's immediate attention.
3. Identify the major complications of coronary artery disease.

Introduction

Coronary artery disease is a chronic heart condition that affects millions of Americans. It is considered the number one cause of death in the United States and worldwide. Heart disease is often described as hardening of the arteries, atherosclerosis, hypertensive heart disease, and heart failure. These conditions are closely connected, one may cause another, but they may be referring to different diseases. The following sections discusses coronary artery disease (CAD), which is a consequence of *atherosclerosis*. For people with CAD, the arteries that bring oxygen and nutrients to the heart have become stiff and narrowed and sometimes these blood vessels can become completely blocked. Coronary artery disease can cause many serious health problems. To a certain degree CAD is caused by a genetic susceptibility to the development of the disease. However, in most cases, CAD is a disease that is primarily caused by lifestyle factors.

Causes Of Coronary Artery Disease

Coronary artery disease is a medical condition that affects the circulatory system of the heart. In CAD, the arteries and veins that supply the heart muscle with blood and circulation are slowly and progressively blocked. These blood vessels can become weak, fragile, and susceptible to rupturing.

Coronary artery disease is a complication of atherosclerosis. Atherosclerosis causes the arteries (the blood vessels that bring oxygen and nutrients to the body) to narrow, stiffen, and occasionally, become completely blocked. Atherosclerosis can affect the arteries supplying the brain and can lead to a stroke. It can also affect the

arteries in the extremities and cause a condition called peripheral vascular disease. When it affects the arteries in the heart, it causes CAD.

Atherosclerosis is a chronic disease characterized by arteries that are stiff, rigid, and occluded by plaques. The plaques are deposits of cholesterol and fats. Atherosclerosis can affect almost any blood vessel anywhere in the body but some parts of the circulation are more likely to develop atherosclerosis than others. The circulation in the heart and the brain are areas that are commonly affected by atherosclerosis.

The heart is responsible for circulating the blood to the body but the heart also pumps blood to itself through the coronary circulation, and it is the arteries and veins of the coronary circulation that become blocked by CAD. Because the heart is such a vital organ and because it is so metabolically active, any disruption to its blood flow can be very damaging. If CAD progresses to a certain point, the heart muscle can become irreversibly damaged and other very serious complications can develop.

Coronary Artery Disease Risk Factors

The exact number of people who have CAD is difficult to determine but a recent report in 2013 estimated that there were approximately 14 million Americans who had CAD. Coronary artery disease is the number one cause of death in the United States, and the complications of coronary artery disease such as angina, arrhythmias, and myocardial infarction are a significant public health problem.

Coronary artery disease is more common in men than women, it affects African Americans differently than it does other ethnic groups, and it is more common in the elderly.

Women and Coronary Artery Disease

Coronary artery disease is the leading cause of death for women in the United States. Men who are older than 45 are at a higher risk for developing CAD than women or than younger men. Although men are more likely than women to have CAD, this is true only before a certain age; around the age of 65, the rate of CAD in women and men begins to equalize. This phenomenon may be due to the presence of female hormones, such as estrogen, in women. It is thought that prior to menopause, female hormones have a protective effect that prevents the development of CAD. It is not known why this is so but one theory is that hormones like estrogen may decrease serum cholesterol levels in women.

After menopause, when estrogen levels drop, the incidence of CAD in women begins to rise and eventually the incidence of CAD in post-menopausal woman rapidly catches up to the rate of CAD in men. Women who have CAD also have more symptoms such as chest pain, and they have a higher mortality rate associated with CAD. Other aspects of CAD that are different for women are the way that plaque is deposited and the signs and symptoms of CAD (discussed later on).

Coronary artery disease is the leading cause of death in women but many studies have shown that most women are unaware of the risk, and this has obvious implications for the way women manage their health and lifestyles.

African Americans and Coronary Artery Disease

African Americans may have *lower* rates of obstructive CAD than other ethnic groups but the incidence of complications caused by CAD is higher among African Americans than it is among other ethnic groups. African Americans are also more likely than other ethnic groups to die from CAD, even when accounting for certain lifestyle factors. Unfortunately, the presence of medical conditions and lifestyle factors such as diabetes, hypertension, and obesity that increase the risk of developing CAD are disproportionately high among African Americans.

Elderly and Coronary Artery Disease

Coronary artery disease is a chronic, progressive disease. As such, it is not surprising that older persons have higher rates of CAD. Elderly people also have pre-existing medical problems such as diabetes and hypertension that increase the chances of CAD. These conditions also make management of the disease more difficult. The elderly suffer from more complications associated with CAD. A great majority of people who die from CAD are over age 65, as well.

Role of Genetics in Coronary Artery Disease

Atherosclerosis is the cause of CAD, and the development of atherosclerosis happens in a complex way. Over time, usually starting in late childhood and perhaps earlier, the arteries in the heart develop *plaques.* These plaques are deposits of fats, cholesterol, and other material. It is not known why these plaques begin to form, especially early in life when many of the risk factors for CAD are not present.

Later in life, the development of these plaques continues, and the initial plaques become larger and more widespread.

Genetics plays a part in the prevalence of CAD. Patient's with a family history of CAD have a greater risk for developing CAD. The role of genetics and CAD is not completely understood but it is clear that to some degree CAD - or the tendency to develop CAD - can be inherited.

Studies have shown that if a person's family member, especially a parent or a sibling, developed CAD at a relatively young age, then the chances that the relative will develop CAD are increased. This tendency to inherit CAD may be due to a genetic susceptibility to accumulate serum cholesterol that is part of the family history. This risk factor cannot be eliminated, and it is not known how much it contributes to the development of CAD.

Modifiable Risk Factors of Coronary Artery Disease

There are modifiable lifestyle risk factors of coronary artery disease. A person with a history of smoking, who is obese and/or lives a sedentary lifestyle, has an increased risk for CAD. Patients with these risk factors should make lifestyle changes. Lifestyle changes are important when associated with medical problems such as an elevated serum cholesterol or high blood pressure.

Coronary Artery Disease Assessment Tools

There are many assessment tools available that can help someone determine what his/her risk is for developing coronary artery disease or developing CAD complications. One of the more commonly used

ones is *The Framingham Risk Score*. This assessment estimates the risk of having a heart attack within the next 10 years. Age, gender, total cholesterol, HDL (high-density lipoprotein) cholesterol levels, tobacco use, systolic blood pressure, and the use/non-use of anti-hypertensives are evaluated, and a risk percentage is determined.

Case Example:

A 65-year-old male has a total serum cholesterol of 240 mg/dL and his HDL cholesterol is 65 mg /dL (within the normal range). He does not smoke, his systolic blood pressure is 142 mm Hg, but he does not take antihypertensive medication. It is estimated that within the next 10 years the patient has a 12% chance of having a heart attack.

The Framingham Risk Score can be found on the website of the National Heart, Blood, and Lung Institute - http://www.nhlbi.nih.gov/. Within that website, a person can then search under *Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack*. There is also a direct link: http://cvdrisk.nhlbi.nih.gov/calculator.asp.

A quick, simple assessment of CAD risk factors may be done by answering the following questions:

1. Male Gender?
2. Age: Are you over 45?
3. Blood cholesterol: Is your total serum cholesterol > 200?
4. Blood pressure: Do you have hypertension?
5. Diabetes: Do you have Type I or type II diabetes?
6. Tobacco: Do you smoke?
7. Family history of CAD?

8. Weight: Are you overweight or obese?
9. Exercise: Are you sedentary or active?

Atherosclerotic plaques that form on the walls of the arteries narrow the arterial passages and block blood flow. Atherosclerosis also causes the arteries to become stiff and rigid, and they cannot open properly. The plaques can also become fragile and rupture. Because there is less room for blood to flow through the arteries and because atherosclerotic arteries are far less elastic than normal arteries, the tissues and organs are deprived of blood and deprived of oxygen and nutrients.

The Significance Of Atherosclerosis

The significance of atherosclerosis and coronary artery disease depend on three things: 1) the location of plaques, 2) the extent of plaque interference with blood flow, and 3) the stability of plaques. If the plaques are in relatively minor arteries, if they are not very large, and they are stable, atherosclerosis and/or CAD may not yet be a serious problem.

If the plaques are in a major artery that supplies an area of the body that is very dependent on a high amount of blood flow - an artery such as the left anterior artery in the heart - than a blockage of that artery can cause a heart attack, also called a myocardial infarction. Of course, just the presence of a plaque, even in a very important artery, does not necessarily mean that the plaque is dangerous. The plaque has to be large enough to interfere with blood flow and it has to be fragile, as well. Atherosclerotic plaques cause damage by blocking

blood flow, but they also cause damage by becoming fragile and rupturing. When this happens, a plug is formed in the artery that completely blocks the flow of blood; this is how most heart attacks happen.

The heart is one of the most active organs of the body. It needs a constant supply of oxygen and nutrients and for oxygen and nutrients to reach the heart muscle, the coronary artery must be open and clean. If the blood supply to the heart is decreased, there are compensatory mechanisms that can, for a while, keep blood flowing to the heart.

Coronary artery disease is a *progressive* disease. Unless the risk factors are tightly controlled the plaques keep growing, they become more fragile, and the blockages of blood flow to the heart become worse. Eventually, someone with widespread CAD will develop one of the serious complications associated with the disease, and when that happens the disease cannot effectively be reversed.

Coronary artery disease is a chronic condition and for most people it progresses very slowly. The plaques build up over decades and although there can be times when they stop increasing in size, there are also times when they progress quickly. If the plaques are relatively small and stable and the arteries do not become too rigid, someone with CAD may not be aware they have the disease. The body can also compensate by growing new blood vessels around the damaged arteries.

However, when the plaques become large enough to obstruct blood flow and the arteries become very stiff, the heart muscle is deprived of oxygen. When that happens, the person with CAD may experience:

- Chest pain (also known as *angina*)
- Heart attack
- Shortness of breath
- Rapid heart rate
- Irregular heart rate
- Inability to tolerate exercise
- Inability to tolerate cold
- Inability to, tolerate heat
- Inability to tolerate stress
- Dizziness
- Sweating

Signs and Symptoms of CAD

All of the above signs and symptoms can happen when someone is resting. However, they are more likely to happen during exercise, when it is cold, or during stress. These are times when the body needs more blood and oxygen, and the heart has to beat stronger and faster to supply it.

If the heart has to work harder and faster, the heart itself needs more blood and oxygen. If the blood vessels in the heart are narrowed, stiff, or blocked, the required amount of blood will not get through and several things are likely to happen. The affected person will likely have *chest pain* because the heart muscle is not receiving enough oxygen. If this continues, the heart can become damaged.

Shortness of breath and *tachypnea* (rapid breathing) would be very common in these situations. The heart cannot pump blood out to the body very effectively, so the muscles, tissues, and organs are deprived of oxygen, and that person feels short of breath. In order to compensate, the rate of breathing is increased.

A rapid heart rate, also called *tachycardia*, is another compensatory mechanism. The heart is not pumping effectively with each beat - so the heart rate is increased to make up.

The basic cause of the signs and symptoms of CAD is a lack of oxygen reaching the heart. At times, these signs and symptoms may start slowly and gradually, offering warnings that someone has developed CAD. Unfortunately, mild chest pain, a little bit of shortness of breath once in a while, an occasional rapid or irregular heartbeat can be easy to dismiss or ignore. Even worse, there are times in which there may not be *any* noticeable signs and symptoms of CAD until the person suffers a cardiac disaster. This is especially true for people with certain medical conditions; the damage is being done and they are unaware.

People who have diabetes and CAD may *not* have any signs and symptoms of CAD until they suffer a serious cardiac event such as a myocardial infarction (heart attack).

Complications Of Coronary Artery Disease

Coronary artery disease can be managed with proper attention to diet, exercise, monitoring the blood pressure, and avoiding alcohol and tobacco. Many people with CAD can adjust and live without any serious

restrictions to their life. However, in many cases, the disease is progressive. If the disease progresses and is not managed well, CAD can cause some serious complications. Those that are common and serious enough will be discussed separately in this section.

Angina

Angina is the medical term for the chest pain that occurs in people with CAD. It is caused by lack of oxygen to the heart. The heart, same as any other organ or tissue of the body, needs oxygen to function and if deprived of oxygen, the person with CAD will experience may experience an attack of angina. Angina can be very painful and can happen when someone is resting or when they are exercising or under stress.

Many people describe angina as a "pain in the chest". It is also frequently described as "pressure in the chest". People who are having an angina attack frequently say it feels as if there is a very heavy weight on the chest. The pain or pressure often radiates down the left arm or up into the neck. Someone who is having an attack of angina will often be sweaty, have shortness of breath, and feel dizzy, weak, and nauseated.

Sometimes, the person who is having an attack of angina will *not* experience any chest pain, pressure or discomfort. He or she may simply feel a little anxious or restless, perhaps a little sweaty, a little short of breath. However, the most common signs and symptoms of an attack of angina are:

- Chest pain or chest pressure

- Pain or pressure that radiates down the left arm
- Pain or pressure that radiates up into the neck or the jaw
- Shortness of breath
- Rapid heartbeat
- Nausea
- Dizziness
- Sweating

Although there are common signs and symptoms of angina, everyone experiences an attack of angina in their own unique way. It was mentioned earlier that the signs and symptoms of CAD are different for women. Women who are having angina or a myocardial infarction are less likely than men to have chest pain or chest pressure. For women, dizziness, feeling lightheaded, nausea, pressure in the abdomen, and shortness of breath are more common.

Another group that experiences complications of CAD in their own way is people who have diabetes. Diabetes can, over a period of years, alter and decrease the ability to sense pain. Someone who has diabetes and CAD and who is having angina or a myocardial infarction may not appear very ill and have minimal signs and symptoms.

Angina attacks may be brief (a few seconds) or they may last for a few minutes. They may go away spontaneously, they may require treatment, or they may progress to actual damage to the heart. People who suffer from angina often carry a medication called nitroglycerin that can be placed under the tongue to relieve the pain.

People diagnosed with angina should also have received instructions from their physician about how to handle an angina attack. For example, if the patient considers the angina pain to be a level 3 on the pain scale of level 1-10, if there are no other symptoms that exist, such as shortness of breath, and if the pain is relieved by one nitroglycerin, it is safe for the patient to stay home. If the pain is at level 8 on a pain scale of level 1-10, and there is no relief after one nitroglycerin, the patient should be advised to go to the hospital.

Myocardial Infarction

Myocardial infarction is the medical term for a heart attack. A myocardial infarction is similar to angina. They both happen to people with CAD. They both happen when the oxygen supply to the heart is disrupted. And they both cause many of the same signs and symptoms. However, myocardial infarction is far more dangerous than angina.

The signs and symptoms of a myocardial infarction are essentially the same as those of an attack of angina. How can the two be distinguished? Many times, someone with angina knows when he or she is having angina, and will know the difference between angina and an experience of having a myocardial infarction. Many times, the signs and symptoms, such as chest pain or pressure, shortness of breath, *etc.*, will be much worse if a myocardial infarction is happening.

It may be very difficult to tell the difference between an attack of angina and a myocardial infarction. At times, an exam by a physician, an electrocardiogram (ECG) and blood tests are the only ways to know

for sure if someone with CAD and chest pain is having angina or a myocardial infarction.

When a person with CAD has a myocardial infarction, the oxygen supply to the heart has been blocked so much of that part of the heart muscle dies. Certainly, that is serious in and of itself. The heart and the patient may recover, but because part of the muscle is no longer functioning, the heart is now much weaker. However, a myocardial infarction can also cause other dire complications, which are highlighted below.

Shock

A strong heart is required in order to maintain a normal blood pressure. A myocardial infarction can damage the heart so seriously that the blood pressure becomes dangerously low and the person can develop shock.

Pulmonary Edema

If a large amount of the pumping action of the heart is lost, blood and fluid will back up into the lungs. This condition is called pulmonary edema, and the patient with this condition will be unable to breath.

Arrhythmias

If the heart muscle has been permanently damaged during a myocardial infarction, there may be changes in the rhythm of the heart. Some of these, such as ventricular fibrillation, may be fatal. Some may be survivable, but the person may require a permanent

pacemaker or defibrillator to shock the heart back into a normal rhythm.

When coronary artery disease disrupts the oxygen supply to the heart, the cardiac muscle often becomes unstable. There is also a specialized conduction system in the heart that acts very much like a system of electrical wires. This conduction system makes sure that each heartbeat starts normally and progresses normally. Coronary artery disease can also damage this specialized conduction system. If there is damage to the heart muscle or the heart conducting system, the heart can develop erratic rhythms.

At best, erratic rhythms might merely require medication. At worst, erratic rhythms can be fatal.

Sudden Death

Sudden cardiac arrest is the most common cause of death in the United States, and most of the sudden coronary death cases have been in patients with underlying CAD. People who had a prior myocardial infarction are at higher risk of a sudden death event.

Treatment Of Coronary Artery Disease

The treatment of coronary artery disease focuses on two areas: 1) lifestyle changes, and 2) preventing complications through varied medical approaches.

Lifestyle Changes

Cigarette smoking, an elevated serum cholesterol, and hypertension greatly increase the risk of developing CAD. For most people, having or not having hypertension is not a choice; 95% of adults with high blood pressure were predisposed to having high blood pressure. However, management of high blood pressure depends on the patient complying with a treatment plan. Smoking cessation and eating a diet that lowers serum cholesterol is done through individual effort.

The evidence is clear that living a healthier lifestyle can not only reduce the risk of developing CAD, it can also reduce the degree of CAD in people who already have the disease. Many people find lifestyle changes difficult to introduce into their lives; quitting smoking and modifying diet may be a continuous struggle. The same is true when it comes to changing exercise habits.

Prevention and Treatment

The line between preventing and treating the major complications of CAD is narrow because many of the therapies do both. Preventing complications is primarily done by having a patient make lifestyle changes but if this is not possible then medication therapy is necessary.

Medications

Medications for preventing and treating CAD complications include those listed below.

Anti-anginal Drugs

Drugs such as the beta blockers (atenolol, metoprolol), the calcium channel blockers (diltiazem, verapamil), and long-acting nitrates can be used to prevent angina attacks. Short-acting nitrates, such as sublingual nitroglycerin, are used to treat an acute angina attack.

Anti-hypertensives and Anti-arrhythmic Drugs

Atrial fibrillation is a common arrhythmia that is caused by CAD. It causes the heart to beat very rapidly and very irregularly, and this can have serious consequences. Digoxin is a drug that is used to treat atrial fibrillation by slowing the heart rate.

Cholesterol Lowering Drugs

Cholesterol lowering drugs are called statins, and Crestor® and Lipitor® are commonly used brands.

Clot Prevention

Drugs that prevent the formation of clots can prevent and decrease the number of angina attacks and prevent the occurrence of myocardial infarctions. Aspirin and Plavix® are drugs that are used to prevent clots. Some patients who have CAD and other types of cardiovascular disease may need to be on more powerful clot preventing medications such as warfarin, also known as Coumadin®.

Clot Dissolving Drugs

Patients who are having an acute myocardial infarction are typically treated with intravenous (IV) medications that dissolve the clot.

Surgery

The two surgical procedures that are used to prevent and/or treat CAD complications are coronary artery bypass graft (CABG) and angioplasty.

Coronary artery bypass graft surgery, commonly know as a "cabbage procedure" or CABG involves replacing the blocked coronary arteries with new blood vessels. *Angioplasty* is as procedure that either physically removes plaques in the coronary arteries or uses an inflatable balloon that is inserted into the coronary arteries in the areas where there are plaques. The balloon is expanded, the plaques are compressed, and the blood vessel is opened up. In either procedure, a tube called a *stent* may be placed in the newly opened arteries in order to keep them open and maintain blood flow.

Caring For Patients With Coronary Artery Disease

Caring for the patient with coronary artery disease involves close monitoring of the patient's pulse and blood pressure and being aware of the conditions and situations that can aggravate CAD. It also involves knowing the major complications of CAD, the signs and symptoms of these complications, and what to do if they occur.

Monitoring Vital Signs

If a patient with CAD has a pulse that is abnormally slow or fast, this can be a sign of a serious problem. If the patient with CAD has a blood pressure that is abnormally low or high, this can also be dangerous. Any of these changes should be reported to a supervisor immediately.

Monitoring Dangerous Situations

Anything that makes the body work harder increases the need for oxygen and makes the heart work more intensely. This is always risky for a patient with CAD. Emotional stress, physical exertion, a fever, intense heat or cold, pain, or a sudden illness are all situations that could be dangerous for a patient with CAD.

Major Complications

The major complications of CAD have already been discussed, as have the signs and symptoms associated with them. If the patient with CAD has any of these signs or symptoms, the certified nursing assistant must notify a supervisor immediately.

It is important for the certified nursing assistant (CNA) to remember that while most people with CAD having angina, a myocardial infarction, or an arrhythmia will have some of the common signs and symptoms previously mentioned, there are those people who will not have symptoms. Each person experiences these complications in his or her own unique way. The certified nursing assistant will need to know his or her patients. Often, it is best to simply ask them what happens when their CAD gets worse.

If a patient with CAD has an abnormal heart rate, an abnormal blood pressure, chest pain or pressure, pain or pressure in the left arm, the neck or the jaw, or difficulty breathing, the CNA must notify a nursing supervisor *immediately*.

Some people with CAD may be suffering from angina, having shortness of breath, and other symptoms associated with CAD, but deny that anything is wrong. Denying symptoms of CAD is not

uncommon. A medical professional must know the patient, know if a patient has CAD, and be a keen observer. The patient with CAD may deny he or she is in pain or cannot breathe but the caregiver must observe the symptoms and review measurements of vital signs.

Summary

Coronary artery disease is defined as narrowed and/or blocked arteries in the heart and is caused by atherosclerosis. Atherosclerosis is defined as a chronic disease characterized by stiff and rigid arteries, occluded by plaques, which are deposits of cholesterol and fats caused by lifestyle factors and certain risk factors. The most important risk factors for developing atherosclerosis and CAD are elevated serum cholesterol, hypertension, and cigarette smoking.

Other risk factors discussed included gender, genetics, and modifiable lifestyle choices that can contribute to heart disease. Coronary artery disease interferes with blood flow to the heart. It is a progressive disease where the heart can suffer serious damage. Prevention and treatment of CAD can improve medical outcomes and help to avoid a catastrophic cardiac event.