Normal Conduction

The Normal Heart

Your heart normally beats about 100,000 times a day, which translates to 60-100 beats per minute. It does this in an orderly fashion, controlled by a steady stream of electrical impulses.

The heart consists of two upper chambers, called the atria, and two lower chambers, called the ventricles. Electrical impulses that coordinate the heart’s contractions originate at the sinoatrial node - also called the sinus node or SA node.

The SA node is a bundle of highly specialized cells in the right atrium. The signal passes through the right and left atria, resulting in contraction. When the atria contract, oxygen-rich blood is pushed into the ventricles. Then the atrioventricular node, or AV node, receives the signal and passes it into the ventricles, which results in them to contract. When the
Ventricles contract, blood is pumped out of the heart into the body.

**Abnormal heart rhythm - Arrhythmia**

Sometimes, however, the flow of electrical signal changes or there is a rhythm disturbance. There may be signals moving out too quickly, or it may send out extra signals. In other cases, the signals bounce around inside one of the heart’s chambers instead of moving on in a regular pattern.

This results in a fast or irregular heartbeat. These abnormal rhythms are called arrhythmias (pronounced: uh - rith - mee - uhs). When the heart beats erratically, it does not pump blood as efficiently as it should, shortchanging the delivery of oxygen throughout the body.

When this abnormal rhythm results in a heart rate that is faster than normal, it is called tachycardia. Tachycardias are given different names depending on where the abnormal signal originated. For example:

- When the SA node in the right atrium misfires, the resulting abnormal rhythms are called atrial arrhythmias or atrial tachycardias.

- Abnormal rhythms that arise from the AV node are called ventricular tachycardias.

- Sometimes the abnormal signals bounce around inside one of the heart’s chambers; this is called a re-entrant tachycardia.

- Arrhythmias that originate at the SA node or in the atria are also sometimes called
supraventricular (literally, “above the ventricles”) tachycardias; they may affect both the atria and the ventricles.

We do not yet fully understand what causes the heart’s electrical system to misfire. Tachycardias occur often among people who have had previous heart trouble, particularly those whose heart has been damaged by a heart attack or surgery. They are also common in people over the age of 65 years.

Most arrhythmias are harmless and occur in people with healthy hearts. Some are a natural response, such as the heart beating faster in order to meet your body’s demand for increased oxygen when you exercise. But sometimes they are dangerous - and can even be fatal.

Some patients with fast and rapid heart rates have no symptoms, while others are severely impaired. Symptoms cover a wide range, from feeling lightheaded to sudden cardiac death.

**Symptoms**

Symptoms are caused by the lack of steady blood flow to the body and can include:

- Palpitations
- Shortness of breath
- Chest pain
- Dizziness
- Lightheadedness
- Fainting (syncope)
Diagnosis

In order to diagnose an arrhythmia, doctors order specific tests, depending on the type of arrhythmia that is suspected. In addition to blood tests, your doctor may order:

- **Echocardiogram**
- **24-hour electrocardiogram, or ECG** (in which you wear a vest-like device called a Holter monitor during normal activity)
- **Electrophysiology study** (used to locate the origin of the rhythm disorder and determine the best treatment)

Treatment

Some palpitations are very brief or mild and do not pose a serious threat. Others require long-term treatment, and some are life-threatening. The
treatment depends on the type of disorder - its frequency, duration, symptoms, and associated risks. Treatment decisions should also take into account any underlying heart conditions.

In very severe and life-threatening palpitations, emergency treatment to restore normal rhythm immediately may be done via electrical shock from a defibrillator or through the use of drugs.

For less-severe conditions whose symptoms are bothersome, long-term treatment is needed. It usually involves the use of medications to stabilize the heartbeat.

- **Antiarrhythmic agents to maintain the heart’s normal rhythm**
- **Beta-blockers to slow the heart rate**
- **Calcium channel blockers to slow the heart rate and suppress tachycardias**

Certain types of arrhythmias, such as atrial fibrillation, come with a high risk of stroke, and patients should also receive blood thinners.

Specialized treatments have recently been developed to restore the heart's normal rhythm and reduce the risks that accompany heart rhythm disorders. These include:

- **Implantable cardioverter-defibrillator (ICD)**: This is a device which is inserted into the patient’s chest, like a pacemaker. ICDs are the treatment of choice for ventricular tachycardia; when an episode begins, the device delivers a shock to end the tachycardia. This prevents the
heart from going into ventricular fibrillation, which is frequently fatal.

- **Catheter ablation:** This specialized procedure is the treatment of choice for most cardiac rhythm disorders like supraventricular tachycardias, including atrial flutter and Wolff-Parkinson-White syndrome. Also called radiofrequency ablation, it is increasingly being used today for ventricular tachycardia, and is under investigational studies for treatment of atrial fibrillation as well. This treatment involves the placement of tiny wires called catheters inside the heart, where they deliver high-energy waves that destroy the areas causing the abnormal rhythm, preventing further triggering of tachycardia.

"Most cardiac arrhythmias can be treated and cured with radiofrequency ablation, eliminating the need for lifelong drug therapy." It is very important to consult your physician for better advise in this regard or meet the cardiology specialist called Electrophysiologist.

### Select the better treatment option for Cardiac Arrhythmias

If you or a member of your family is diagnosed with irregular heart beats or palpitation, today you have the option to undergo an Electrophysiology study for better diagnosis.

A problem anywhere along the electrical pathway causes an arrhythmia, or heart rhythm disturbance. By accurately diagnosing the precise cause of an arrhythmia, it is possible to select the best possible treatment option.
The Human Heart

What is an EP Study

An electrophysiology (EP) study is a specialized procedure conducted by a highly trained cardiac specialist, the electrophysiologist. In this procedure, one or more thin, flexible wires, called catheters, are inserted into a blood vessel (usually in the groin) and guided into the heart. Each catheter has one or more electrodes to measure the heart's electrical signals as they travel from one chamber to another.

EP studies are done to diagnose the cause and source of such cardiac rhythm disorder and to pinpoint the site where therapy may be useful. Two different reports can be created from this test:

- An electrogram, which is like an electrocardiogram (ECG) of the inside of the heart. It shows the abnormal signals where they start and how they move around inside the heart.
- A map of the heart's electrical activity.
In an ECG, sensors are attached to your chest. In an electrogram, the sensors (electrodes) are inside your heart.

The latest technology combines an electrical map of the heart with the patient's CT or MRI scan. This gives the electrophysiologist a three-dimensional view of the patient's heart.

If you do not experience any abnormal rhythm during the EP test, the electrophysiologist can stimulate the arrhythmia with the electrodes on the catheter. They are also used to help evaluate the effectiveness of some medications in controlling the abnormal rhythm and to assess the need for a device such as a pacemaker or defibrillator (also known as an implantable cardioverter defibrillator, or ICD).

EP studies have been performed safely for many years; complications are very rare.

**Preparing for the EP study**

- Your doctor will tell you ahead of time whether to stop taking any of your medications. Do not modify your medications without consulting your doctor.
  - You will have to sign an Informed Consent form, which details any risks or problems that may occur.
  - Usually, your doctor will tell you not to eat or drink for 6 to 8 hours before the test.
  - The area where the catheter will be inserted will be thoroughly cleaned and shaved. This is usually in the groin and or in the neck region.
You will receive a local anesthetic in that area.

- You will be given a mild sedative.

- The EP Study requires that you have an empty stomach unless you are told otherwise.

- It is also important to let your doctor know if you are allergic to any particular medicine.

**During the EP study**

A team of people will work together to assist in the procedure and assure your safety. Besides the electrophysiologist (or EP, who is a physician), there will be specially trained healthcare technicians and nurses to assist the EP and to monitor your condition.

EP studies are carried out in a specially equipped lab that resembles an operating room. The same precautions for maintaining a sterile environment will be followed.
The EP lab features a lot of equipment including a type of x-ray system called fluoroscopy. The EP will watch a screen to follow the catheter as it is advanced through your blood vessel and into your heart.

You will lie flat on the surgical table, covered with surgical drapes, except for the area where the catheter will be inserted. You will have an IV in your arm to deliver medications as needed. You will be given a local anesthetic at the point where the catheter will be inserted. There will be a small amount of bleeding at the site, but it will be controlled and there is no danger to you.

EP studies are usually done with “conscious sedation” that is, you will be given medication to relax, but will not be put under general anesthesia. Your doctor will talk to you ahead of time about the level of anesthesia planned for you.

You will be awake, but you must remain still during the procedure. Some patients fall asleep, while others watch the monitors and ask questions.
The procedure involves insertion of a catheter - a narrow flexible tube attached to electricity monitoring electrodes, into a blood vessel, often through a site in the groin or neck, and winding the catheter wire up into the heart. The journey from entry point to heart muscle is navigated by images created by a fluoroscope, an x-ray machine provides "live or real time" images of the catheter positioning, its movement and the heart muscle. The electrodes at the tip of the catheter gather data and a variety of electrical measurements are performed. This data helps in pinpointing the faulty electrical site. **During this "electrical mapping" the electrophysiologist, may instigate, through pacing [the use of tiny electrical impulses] some of the very arrhythmias that are the cause of the disorder. The events are safe, given the range of experts and resources close at hand and are necessary to ensure the precise location of the problematic tissue. Once the damaged site or sites are identified the EP may administer medications or electrical impulses to aid in evaluating your heart's rhythm.**
Patients seldom complain of pain, although you may have a somewhat unpleasant sensation in your chest.

The EP study usually takes 1-2 hours. If other procedures are done immediately, your time in the EP lab will be longer, up to 6 hours in some cases.

**After the EP study**

- If the results of the EP study lead to the conclusion that catheter ablation is the right treatment option, the procedure is usually done immediately.

- Whether or not you undergo another procedure, you need to remain still for 4-6 hours afterward. This should help the incision where the catheter was inserted to aid healing properly. It is normal to have a small lump (about the size of a walnut) at the site. Contact your doctor right away if you experience bleeding, bruising or pain at the insertion site or if you develop a fever over 100°F.

- Once you can get up and move around, you may feel stiff from lying still for so long.

- Some doctors want to keep patients overnight to monitor their heart rhythm particularly if another procedure was done. If you are discharged from the hospital the same day, you should arrange for someone else to drive you home.
What are the potential risks of EP Studies?

The EP Study is a low-risk procedure that has been performed in heart centres for many years. The information it provides may be vital to your life. The potential risks of having an EP Study are similar to those of having a cardiac catheterization. These procedures are relatively safe, but because they are invasive procedures involving the heart, several complications are possible. You should not have an EP Study unless there is a reasonable likelihood that the information gained from the procedure will be of significant benefit.

Minor complications include minor bleeding at the site of catheter insertion, temporary heart rhythm disturbances caused by the catheter irritating the heart muscle and temporary changes in blood pressure.

More significant complications include perforation of the heart wall (causing a life-threatening condition called "cardiac tamponade") extensive bleeding or (because potentially lethal arrhythmias are being induced) cardiac arrest. The risk of dying from an EP study is less than 1 out of 1,000.

Sources:
What is Catheter Ablation

More than likely, your doctor has recommended that you undergo catheter ablation because other treatments that have been prescribed for your arrhythmia have not provided the relief you need. In catheter ablation, the electrode delivers a low-voltage, high-frequency current that destroys the heart tissue responsible for the arrhythmia.

The majority of people who have a catheter ablation experience either:

- A long-term reduction in the number of episodes of arrhythmia and the severity of symptoms, or
- A permanent return to normal heart rhythm

This means that medicines for controlling heart rate or rhythm may be stopped or reduced following successful catheter ablation. Do not modify your medications without consulting your doctor. Catheter ablation is considered safe and is not associated with a significant risk, so the chance of experiencing complications is very low. For example, the overall rate of complications of catheter ablation for atrial flutter is 1.2%¹. That's comparable to the risk of tubal ligation (1-2%)² and much lower than the risk of appendectomy (18%)³. The electrophysiologist will discuss any particular risks with you before the procedure.

The procedure always begin with an electrophysiology (EP) study.


**Preparing for catheter ablation**

- Your doctor will tell you ahead of time whether to stop taking any of your medications. Do not modify your medications without consulting your doctor.
- You will have to sign an Informed Consent form, which details any risks or problems that may occur.
- Usually, your doctor will tell you not to eat or drink for 6 to 8 hours before the test.
- The area where the catheter will be inserted will be thoroughly cleaned and shaved. This is usually in the groin, but may be in the neck. You will receive a local anesthetic in that area.
- The catheters will then be inserted; you may initially feel some pressure at the site of insertion.
- You will be given a mild sedative.

**During catheter ablation**

The EP and other healthcare specialists in the lab will use a variety of imaging and monitoring systems to help them navigate the catheters to your heart, locate the precise location for the ablation, and
evaluate their progress.

Also, depending on your anatomy, some specialists will take extra steps to avoid damaging tissue near your esophagus. They may ask you to drink a creamy substance to help the esophagus show up better on the x-ray.

Catheter ablation uses a series of thin, flexible wires (catheters) that are inserted through an artery or a vein (usually in the groin or neck) and guided to the heart.

The position of the catheters can be seen using fluoroscopy, a special monitoring technique that uses x-rays.

Once in the heart, one or more of the catheters are used to pinpoint the source of the abnormal electrical signals.

Medications will be given to increase your heart rate. You may also be given a drug or electrical stimulation to bring on the abnormal rhythm. This will help the doctor identify the areas of the heart producing the arrhythmia.

Some patients may feel temporary chest discomfort during the procedure. If that happens to you, be sure to tell the doctor, who can give you medication to relieve it.

When the EP has located the source of your arrhythmia, he or she moves another catheter to the site. That catheter delivers bursts of high-energy waves that ablate, or destroy, the abnormal areas. This creates a small scar (called a “lesion”) which prevents electrical signals from passing through.
Catheter used for ablation

After ablating the problem areas, the doctor will try to re-start your arrhythmia. If the abnormal rhythm cannot be induced in this way, then the procedure is a success. If a fast rhythm does return, further ablation may be needed.

The whole procedure (including the EP study and mapping) may take several hours.

After catheter ablation

Immediately after the procedure, the catheters will be removed and pressure will be applied to the insertion site to minimize or prevent bleeding; a bandage may be applied.

It is important to remain still during this time and to not move or bend your leg.

Generally, you will stay in bed for some hours or overnight after the procedure for observation and go home the next day. Once you can get up and move around, you may feel stiff from lying still for so long.
At home, you will need to limit your activity for several days and avoid all strenuous physical activity. Most people can return to their normal routine within a few days.

It is common to have a small bruise or lump (about the size of a walnut) at the site of catheter insertion, but you should contact your doctor immediately if the spot becomes warm, tender, or painful, or if it swells. You should also contact your doctor immediately if you experience fever, dizziness, or any other symptoms.

Be certain to carefully follow your doctor’s instructions regarding any medications and follow-up appointments.

Ref:

For more information
Heart Rhythm Society
www.hrspatients.org

American Heart Association
www.americanheart.org

National Institutes of Health

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Work Profile  
- Working in CIMS Ahmedabad and visiting tertiary care centers nationally  
- Many publications in major international and national journals  
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- National and International faculty for Cardiac Electrophysiology