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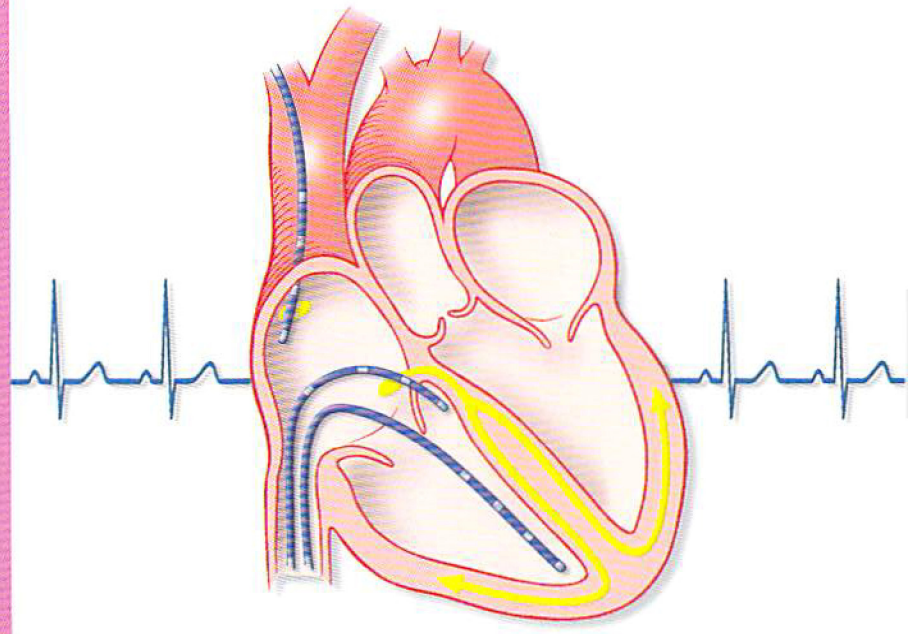
Electrophysiology (EP) Study



A Patient's Guide

This booklet is not intended to replace professional medical care. Only your doctor can diagnose and treat medical problems.

Catheter Ablation

Catheter ablation, as we've seen, is a procedure that destroys parts of the abnormal pathway that's causing your arrhythmia (see page 17). It is used for treating certain *rapid* heart rhythms.

Catheter ablation can permanently cure your heart rhythm problem. In many cases, it will allow you to stop taking medications and to lead an active and productive life.

. . . . .

Your doctor will decide if you need treatment, and if so, which treatment is best for you. He or she will discuss the treatment with you.

Follow your doctor's instructions, take medications as directed, and report any symptoms and side effects you have. That's the best way to make sure you get the most benefit from whatever treatment option your doctor recommends.

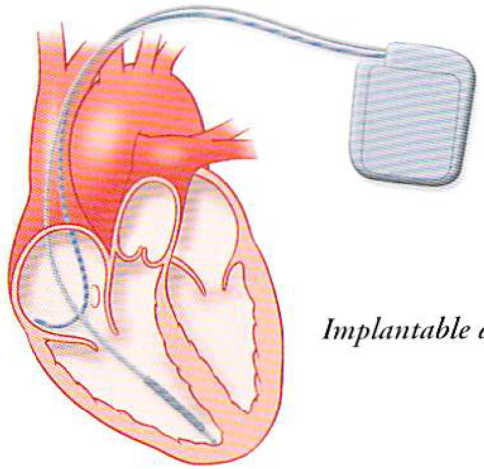
Implantable Cardioverter Defibrillator

An implantable cardioverter defibrillator (**ICD**), is a small electronic device, like a pacemaker, that is implanted (inserted) in the body. It is used for people who are at risk for dangerous rapid heart rhythms.

The ICD monitors the heartbeat at all times. If it senses a dangerous rapid heart rhythm, the device delivers pacing impulses or shocks to the heart and restores a normal rhythm.

ICDs are used for people who have had dangerous rapid heart rhythms or cardiac arrest (a condition in which the heart stops pumping blood). It may also be prescribed for people who are at an increased risk for cardiac arrest because of heart disease.

If you have a rapid heart rhythm problem, an ICD may be the best treatment for you. It can save your life by quickly bringing a dangerous heart rhythm under control.



Implantable defibrillator

Your doctor has recommended an electrophysiology (EP) study to find out what is causing your heart rhythm problem. Now, you probably have questions and concerns about the test. This booklet can help answer many of your questions.

What Is an EP Study?

An EP study is an accurate method for studying the heart's electrical system. It allows doctors to find abnormal sites inside the heart that may be causing serious arrhythmias (abnormal heart rhythms).

During an EP study, doctors insert special electrode catheters (long, flexible wires) into the heart. These catheters can sense electrical activity in different parts of the heart. They can also be used to deliver tiny electrical impulses to pace the heart (cause it to beat).

Why Is the EP Study Important?

The EP study gives more detailed information about the heart's electrical system than other tests. It helps doctors diagnose your problem accurately and lets them choose the best treatment for you.

EP studies are most often used for people who have symptoms of a rhythm problem, such as palpitations, lightheadedness, or fainting spells. They are also used for people who have had dangerous arrhythmias or are at risk for cardiac arrest. (During cardiac arrest, the heart stops pumping blood.)

How the Heart Works

Before discussing the details of the EP study, it helps to understand how the heart works.

The Heart as a Pump

The heart is a hollow organ made of strong muscle that constantly pumps blood throughout the body.

The heart has four chambers: two chambers on the left side and two on the right. The upper chamber on each side, called an **atrium**, receives and collects blood. The lower chamber on each side, called a **ventricle**, pumps blood out of the heart.

The four heart chambers work together to contract (squeeze) and pump blood. As it circulates, blood delivers oxygen and nutrients throughout the body.

The Heart's Electrical System

The heart has an electrical system that produces tiny electrical impulses. These impulses travel from the upper to the lower chambers and tell the chambers to contract and pump blood.

The heart's electrical impulses normally begin at the sinoatrial node, or **SA node**. This cluster of special cells, also known as the heart's natural pacemaker, is located at the top of the right atrium. It produces electrical impulses at regular intervals and sets the proper rhythm for the heartbeat.

Each electrical impulse spreads throughout the atria (plural of atrium), causing them to contract and pump blood into the ventricles.

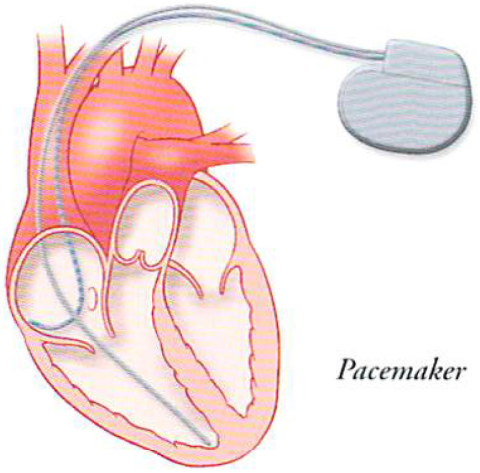
Pacemaker

A pacemaker is a small, lightweight, electronic device that is implanted (inserted) in the body to pace the heart (cause it to beat). It is used for people whose hearts are beating *too slowly*.

The pacemaker has two parts: a pulse generator that contains a battery and electronic circuitry, and one or two pacing wires, or leads, that carry electrical impulses from the pulse generator to the heart.

The pacemaker keeps track of the heart's electrical activity. If it senses that the heart is beating too slowly or is pausing too long between beats, the pacemaker delivers electrical impulses that stimulate the heart and keep it beating at the proper pace.

If you have a slow heart rhythm, a pacemaker can give your heart the extra help it needs to relieve your symptoms and help you feel better.



Pacemaker

Treatment Options

The treatment your doctor recommends will depend on the kind of arrhythmia you have, how severe your symptoms are, and whether you have other problems with your heart.

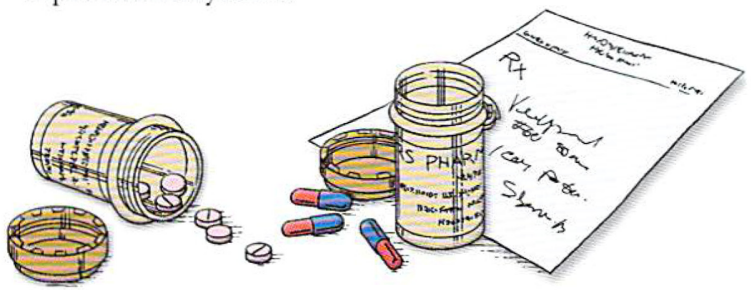
If your problem is not too serious, your doctor may simply adjust your medications. Or, he or she may prescribe a pacemaker or a defibrillator to treat a heart rhythm that's too slow or too fast.

In some cases, your doctor may decide to do catheter ablation immediately following the EP study. This possibility will be discussed with you before the study.

Antiarrhythmic Drugs

Medications can help restore a normal heart rhythm and prevent tachycardias from recurring.

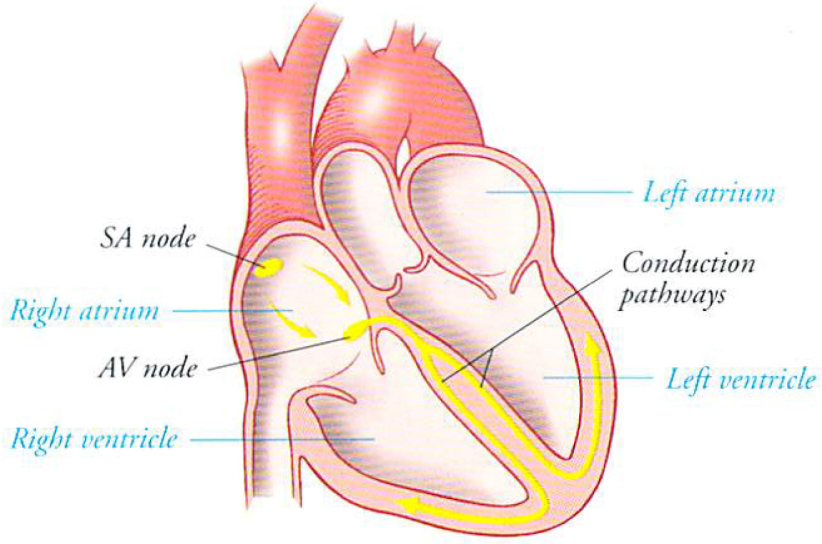
Most antiarrhythmic drugs work by changing the electrical signals inside the heart. This helps keep abnormal sites in the heart from starting irregular or rapid heart rhythms.



From the atria, the electrical impulse reaches the atrioventricular node, or **AV node**, which is located between the atria and the ventricles. The AV node slows down each electrical impulse before it passes through to the ventricles.

The impulse then travels to the ventricles through **conduction pathways**. The impulse stimulates the ventricles, causing them to contract and pump blood out of the heart.

At rest, the SA node normally starts 60 to 100 beats a minute. When you are physically active or excited, your body needs more blood flow. A healthy SA node responds to these changes in the body by increasing the **heart rate** (the number of beats per minute).



Why Is an EP Study Done?

An EP study is an accurate method for studying the heart's electrical system. It allows doctors to find abnormal sites inside the heart that may be causing serious arrhythmias.

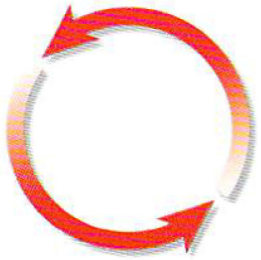
What Are Arrhythmias?

Normally, the SA node sets the pace for the heartbeat. The atria contract first and squeeze blood into the ventricles. A fraction of a second later, the ventricles contract and pump blood to the body.

During an **arrhythmia**, either the rate or the pattern of the heartbeat changes. The heart may beat too fast, resulting in **tachycardia**; it may beat too slowly, resulting in **bradycardia**; or the heart rhythm may become irregular.

Rapid Heart Rhythms

Most cases of tachycardia are caused by an abnormal pathway, called a **re-entry circuit**. If an electrical impulse enters this pathway, it may start traveling in a circle. This can make the heart contract each time the impulse travels through the pathway. The result is a very rapid heart rhythm.



Re-entry circuit

An electrical impulse has entered the abnormal pathway to form a circuit. If the impulse continues to travel in a circle, it can cause a very rapid heart rhythm.

After You Go Home

- **Limit your activity** during the first couple of days at home. You can move about, but do not strain or lift heavy objects.
- **A bruise or a small lump** under the skin at the catheter insertion site is quite common. It should disappear within a few weeks.
- **Call your doctor or nurse** if the insertion site becomes painful or warm to the touch, the bruising or swelling increases, or you develop a temperature over 100°F.
- **Ask your doctor** when you can return to your normal activities, and whether there are things you should not do.
- If you had catheter ablation, you may have **occasional skipped heartbeats** for a few weeks. You may also feel palpitations that last for 2 to 3 beats. These symptoms are common and will happen less often over time.
- **Call your doctor if your rapid heart rhythm returns**, or if you have dizzy spells, chest pain, or shortness of breath.
- Be sure to **check with your doctor or nurse about medications**—which ones to keep taking and which ones to stop.

After the EP Study

After the EP study is completed and the catheters have been removed, the doctor or nurse applies firm pressure to the insertion site for 10 to 20 minutes, to keep the site from bleeding.

Then you'll be taken to the recovery area or to your room. The nurse will apply a dressing or a small sandbag over the site.

You'll need to lie flat on your back for 4 to 6 hours, so that the insertion site can begin to heal properly. During that time, do not bend or lift the leg where the catheters were put in. To help prevent stiffness, you may move your foot or wiggle your toes.

The nurse will check your pulse and blood pressure often, and will also check the insertion site for bleeding. If you feel sudden pain at the site or if you notice bleeding, let the nurse know right away.

The doctor may be able to discuss with you some of the findings soon after the procedure. However, a complete analysis of the study will take more time.

Depending upon the results, you may be sent home several hours after the procedure, or the next day. Some patients may need to stay for more tests or treatments. When it's time to go home, have a friend or family member drive you.

Slow Heart Rhythms

In some cases, the SA node fails to work as the heart's natural pacemaker. As a result, the heart may beat too slowly or it may pause for too long between beats. In other cases, the electrical impulses that travel along the conduction pathways are slowed down or blocked. This can cause the heartbeat to be very slow and unreliable (a condition known as heart block).

Symptoms of Arrhythmias

Arrhythmias can cause palpitations, lightheadedness, fainting spells, and other symptoms.

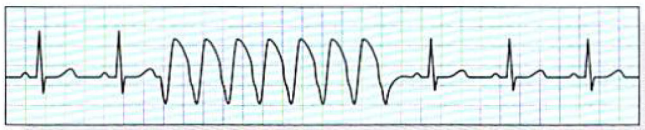
- **Palpitations** create an uncomfortable awareness of the heartbeat. People with tachycardia most often describe their palpitations as a "racing heart" or as "thumping or fluttering" in the chest.
- **Near-syncope** is a feeling of severe lightheadedness, dizziness, and weakness, as if you were about to pass out. The feeling usually lasts for only a few seconds.
- **Syncope**, or fainting spell, happens when the heart is not able to pump enough oxygen-rich blood to the brain. Syncope can be caused by the heart beating too fast or too slowly.
- Arrhythmias may also cause **other symptoms**, such as chest pain, shortness of breath, or tiredness.

Your Medical Evaluation

If your doctor thinks you might have an arrhythmia, he or she may order one or more of these tests:

- An **electrocardiogram**, or **ECG**, is a simple test that records the electrical activity of your heart. The heart's electrical impulses cause a needle to trace the heartbeat as a wavy line on a sheet of paper. By examining the sequence of events on the tracing, doctors are able to diagnose arrhythmias.

An ECG recording of a normal heart rhythm at rest.



An ECG recording of an arrhythmia.

- **Holter monitoring** is a continuous recording of your ECG, usually for 24 hours, while you go about your normal daily activities. The recorder is small and portable. The test is especially useful for detecting arrhythmias that may not appear during a resting ECG at the doctor's office.
- An **echocardiogram** uses ultrasound waves to create an image of the heart and the pattern of blood flow through it. It is a safe, painless test that can help doctors find out whether an arrhythmia is linked to a specific heart problem.

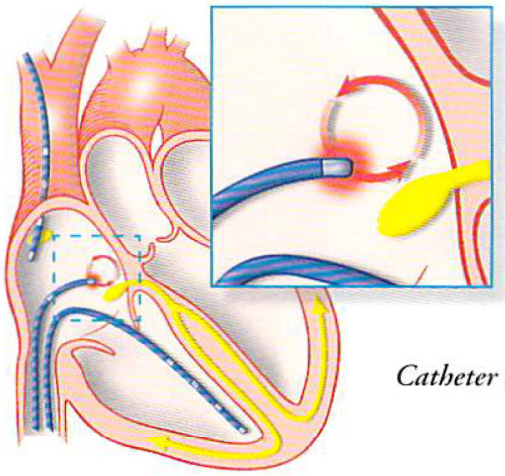
Catheter Ablation

Your doctor may decide to perform catheter ablation while you are still in the lab (you will be told about this ahead of time).

Catheter ablation is a non-surgical procedure used to **ablate** (destroy) parts of an abnormal electrical pathway that is causing a rapid heart rhythm.

Catheter ablation is very similar to an EP study. The main difference between the two is that the EP study is done to *diagnose* your arrhythmia, and catheter ablation is done to *treat* it.

During ablation, doctors insert a special electrode catheter into the heart. They place the catheter so that it lies close to the abnormal pathway. Then they pass radio-frequency (heat) energy through it. The tip of the catheter heats up and destroys the small area of heart tissue where the abnormal pathway is.



Catheter ablation

An arrhythmia brought on in the EP lab will often stop on its own. If it does not, doctors will pace the heart or give medication through the IV line to try to restore a normal heart rhythm.

If a very fast rhythm still does not stop, an electric shock may be delivered to the heart to restore a normal rhythm. You will not feel the shock because you will be sedated first.

An EP study usually takes from 1 to 4 hours, but it can sometimes last longer.

Is the EP Study Safe?

Because one or more catheters are put into the body, an EP study does have some risk. The ***risk is small***, however, and the test is generally safe.

Some people may have bleeding at the insertion site. Blood collects under the skin and causes swelling and/or bruising in the groin or arm.

More serious complications are rare. They include infection, blood clots, damage to the heart or blood vessels, collapsed lung, stroke, or heart attack. Death is very rare.

Most patients who have an EP study do not have serious complications. However, you should be aware of the risk involved. If you have any questions about your own risk, ask your doctor.

- **Tilt table testing** helps determine how the body responds to changes in body position. It is used for patients who have had syncope (fainting spells). The patient lies on a table that can be moved to a nearly upright position while the heart rate, blood pressure, and symptoms are monitored.

Why Do an EP Study?

If these basic tests do not give your doctor all the information he or she needs, you may be a candidate for an EP study. The EP study provides the most accurate and detailed information about how your heart's electrical system is working.

In general, the EP study is done for one or more of the following reasons:

- to diagnose the cause of your symptoms, such as palpitations, lightheadedness, or fainting spells
- to pinpoint the location of a known arrhythmia and decide the best treatment
- to see how severe an arrhythmia is and predict the risk of a future cardiac event, such as dying from a heart-related problem
- to see how well certain medications are working to control an arrhythmia
- to decide whether you need an implantable device (such as a pacemaker or defibrillator) or a treatment procedure (such as catheter ablation)

Preparing for the EP Study

Unless you are already in the hospital, you will most likely be asked to arrive in the morning on the day of the EP study, or perhaps the night before.

You may have several routine tests, such as an ECG, x-rays, and blood tests. (These tests may be done a few days before the EP study.)

The doctor will review your medical history and examine you. (You may see the doctor at the office several days before the test.)

The doctor or nurse will talk with you about the test and its purpose, benefits, and risks. This is a good time to ask questions and, most important, to share any concerns you may have. You will then be asked to sign a consent form.

A nurse will shave and cleanse the area where the catheters will be inserted. This is usually at the groin (the fold between the thigh and abdomen). In some cases it may be at the arm, shoulder, or neck. Shaving and cleansing makes it easier to insert the catheters and helps to prevent infection.

An intravenous (IV) line will be inserted into a vein in your arm. This line allows drugs to be injected directly into the vein, if they are needed. To help you relax, you'll be given a sedative.

Inducing arrhythmias in the EP lab *allows doctors to test how well medications help your heart rhythm problem*. For example, if an arrhythmia can no longer be brought on after you're given a medication, it is likely that taking this medication will prevent similar arrhythmias in the future.

The EP study also *helps determine the exact location of abnormal electrical pathways*. For example, in patients with tachycardia, several electrode catheters are inserted into the heart to help pinpoint where the abnormal pathway is. This is called "**mapping**."

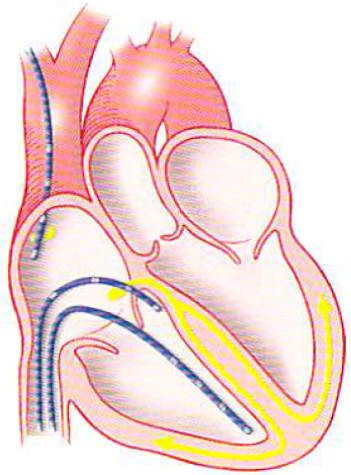
The results of your EP study can *help your doctor decide which treatment would be best for you*.

What You Can Expect

You will be given medication to help you relax and make you drowsy. You may be awake, or you may sleep through part or all of the test. The staff will be monitoring you at all times.

The EP study generally is *not painful*, although you may feel some pressure as the catheters are put in. You may also feel some discomfort from lying still for a long time.

During the study, doctors may stimulate your heart with tiny electrical impulses. You will not feel these impulses, but they may bring on the arrhythmia that has caused your symptoms in the past. Let the staff know if you feel palpitations, lightheadedness, chest pain, shortness of breath, or other symptoms.



Electrode catheters inside the heart

One or more catheters are inserted into the body and moved toward the heart, while the staff watches their progress on a television screen. The catheters are then put in place inside the heart chambers.

How Is the EP Study Done?

In general terms, the EP study is performed by doing two basic things:

- *Recording Electrical Signals.* Electrode catheters sense electrical activity in areas of the heart and measure how fast these impulses travel.
- *Pacing the Heart.* Electrode catheters can also be used to deliver tiny electrical impulses to **pace** the heart (cause it to beat). By pacing the heart, doctors can **induce** (bring on) certain arrhythmias so that they can be watched in the EP lab.

Before the Procedure

- Generally, **you'll be asked not to eat or drink anything** for 6 to 8 hours before the EP study. This helps prevent nausea. You may have small sips of water to take your medications.
- Check with your doctor several days before the EP study. **You may be asked to stop some medications** (such as antiarrhythmic drugs) for 2 or 3 days before the test.
- **Make arrangements** with a friend or family member to drive you to and from the hospital. You won't be permitted to drive home after the test, since you may be sedated.
- **Pack a small bag for your hospital stay.** You may want to include a robe, slippers, pajamas or nightgown, and toiletries.
- **Bring a list of the names and dosages of all the medications** you are taking.
- **Tell the doctor or nurse** if you have had any reactions to medications or anesthesia, or if you have a history of bleeding problems.
- Because the EP study can take several hours, **be sure to empty your bladder** beforehand. There will also be a bedpan or a urinal, should you need it during the test. (In some cases, a urinary catheter may be inserted to drain your bladder during the test.)

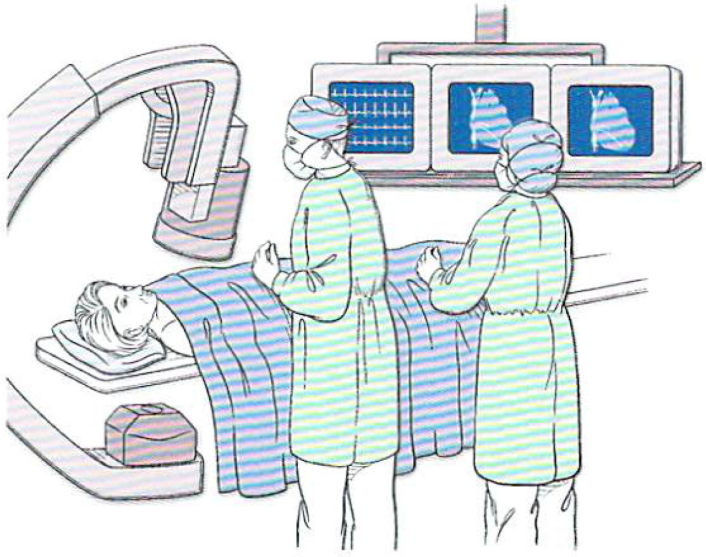
During the EP Study

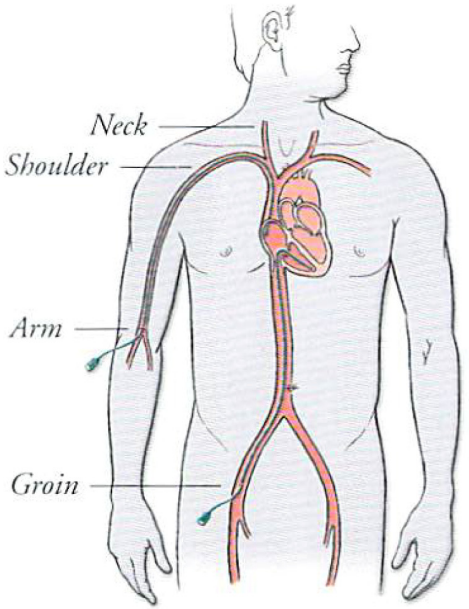
The EP study is done in a special room, called an electrophysiology lab, or **EP lab**.

You will be taken to the EP lab in a wheelchair or on a movable bed. Then you'll be helped on to an x-ray table. The table has a large x-ray camera above it and television screens close by. There also are heart monitors and other instruments.

The EP lab team usually includes a specially trained doctor (electrophysiologist), an assistant, nurses, and technologists.

Once you are positioned on the x-ray table, you will be connected to several monitors and then covered with sterile sheets. The staff will be wearing sterile gowns, gloves, and possibly masks.





Possible sites where the catheters are inserted

What Happens During the EP Study?

The site where the catheters will be inserted (usually the groin; sometimes the arm, shoulder, or neck) is cleansed with an antiseptic solution. A local anesthetic is then injected into the skin with a tiny needle to numb the area. This may cause a stinging sensation.

A small incision is made in the skin, and a needle is used to puncture the blood vessel (usually a vein, occasionally an artery) where one or more catheters will be inserted.

The special **electrode catheters** used during the EP study are long, flexible wires that carry electrical impulses to and from the heart.