

Electrophysiology

To diagnose and treat arrhythmias

This handout explains arrhythmias, an irregular or timing problem in the heart's electrical system. It describes electrophysiology studies that are used to diagnose the issue and various treatment options.

What is electrophysiology?

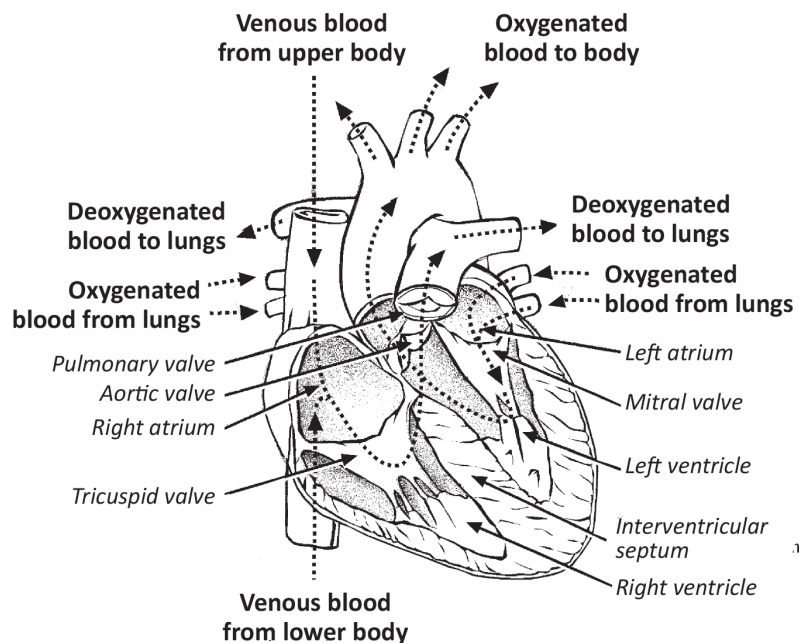
The word *electrophysiology* is made up of 2 words: *electro*, which means “electric” or “electricity,” and *physiology*, which is the study of how a physical body works. An electrophysiology (EP) study measures the electrical signals inside the heart.

What are arrhythmias?

The heartbeat rhythm is usually regular. But, sometimes a “timing problem” in the heart’s electrical system causes very slow, rapid, or irregular heartbeats. These are called *arrhythmias*.

If arrhythmia occurs, it is important to find out what area of the heart is involved. Most times, arrhythmias come from either:

- The left or right *ventricle* (lower pumping chamber); or
- The left or right *atrium* (above the ventricles)



How blood flows through the heart.

Types of Arrhythmia

Premature Ventricular Contractions

Premature ventricular contractions (PVCs) are the most common type of arrhythmia. They occur when an area in the heart's ventricle fires too early or out of turn. These premature beats are often referred to as "skipped" or "extra" beats. If PVCs occur often or in groups, you may feel palpitations or a fluttering in your chest. If this occurs, call your doctor.

PVCs may be caused by too much caffeine, tobacco, or alcohol. They may also occur when you are nervous or very tired.

Tachycardia

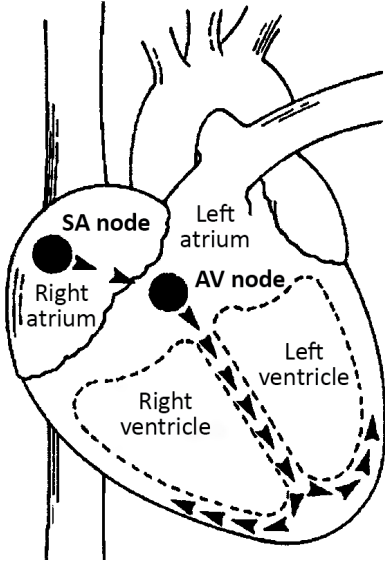
Tachycardia (rapid heart beat) may start above the ventricles, producing *supra ventricular tachycardia* (SVT) or, within the ventricles, producing *ventricular tachycardia* (VT). Patients with tachycardia may have symptoms such as:

- Feeling lightheaded
- Dizziness
- Heart palpitations
- Chest discomfort
- Sweating

Medical treatment may be needed if tachycardia episodes last a long time, occur often, or involve very rapid heart rates. Treatment depends on the cause of the rapid heartbeat. The doctor may prescribe medicines, an implanted device, diagnostic studies, or surgery.

There are many types of SVTs. Among them are:

- **Atrial fibrillation/flutter:** An abnormal, usually irregular rapid rhythm, which starts in the upper chambers of the heart.
- **Ectopic atrial tachycardia (EAT):** A rapid rhythm starting from a single focus in the atrium, not the sinoatrial (SA) node.
- **Atrioventricular nodal re-entry tachycardia (AVNRT):** A fast rhythm resulting from the presence of a "short circuit" **near** the atrioventricular (AV) node, which allows a circular rhythm pattern to occur.
- **Wolff-Parkinson White syndrome:** An abnormally fast rhythm that occurs when an electrical pathway uses both the normal AV node and an abnormal extra pathway between the atria and ventricles.



The pumping action of the heart is controlled by an electrical system inside the heart itself. The SA node emits electrical impulses that cause the atria to contract. The AV node emits electrical impulses that cause the ventricles to contract.

Ventricular Fibrillation

Ventricular fibrillation (VF) is also called cardiac arrest, sudden cardiac death, or VF arrest. It is a chaotic electrical pattern that causes the heart to *fibrillate* (quiver). As a result, your heart suddenly stops pumping blood, causing you to lose consciousness. This condition requires *cardiopulmonary resuscitation* (CPR) right away, until an electric shock (*defibrillation*) can restore the normal heartbeat. Ventricular fibrillation is **not** the same as a heart attack.

Why do I need an electrophysiology study?

An electrophysiology (EP) study is done for one of these reasons:

- To diagnose an abnormal heart rhythm
- To help doctors determine the best treatment for heart arrhythmia
- To check how well antiarrhythmic drugs are working.

What happens during an EP study?

An EP study uses the same methods that we use for a heart catheterization. Your doctor will insert 2 or more *catheters* (long, narrow, flexible tubes) into a blood vessel in your groin and/or shoulder.

Before the Study

- The night before your EP study, do **not** eat or drink anything after midnight. You may take sips of water with prescribed medicines.
- We will take routine blood tests and check your blood levels of any antiarrhythmic medicines you may be taking.
- *Women:* Tell the doctor or nurse if there is **any** chance that you may be pregnant.

What to Expect

The EP lab is usually cool. You will see large equipment in the room.

We will first ask you to lie on your back. We will then connect you to 2 heart monitors, an ECG (*electrocardiogram*) machine, and an oxygen monitoring device.

The EP study is done under germ-free (*sterile*) conditions. We will shave the insertion sites and apply an antiseptic solution. We will cover you with sterile drapes. Only the area where the catheters will be inserted are open to the air.

A machine called a *fluoroscope* will be placed over you. This machine takes special X-rays that will help your doctor can guide the catheters into your heart.

We will give you medicine to make you comfortable during the procedure. Before the catheters are inserted, we will use a *local anesthetic* to numb the skin around the blood vessel. Patients often say this insertion feels like a bee sting.

After the anesthetic takes effect, you should only sense a slight pressure where the doctor is working. Your doctor will use the fluoroscope to carefully guide the catheters to your heart. Most patients do not feel the presence of the catheter in the heart.

Once the catheter is positioned in your heart, we will start to measure your heart's electrical activity. One of the catheters will be used as a pacemaker to control your heart rhythm. You may feel your heart beating faster when the doctor turns on the pacemaker. This may cause your arrhythmia to occur. This rhythm may return to normal on its own, or we may need to use *electrical pacing* to interrupt the rhythm, or an electric shock (defibrillation) to restore the heart's normal rhythm. If your arrhythmia is triggered, you may feel the same symptoms you have had in the past.

If you feel any pain, chest pressure, nausea, or dizziness, please tell your doctor. We will treat these symptoms right away.

After we have the information we need, the doctor will remove the catheters. To prevent bleeding, we will then apply firm pressure to the insertion site for about 5 minutes.

After the Study

You will need to keep your leg straight and lie flat when the catheters are in your groin. You will need to hold this position for 4 to 6 hours after the catheters are removed. This will prevent bruising or bleeding. You may lie on either side, as long as you keep your leg straight.

Once you return to your room, your nurse will check often for bleeding at the catheter insertion site. We will also check your heart rhythm and blood pressure. Your doctor will come to talk with you and your support person after the test. You may eat and drink after the procedure.

How are arrhythmias treated?

Medicines

Your doctor may prescribe an *antiarrhythmic drug* to help control your heart's rhythm. This drug may be used alone or along with other treatments, such as surgery or an implanted device.

If you receive an antiarrhythmic drug, we may do a blood test from time to time to check how much of the drug is in your system. We may also do other tests regularly to make sure the drugs are working well for you. These tests may include *electrocardiograms* (ECGs), Holter monitor recordings, chest X-rays, eye exams, and breathing tests.

Permanent Pacemaker

A permanent pacemaker may be implanted to control a very slow heart rhythm. A small incision is made just beneath the collarbone, usually on the left side. An *electrode* (soft wire) is inserted into a vein and then advanced to the right ventricle of the heart. Some patients need an extra electrode for the right atrium. Electrodes are connected to a battery-powered pulse generator, which is placed under the skin.

The procedure takes 1 to 4 hours to complete. You will receive a local anesthetic and medicine to help you relax, but you will be awake.

After the pacemaker is implanted, you will return to your room, where we will monitor your heart rhythm. To lessen the risk of dislodging the electrode, your doctor may order an arm sling or bed rest, or both. We may also ask you not to raise your arm more than 90 degrees as you recover from the procedure.

Implantable Defibrillator System

The *implantable defibrillator system* (IDS) is a device to treat life-threatening heart rhythms. It is used to treat patients with *symptomatic or uncontrollable ventricular tachycardia* (VT). It is also used to protect patients who have had a cardiac arrest or ventricular fibrillation (VF). When the defibrillator detects VT or VF, it delivers an electric current to your heart to try to restore normal rhythm.

Different companies make defibrillator. Each type may have a different name or slightly different programming.

A defibrillator system has 2 main parts:

- A *pulse generator* that monitors your heart rhythm
- A *lead system* that connects the generator to your heart

The pulse generator is usually implanted under the skin or muscles below your left collarbone. When the device detects an arrhythmia, it sends an electrical current to your heart to restore a more normal rhythm. The therapy is either a pre-programmed pacing therapy, or an “internal” shock.

An IDS is implanted in the operating room under general anesthesia. During the procedure, your doctor will trigger your arrhythmia to make sure the device will detect it and treat it correctly.

Catheter Ablation Procedure

People with Wolff-Parkinson-White (WPW) syndrome and AVNRT have an *accessory* (extra) pathway between the atrium and the ventricle. This may cause very fast heartbeats called *supra-ventricular tachycardias* (SVTs). If these SVTs happen rarely, your doctor may prescribe medicines to control them.

If SVTs happen more often, your doctor may advise you have a *catheter ablation*. This procedure is done by using radiofrequency energy to interrupt the extra pathway that allows SVT to occur.

An extra pathway can sometimes be seen on an ECG, but we will need to do an EP study to find its exact location.

Catheter ablation is like an EP study. You will have catheters placed in your groin and in a vessel below your collarbone. This is done so that a special catheter can be directed to the precise location of the extra pathway. Radiofrequency waves are sent through this catheter.

These waves cause scarring to form, which stops impulses from traveling over this pathway. The procedure lasts about 4 to 8 hours. You will receive *sedation* medicine to help you stay calm and relaxed.

After the procedure, we will take a chest X-ray. We may also do an ECG the next day to check the results of the procedure.

As with an EP study, you will need to lie flat in bed for 4 to 6 hours. You may feel sleepy when you return to your room. If you wish, you may eat and drink liquids.

Follow-up After Your EP Study

Your follow-up visits will be with your regular cardiologist. Call your doctor if you:

- Have tachycardia
- Feel dizzy
- Feel lightheaded
- Feel like you might pass out

If You Have a Defibrillator Implanted

- **Any time you receive a shock from your defibrillator, call your doctor right away.**
- A computer programmer in the cardiology diagnostic center will need to check your device every 3 or 4 months. We will tell you what schedule to follow.

Questions?

Your questions are important. Call your doctor or healthcare provider if you have questions or concerns.

Cardiology Clinic:
206.598.4300

Electrophysiology Lab:
206.598.4555

After hours, call 206.598.6190 and ask to page the EPS fellow on call or the EPS attending doctor.