

Electrophysiological Studies and Catheter Ablation

An electrophysiological study (often called EPS) is a procedure that examines the electrical function of the heart to determine the source and mechanism of abnormal heart rhythms (called arrhythmias). The heart is a muscle pump, and the function of this pump is controlled by electrical activity which spreads across the heart and causes it contract.

An EPS involves using X rays to position small plastic wires (called catheters) through the venous blood vessels (from the groin) into various chambers of the heart. These catheters are equipped with metallic tips and rings (called electrodes) which allow them to detect electrical activity in the heart muscle. By interpreting the pattern of electrical signals detected by the catheters, the mechanism of the arrhythmia can be determined and a treatment strategy devised (usually with catheter ablation – see below).

Why is it done?

Your doctor may recommend that you have an electrophysiological study if you have:

- Symptoms of racing heart (palpitations) and (usually) evidence of an abnormal fast rhythm captured on an electrical trace (electrocardiograph or ECG). Conditions which commonly indicate an electrophysiological study include:
 - Supra-ventricular tachycardia (or SVT)
 - Ventricular tachycardia (or VT)
- Abnormal findings on a resting ECG and the suspicion of arrhythmia
- Un-explained collapses or loss of consciousness and the suspicion of an arrhythmia

Because there's a small risk of complications, electrophysiological studies are usually only performed where there is a high suspicion of an arrhythmia that can be treated by ablation, or where the results will change your management.

Catheter Ablation

Once the arrhythmia and its mechanism have been identified during the electrophysiological study, the culprit is usually an abnormal electrical connection, or a small area (or foci) of abnormal electrical activity. The treatment is to use a special type of catheter (called an ablation catheter) to deliver a small amount of targeted heat energy this area. This disrupts this pathway or focus (permanently) and can eliminate the cause of the arrhythmia. The vast majority of electrophysiological studies will involve an ablation of the arrhythmia source.

Risks

As with most procedures done on your heart, an electrophysiological study entails some risk, such as radiation exposure from the X-rays used. Major complications are extremely rare, though. Potential risks and complications include:

- Injury to the groin artery or vein
- Excessive bleeding

- Stroke or heart attack
- Damage to the electrical wiring (conduction system) of the heart requiring the need for a pacemaker
- Injury to the heart requiring urgent treatment or heart surgery

How you Prepare

Most electrophysiological studies are elective or scheduled in advance, giving you time to prepare. Electrophysiological studies are performed in the cardiac catheterization (cath) lab of a hospital. Your health care team will give you specific instructions and talk to you about any medications you take. General guidelines include:

- Usually, if you are on medications to suppress arrhythmias (called anti-arrhythmic medications), these need to be stopped at least 5-7 days prior to the procedure. Your doctor will advise you exactly which medication(s) to stop and when. This is necessary because during the EPS, the arrhythmia will usually need to be induced so its mechanism can be identified and the appropriate ablation performed.
- Don't eat or drink anything after midnight before your procedure.
- Take all your medications to the hospital with you in their original bottles. Ask your doctor about whether or not to take your usual morning medications.
- If you have diabetes, ask your doctor if you should take insulin or other oral medications before your procedure.
- If you are on blood-thinning medication, these sometimes need to be stopped beforehand. Ask your doctor about your blood thinners.

What you can expect?

Before the Procedure

Before your EPS procedure starts, your health care team will review your medical history, including allergies and medications you take. You'll also empty your bladder and change into a hospital gown. You may have to remove contact lenses, eyeglasses, jewellery and hairpins.

During the Procedure

For the procedure, you lie flat on your back on an X-ray table. X-ray cameras may move over and around your head and chest during the procedure.

An IV line is inserted into a vein in your arm. You will be given a sedative through the IV to help you relax, as well as other medications and fluids. You'll be very sleepy and may drift off to sleep during the procedure, but you'll still be able to be easily awakened to follow any instructions.

Electrodes on your chest monitor your heart throughout the procedure. An EPS usually involves a number of additional stickers and patches placed on over the chest. A blood pressure cuff tracks your blood pressure and another device, a pulse oximeter, measures the amount of oxygen in your blood.

A small amount of hair may be shaved from your groin where a flexible tube (catheter) will be inserted under ultra-sound guidance, and on your chest where electrode stickers must attach. The area is washed and disinfected and then numbed with an injection of local anaesthetic.

A small incision is made at the entry site, and 2 or 3 short plastic tubes (sheath) are inserted into your groin vein. The catheter is inserted through the sheath into your blood vessel and carefully threaded to your heart. There are no pain sensation nerves in the blood vessels so this is not painful so threading the catheter shouldn't cause pain, and you shouldn't feel it moving through your body. Tell your health care team if you have any discomfort.

The catheters are positioned in the heart. The catheters can also be used to stimulate the heart at different rates and timings to both test the electrical function of the heart, and to see if the abnormal rhythm can be induced. You may feel these paced beats and they do not cause pain or discomfort. Inducing the arrhythmia during an EPS is safe and usually desirable as it allows the mechanism of the arrhythmia to be determined, and provides a clear endpoint for the procedure after ablation. They do not cause any harm to your heart.

You will commonly feel your heart racing during this time, this is expected.

Often, to aid in inducing the arrhythmia, a medication called isoprenaline (a form of adrenaline) may be administered through the drip to stimulate the heart. This may cause a flushing sensation as well as sweating and palpitations. This is expected and is short-lived as the medication wears off very quickly. If you experience discomfort, please let the team know and we can make you more comfortable.

Occasionally an additional computer system called a 'mapping system' may be used to help treat more complex arrhythmias. This allows the catheters and the internal structure of the heart chambers to be visualised in 3D and real-time without the need for X-rays, so that the pattern of complex arrhythmias can be determined.

Usually ablation is required to treat the arrhythmia. This involves the delivery of a small amount of heat energy to the culprit electrical pathway. This usually occurs over a few minutes and occasionally may cause some mild chest discomfort. Additional analgesia will be given in anticipation of this.

Having an EPS, including catheter ablation takes between 60-120 minutes depending on how readily the arrhythmia can be induced and how much ablation is required. Preparation and post-procedure care can add more time.

After the Procedure

When the EPS is over, the catheters and plastic tubes are removed from your arm or groin and the incision is closed with manual pressure or occasionally a temporary stitch or an air-cushion clamp.

You'll be taken to a recovery area for observation and monitoring. When your condition is stable, you return to your own room, where you're monitored regularly.

You'll need to lie flat for a few hours to avoid bleeding. During this time, pressure may be applied to the incision to prevent bleeding and promote healing.

You may be able to go home the same day, or you may have to remain in the hospital overnight. Drink plenty of fluids to help flush the dye from your body. If you're feeling up to it, have something to eat.

Ask your health care team when to resume taking medications, bathing or showering, working, and doing other normal activities. Avoid strenuous activities and heavy lifting for several days.

Your puncture site is likely to remain tender for a while. It may be slightly bruised and have a small bump.

Call your doctor's office if:

- You notice bleeding, new bruising or swelling at the catheter site
- You develop increasing pain or discomfort at the catheter site
- Weakness or numbness in the leg or arm where the catheter was inserted
- You develop chest pain or shortness of breath

If the catheter site is actively bleeding and doesn't stop after you've applied pressure to the site, contact 000 or emergency medical services. If the catheter site suddenly begins to swell, contact 000 or emergency medical services.

Results

Outcomes

An EPS can diagnose many common cardiac arrhythmias and the accompanying ablation can treat the vast majority of these. The success rates depend on the type of arrhythmia being treated. These conditions include.

- The most common types of SVT (either AV nodal re-entry tachycardia (AVNRT) or atrio-ventricular re-entry tachycardia (AVRT)), have success rates after a single procedure of over 95% with no further need for ongoing anti-arrhythmic medications.
- In the less common arrhythmia caused by an over active focus (focal atrial or ventricular tachycardia), success rates vary from 60-90% depending on the location of the culprit focus. Occasionally a second procedure may be needed.
- Very rarely, an electrical pathway can be in an unsafe or dangerous location to ablate due to an undue risk of injury to cardiac structures (such as a coronary artery or the AV node). Your doctor will discuss alternative treatment options in this rare scenario.
- In cases where an EPS is performed as a purely diagnostic tool, the results can help diagnose rare conditions or help determine if a pacemaker or defibrillator may benefit you.