Understanding how your heart works is important in your recovery from a heart attack or heart surgery. In this chapter, you will be given information on how your heart works, and how heart disease develops. In addition, treatment of heart disease will be discussed.

SECTION 1

The Heart and How it Works

The heart is a hollow, muscular organ that pumps blood, rich in oxygen and nutrients, to all parts of the body. It weighs about one pound and is the size of a human fist. The heart lies in the middle of the chest, slightly to the left. The heart is protected by the breastbone (sternum) and rib cage.

The heart circulates blood throughout the body. Oxygen is carried in the blood. The heart has four chambers. The upper two are called atria, and the lower two are called ventricles. The upper chambers are smaller than the lower chambers. The upper and lower heart chambers are separated by valves which allow blood to flow in one direction. A wall
of tissue called the septum separates the right and left sides of the heart.

Each side of the heart has a special job. The right side receives blood from the body, then pumps it into the lungs where the carbon dioxide is removed and oxygen added. The oxygen-rich blood returns from the lungs to the left side of the heart. The left side of the heart pumps the oxygen-rich blood through the aorta and throughout the body.

Coronary Arteries
In order for the heart to work, the heart muscle needs its own blood supply. The heart’s blood is supplied by the coronary arteries. The coronary arteries come from the aorta. The left coronary artery divides into two major branches, the left anterior descending artery and the circumflex artery. The right coronary artery has no major branches. These main arteries lie on the surface of the heart and divide into smaller branches which feed the heart with oxygen-rich blood.

SECTION 2

Coronary Artery Disease and Angina Pectoris
Atherosclerosis is a disease process which develops slowly, often starting in childhood. Atherosclerosis can slowly block any artery in the body. Fatty deposits form on the lining of the arteries. These deposits are called plaque. Plaque makes the artery lining rough, narrow and hard. Blood cells may collect on the plaque and form a blood clot. If atherosclerosis occurs in the arteries of the heart, this is called coronary artery disease (CAD). Plaque and blood clots decrease oxygen to the heart, causing discomfort called angina. Angina may be an advanced warning of a heart attack. It can occur at rest or exercise, day or night, and does not feel the same to everyone.

Atherosclerosis
Atherosclerosis

When a clogged artery keeps the heart from getting enough blood and oxygen, angina can occur.

**What to do when angina occurs:**
- Stop and sit down
- Place a nitroglycerin under your tongue and let it dissolve
- Five minutes later, if angina continues, take another nitroglycerin
- Five minutes after the second dose, if angina continues, take one more nitroglycerin
- If angina continues after 3 nitroglycerin doses, call your local emergency number **Do not drive yourself to the hospital.**

*It may be difficult for you to know if your discomfort is angina or if indeed it is a heart attack. If you think you might be having a heart attack, call for emergency medical help at once. It is better to have your symptoms checked out rather than taking the chance of having a heart attack.*

**Symptoms of angina include:**
- Tightness, squeezing, pressure, pain, or mild ache in the chest
- Sharp, burning, or cramping pain
- Ache in the neck, jaw, throat, shoulders and back
- Discomfort between the shoulder blades
- Indigestion or heartburn
- Difficulty in catching your breath
- Heaviness, numbness, tingly sensations or pain in either arm, elbow, or wrists

**What is the difference between angina and a heart attack?**

Angina is caused by a temporary lack of oxygen-rich blood to the heart muscle and does not result in damage to the heart muscle. This type of chest discomfort:
- Usually lasts less than 15 minutes
- Is quickly relieved by nitroglycerine
- May be reduced or alleviated by stopping the activity and resting

A heart attack is caused by a prolonged lack of oxygen-rich blood to the heart muscle. This results in damage to the muscle. The pain of a heart attack:
- Is more severe than angina
- Lasts longer than angina
- Can include symptoms like:
  - shortness of breath
  - sweating
Heart Attack

- nausea
- vomiting
✓ Is usually not relieved by nitroglycerin and rest

damage), or MI. The location of the damage to your heart muscle depends on the coronary artery that was blocked.

What causes a heart attack?
In most cases, a heart attack is caused by coronary artery atherosclerosis. Atherosclerosis is a build up of fats, cholesterol, calcium and blood clotting products in the lining of an artery. A heart attack occurs when a small blood clot gets stuck in this narrowed area of an artery causing a complete blockage of the artery. Heart attacks can also result from a prolonged spasm (sudden squeezing) of the coronary artery. When the artery is completely blocked no

SECTION 3

Heart Attack
A heart attack occurs when there is a prolonged blockage of a coronary artery. Blood supply to the heart muscle is cut off, and a portion of the heart muscle begins to die. This creates an area of dead tissue called an infarction.

You will hear a heart attack referred to as a myocardial infarction (myo = muscle, cardial=heart, infarction =
blood flow can get through. The muscle fed by the artery begins to die.

**Diagnosis of a heart attack?**
A heart attack diagnosis is made by assessing:

- **Symptoms** (chest pressure, tightness, burning, etc.)
- **History** — how you describe your heart attack is very important.
- **Physical exam** — changes in the heart function may be heard with a stethoscope.
- **Electrocardiogram (EKG)** — may show recent changes.
- **Blood test** — certain enzyme levels increase in the blood when there is damage to the heart.
- **Heart function and movement** — this can be evaluated through a heart catheterization or echocardiogram.

*Please refer to the Diagnostic Tests chapter in this notebook for a complete description of these tests.*

**How does the heart heal?**
The damaged area of your heart muscle is similar to a bruise. Soon after a heart attack, the body’s white blood cells come to the damaged area to prepare for healing. You often have a slight fever during this time. A period of four to six weeks is required for the heart muscle to heal. The damaged muscle is gradually replaced by firm scar tissue. Small blood vessels around the damaged area become larger and new vessels form to increase the blood supply to the area. This is called collateral circulation.

Your heart attack might have decreased your heart’s power to pump. This may cause you to feel tired and weak. However, the heart muscle can be conditioned like other muscles in your body. In most cases, after a period of healing and rehabilitation, you will feel stronger and be able to return to your previous activities.

**Why should I seek medical attention quickly?**
Your doctor has several different ways to reduce the damage of a heart attack. One of these is a medicine called thrombolytics. The most common thrombolytic agents are:
- **Tissue Plasminogen Activator (TPA)**
- **Tenecteplase (TNKase)**

These medicines have the ability to dissolve blood clots. They are given into a vein in the arm. If given quickly enough, these substances may prevent permanent damage to the heart or reduce the amount of damage.

Integrilin is another drug that may be given. This drug keeps the platelets in your blood from clotting. This is used in patients to prevent a heart attack or for those needing angioplasty.

To work best, the medicines must be given in the first few hours after onset of heart attack symptoms. The effectiveness of the drugs are decreased if the symptoms have been present for more than 6 to 8 hours.
Angioplasty

A catheter (thin tube) is guided into your clogged artery. A smaller catheter with a balloon tip goes into the first catheter. The balloon is inflated to push against the plaque and open the artery. Then the balloon is deflated and the catheter withdrawn. Now the artery is wider and blood can flow more freely.

SECTION 4

❤️ Treatment Options

The treatment you receive in the hospital is designed to support your heart’s healing process. Rest is important in order to decrease the work of the heart and allow it to heal. You will usually have a short stay in the intensive care unit where you are closely monitored. Medication and oxygen will be given. As you recover, you will be transferred to a regular room. A program, in which you gradually increase your activities, will be explained to you by the hospital nursing and cardiac rehabilitation staff. It is important for you to let your nurses know if you have any type of chest pain or pressure.

Angioplasty

Angioplasty is performed in the cardiac catheterization lab. You will be given medications to help you relax and medication as needed for any pain or discomfort. It is important for you to be awake to move and breathe deeply when asked by the cardiologist. Angioplasty is performed with a special balloon-tipped catheter that is inserted through a tube (sheath) in your groin. The cardiologist passes this catheter across the narrowed space in the artery and inflates the balloon. This balloon pushes the fatty plaque against the vessel wall thus allowing more blood flow through the artery. It is important to remember during each inflation of the balloon, blood flow is restricted through the artery and heart muscle thus potentially causing “angina” type symptoms.
Stent
In certain instances following angioplasty, the cardiologist may decide to insert a stent inside the coronary artery. The stent, usually made of stainless steel, functions as a scaffold to hold open the inside of the coronary artery. Frequently, your doctor will choose to use a drug-eluting stent, sometimes called a “coated” or “medicated” stent. These stents have been coated with a drug to prevent reblocking of the artery. The stent is on a balloon catheter. When the balloon is inflated, the stent expands and presses the fatty plaque against the wall of the vessel. The balloon is deflated and removed, with the stent remaining in place keeping the artery open.

After angioplasty or stenting, you will return to your room in the ICU. The nurse will frequently check your pulse and blood pressure. The nurse will also look for bleeding at the insertion site. A small sample of blood will be drawn frequently. Blood thinning medicine is adjusted according to the blood count. The sheaths in the groin will be removed when the blood clotting time is in a safe range.

Implantable Cardioverter-Defibrillator
An implantable cardioverter-defibrillator system (often called an ICD) is a small electronic device that’s implanted in the body. The ICD continuously monitors your heartbeat and is like a small computer. Although it does not prevent irregular beats, if it senses dangerous or a prolonged rapid heartbeat, it delivers one or more shocks to the heart, restoring a normal rhythm.

Coronary Artery Bypass Graft Surgery
Surgery may be needed to treat your heart disease. In this procedure, a vein (the saphenous vein) from your leg and/or artery (the internal mammary artery) from your chest will be used to build new pathways for blood to flow. The artery and vein will be attached above and below the blocked artery. This will increase blood flow and oxygen to your heart muscle.

The surgery is a long process, lasting four to six hours. Many heart team members will be involved with your surgery. The team includes: lead surgeon, physician assistant surgeon, the operating nurses, chaplain/pastor, anesthesiologist, perfusionist, nurse practitioner, ICU nurses, respiratory therapist, cardiac rehabilitation nurses and the step-down nurses and staff. The surgery begins with the preoperative nurse coming to your room to shave your chest and legs. An IV will be placed, and the nurse will give you relaxing medications. Your family will be able to spend time with you before going to surgery. The Chaplain may also come visit. You
Coronary Bypass

will be taken to the operating room where the anesthesiologist will begin preparing you for surgery. At this time, special tubes and wires may be placed to monitor your vital signs during surgery and recovery. To work on the heart, the heart surgeon will make an incision down the middle of the chest and through the breastbone. At the same time, the physician assistant will be removing vein from your leg for grafting to the heart. This is usually done through a small incision at the knee and ankle using a tiny camera and a tv screen. This endoscopic technique reduces discomfort and the risk of infection.

Heart surgery is often performed with the heart beating, but sometimes a heart-lung machine is needed to support the body's circulation and rest the heart.

After the grafts are complete, the surgeon closes the chest by wiring it together with stainless steel wire. The wire works as a “cast” to hold the bone together so it can heal properly.

Immediately after surgery, you will go to the Intensive Care Unit (ICU). You will be connected to many tubes and wires. Each is important to your recovery. As your body begins to heal, the tubes and wires will be removed.
The usual tubes include:

- ✔ A breathing tube is in the trachea. It is connected to a ventilator to help you breathe until you are more awake and can breathe on your own. You will not be able to speak while this tube is in place.
- ✔ A stomach tube is used to keep the stomach empty.
- ✔ Chest tubes are used to drain fluid from the chest cavity.
- ✔ Pacing wires are placed to support the heart rhythm if needed.
- ✔ An arterial line measures blood pressures continuously. Blood may be drawn from an arterial line.
- ✔ A pulmonary artery catheter measures heart pressures.

You will move to a step-down unit usually the day after surgery, and will recover there for 1 to 2 more days. 

Bypass surgery, angioplasty and stenting do not cure coronary artery disease. These treatments provide a new supply of blood to the heart. To prevent progression of coronary disease, it is important to follow a program of risk factor modifications.

This includes:

- ✔ Follow a low-fat diet
- ✔ Exercise regularly
- ✔ Stop smoking
- ✔ Lose weight
- ✔ Control your blood pressure and cholesterol
- ✔ Find ways to manage stress
- ✔ Control your diabetes

SECTION 5

Heart Valve Surgery

The four valves of the heart are made of thin, strong flaps of tissue. The valves open and close as the heart pumps. Surgery may be recommended to repair diseased valves.

The most common valves to be replaced are the aortic and mitral valves. There are two different types of valve replacements: the mechanical valve and the biological tissue valve.

The mechanical valves are made of metal or plastic in a variety of designs. This type of valve typically never needs to be replaced, but does require lifetime use of a medication known as Coumadin/Warfarin. This is blood thinner that prevents blood clot on the valve. Biological tissue valves are made of animal tissue that has been
chemically treated. The tissue valve is similar to your natural heart valve and is tolerated well by your body. This type of valve requires NO blood thinner use, but is less durable and may need to be replaced in your lifetime.

Valve surgery requires a full team of people and a process similar to bypass (see previous section). However, the use of the heart-lung machine is necessary in valve surgery.

**Valve Surgery Patient Information**

If you have had valve repair or replacement surgery, there are some additional guidelines for you to follow.

1. If you are on anticoagulant therapy (Coumadin):
   A. You will be given a guidebook explaining the use of this medication. It helps to prevent blood clots from forming on your valve (also refer to the Medications chapter of this notebook).
   B. We recommend you order a medical identification bracelet or necklace. Ask a nurse or the cardiac rehab staff for an order form.
   C. Your doctor will arrange for follow-up blood work (Protime with INR). This test checks your blood to make sure you are taking the right amount of blood thinner.

2. Before having any dental work done, including teeth cleaning, let your dentist know you have had valve surgery. Your doctor or your dentist may order an antibiotic for you to take before your appointment.

3. Be aware of the signs and symptoms of bacterial endocarditis (infection around the heart valve). These include:
   - chills/sweating
   - poor appetite/weight loss
   - joint pain
   - fatigue and weakness
   - temperature greater than 100 degrees F.

4. Carry the valve card that you received from the health center and valve company with you at all times.

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**SECTION 6**

**Peripheral Vascular Disease**

Peripheral Vascular Disease (PVD) is another form of atherosclerosis that occurs in the arms or legs. It is a condition in which the arteries that carry blood to the arms or legs become narrowed or clogged. This is a gradual process in which cholesterol and scar tissue build up, forming a substance called “plaque” that clogs the blood vessels. In some cases, PVD may be caused by blood clots that lodge in the arteries and restrict blood flow. PVD is sometimes called peripheral arterial disease, or PAD. Many people also refer to the condition as “hardening of the arteries.”
The most common symptom of PVD is painful cramping in the leg or hip, particularly when walking. This symptom, also known as “claudication,” occurs when there is not enough blood flowing to the leg muscles during exercise. The pain typically goes away when the muscles are given a rest.

Other symptoms include:
- Leg or hip pain during walking that stops when you rest
- Numbness, tingling or weakness in the legs
- Burning or aching pain in feet or toes when resting
- Sore on leg or foot that won’t heal
- Cold legs or feet
- Color change of skin of legs or feet
- Loss of hair on legs

Who is at risk for PVD?
The disease affects everyone, although men are somewhat more likely than women to have PVD. Those who are at risk are:
- Over the age of 50
- Smokers
- Diabetic
- Overweight
- People who do not exercise
- People who have high blood pressure or high cholesterol
- People who have a family history of heart or vascular disease.

Diagnosing PVD
The most common test for PVD is the ankle-brachial index (ABI), a painless exam in which a special stethoscope is used to compare the blood pressure in your feet and arms. Based on the results of your ABI, as well as your symptoms and risk factors for PVD, the physician can decide if further tests are needed. When the ABI indicates that a person may have PVD, other imaging techniques may be used to confirm the diagnosis, including duplex ultrasound, magnetic resonance angiography (MRA) and computer tomography (CT) angiography.

SECTION 7

❤️ Sudden Cardiac Death
What is sudden cardiac death?
Sudden cardiac death (also called sudden death) is death resulting from an abrupt loss of heart function (cardiac arrest). The victim may or may not have diagnosed heart disease. The time and mode of death are unexpected. It occurs within minutes after symptoms appear. The most common underlying reason for patients to die suddenly from cardiac arrest is coronary heart disease.
What causes sudden cardiac death?

All known heart disease can lead to a cardiac arrest and sudden cardiac death. Most of the cardiac arrests that lead to sudden death occur when the electrical impulses in the diseased heart become rapid (ventricular tachycardia) or chaotic (ventricular fibrillation) or both. This irregular heart rhythm (arrhythmia) causes the heart to stop beating suddenly. Some cardiac arrests are due to extreme slowing of the heart (bradycardia).

causes corrected to prevent future episodes. Possible causes include myocardial ischemia (is-KE’me-ah), arrhythmia, etc. Possible tests and treatments include:

- Cardiac catheterization
- Electrophysiology (EP) study
- Coronary artery bypass surgery
- Balloon angioplasty or PTCA
- Antiarrhythmic medicine
- Implantable cardioverter defibrillator (ICD)
- Implantable pacemaker
- Heart transplant

Can the cardiac arrest that causes sudden death be reversed?

Brain death starts to occur in just four to six minutes after someone experiences cardiac arrest. Cardiac arrest is reversible in most victims if it’s treated within a few minutes with an electric shock to the heart to restore a normal heartbeat. This process is called defibrillation. A victim’s chance of survival is reduced by 7 to 10 percent with every minute that passes. Few attempts at resuscitation succeed after 10 minutes.

What are treatments for survivors

If a cardiac arrest was due to ventricular tachycardia or ventricular fibrillation, survivors are at risk for another arrest, especially if they have underlying heart disease. Survivors of cardiac arrest must have all