



## 电生理学

### 诊断及治疗心律失常

本讲义对心律失常、即心脏电系统不规则或定时问题做了解说。它说明了用于诊断该问题的电生理学测试及各种治疗方案。

### 什么是电生理学？

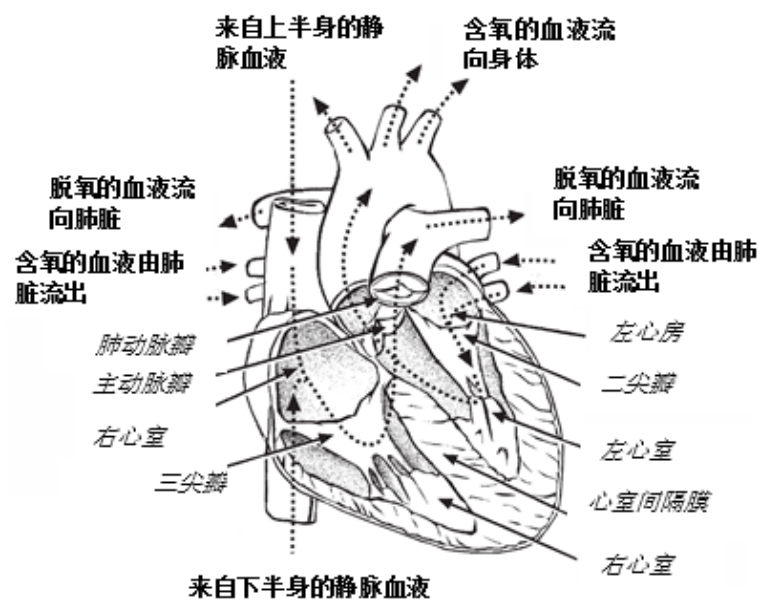
电生理学 这个词是由 2 个英文词组成的：电-*electro*，意思是“电的”或“电”，及生理-*physiology*，是研究人体如何运作的。电生理（EP）测试是测试心脏内部的电信号。

### 什么是心律失常？

心脏跳动的节奏通常是有规律的。但是，有时心脏电系统的“定时问题”会导致非常缓慢、快速或不规则的心跳。这些被称为心律失常。

如发生心律失常，关键是要找出是发生在心脏的那个部位。大多数情况下，心律失常来自其中之一：

- 左心室或右心室（下泵房）；或
- 左心房或右心房（在心室上方）



血液如何流经心脏

## 心律失常的类型

### 室性早搏

*室性早搏* (PVC) 是最常见的心律失常类型。在心脏的心室区域过早或失序时发生。这些早搏通常称为“跳过”或“额外”的搏动。如室性早搏经常发生或密集地发生，患者能会感到心悸或胸腔颤动。如发生这种情况，请与医生联系。

室性早搏可能是由于咖啡因过多、烟草或酒精引起的。它们也可能在紧张或非常疲倦时发生。

### 心动过速

*心动过速* (快速心跳) 可能从心室上方开始，产生*室上性心动过速* (SVT)，或在心室内产生*室性心动过速* (VT)。心动过速患者可能有以下的症状：

- 头重脚轻
- 头昏
- 心跳加速
- 胸部不适
- 出汗

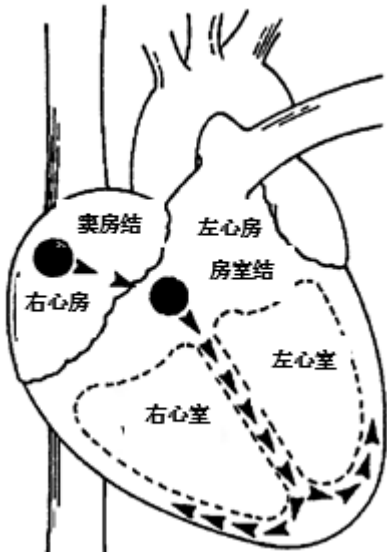
如心动过速发作持续的时间很长、经常发生、或涉及非常快的心率，则可能需要治疗。治疗方法取决于心动过速的原因。医生可能会开出药物、植入设备、诊断性测试或手术。

室上性心动过速 (SVTs) 有许多类型，其中包括：

- **心房颤动/扑动**：一种异常的、通常是不规则的快速心律，始于心脏的上腔。
- **异位房性心动过速-EAT**：从心房的单一个焦点开始的快速心律，而不是从心房结-SA 开始。
- **房室结折返性心动过速 (AVNRT)**：由于房室结(AV)附近出现“短路”导致的快速心律，而出现圆形节律模式。
- **沃尔夫-帕金森-怀特综合征**：当电通路同时使用正常的房室结和心房与心室之间的异常额外通路时发生的异常快速心律。

### 心室颤动

*心室颤动* (VF) 也被称为心脏骤停、心脏猝死或室颤停止。它是一种混乱的电模式，导致*心脏颤动* (颤抖)。因此，心脏突然停止泵血，导致患者失去知觉。这种情况需要立即做*心肺复苏*



心脏的泵送动作是由心脏内部的一个电路系统控制的。窦房结-SA 发出电脉冲，使心房收缩。房室结-AV 发出电脉冲，使心室收缩。

(CPR)，直到电击（除颤）能够恢复正常心跳。心室颤动与心脏病发作不一样。

## 为什么我需要做电生理测试？

由于以下原因而需要做电生理（EP）测试：

- 诊断异常的心律。
- 帮助医生确定治疗心律失常的最佳方法。
- 检查抗心律失常药物的效果如何。

## 如何做电生理测试？

电生理测试使用的方法与我们做心导管检查的方法相同。医生会在患者的腹股沟和/或肩部的血管中插入 2 根或更多的导管（长、细、的柔性管）。

### 测试前

- 在做电生理（EP）测试的前一天晚上，午夜后不要吃或喝任何东西。可用一小口水来送服处方药。
- 我们将做常规的血样检测，如患者正在服用某些抗心律失常药物，即可检测药物在血液的水平。
- 女性患者：如可能怀孕了请告诉医生或护士。

### 测试的过程

电生理（EP）测试的程序室通常很冷。患者会看到房间里有一些大型的设备。

首先会请患者仰卧。然后连接到两个心脏监测器、一个心电图机、一个氧气监测设备。

电生理测试是在无菌（消毒）条件下做的。我们将剃除导管插入部位的体毛发并在该处涂抹消毒液。我们将给患者覆盖无菌帘。仅有插入导管的部位是显露的。

在患者身体的上方有一台称为荧光镜的机器。这台机器拍摄特殊的 X 射线，来引导医生将导管进入心脏。

我们会给患者药物，使患者在手术过程中感到舒适。在插入导管之前，我们将使用局部麻醉剂来麻痹血管周围的皮肤。患者常常说打这种针的感觉就像被蜜蜂蜇了一下。

麻醉剂起作用后，患者应该只感到医生工作的部位有些轻微的压力。医生将使用荧光镜引导谨慎地将导管插入心脏。大多数患者不会感到心脏中有导管。

一旦导管在心脏中定位，我们将开始测量心脏电活动。其中一根导管是用来做起搏器以控制心律。当医生打开起搏器时，可能会感到心脏跳动加速。这可能会导致心律失常。这种心律可能会自行恢复正常，或者可能需要使用 *电击起搏器* 来中断心律，或使用电击（除颤）来恢复心脏的正常频率。如触发了心律失常，可能会感到与过去有的症状相同。

如感到任何的疼痛、胸闷、恶心或头晕，就请告诉医生。我们将立即治疗这些症状。

在我们获得所需的信息后，医生将移除导管。为了防止出血，我们将在插入部位用力按压约 5 分钟。

## 测试后

当导管在腹股沟时，腿部需要保持伸直并平躺。取出导管后，需要保持这种姿势 4 至 6 小时。这可防止瘀伤或出血。只要腿部保持伸直，可以躺在任何一侧。

回到病房后，护士将经常检查导管插入部位的出血情况。我们还将检查患者的心律和血压。医生会在测试后与患者及其亲友交谈。做完程序后即可进食。

## 如何治疗心律失常？

### 药物

医生可能会开一种 *抗心律失常* 的药物来帮助控制心律。这种药物可以单独使用或与其他治疗方法一起使用，如手术或植入设备。

如服用抗心律失常的药物，可能需要经常做血液检查，以检查药物在体内的含量。也可能会定期做其他测试，以确保药物对患者有效。这些测试可能包括 *心电图*（ECG）、随身携带的心电图监测记录、胸部 X 光检查、眼部检查和呼吸测试。

### 永久性心脏起搏器

可以植入永久性起搏器来控制非常缓慢的心律。在锁骨下方做一个小切口，通常在左侧。将电极（软线）插在静脉中，然后进入心脏的右心室。有些患者需要一个额外的右心房电极。电极连接到放置在皮肤下的电池供电的脉冲发生器。

此程序需要 1 到 4 个小时。会给患者局部麻醉剂和药物来帮助放松，但患者是在清醒的状态。

植入起搏器后，患者将返回病房，在病房里监测心律。为了降低电极脱落的风险，医生可能会要求使用手臂吊带或卧床休息，或两者并用。当患者从手术中恢复时，也可能会要求患者不要将手臂抬起超过 90 度。

## 植入式除颤器系统

植入式除颤器系统 (IDS) 是一种治疗危及生命的心律的装置。它用于治疗有症状或无法控制的室性心动过速 (VT) 的患者。它还用于保护心脏骤停或心室颤动 (VF) 的患者。当除颤器检测到无法控制的室性心动过速 (VT) 或心室颤动 (VF) 时，它会向心脏输送电流，试图将心律恢复正常。

有不同的公司制造除颤器。每种类型可能有不同的名称或稍有不同的编程。

除颤器系统有两个主要部分：

- 脉冲发生器是个监测心律的
- 导线系统将发生器与心脏相连。

脉冲发生器通常是植入在左锁骨下的皮肤或肌肉下。当设备检测到心律失常时，它会向心脏发送电流以恢复正常的心律。这种疗法是预先编程的起搏疗法，或是 "内部" 电击。

除颤器系统-IDS 是在全身麻醉的情况下在手术室植入的。在过程中，医生将触动患者的心律失常，以确保设备能检测到心律失常、并正确地治疗它。

## 导管消融程序

患有沃尔夫-帕金森-怀特 (WPW) 综合征和房颤的患者在心房和心室之间有一条 *辅助* (额外) 通道。这可能导致心跳非常快速，称为 *室上性心动过速* (SVTs)。如这些室上性心动过速很少发生，医生可能会开一些药物来控制它们。

如 *室上性心动过速*-SVT 发生得比较频繁，医生可能会建议患者做导管消融术。使室上性心动过速-SVT 发生的额外通路、可以经这个程序使用射频能量来中断。

在心电图上有时可以看到额外的通路，但我们需要做一个电生理测试来找到它的确切位置。

导管消融就如电生理测试。在患者的腹股沟和锁骨下的血管中放置导管。以便使一根特殊的导管能够被引导到额外通路的准确位置。通过这根导管发送射频波。

这些电波会形成疤痕，即可阻止电冲在这一路径上传播。此程序约需要 4 至 8 小时。会给患者镇静药物以帮助保持平静和放松。

程序完成后，即做胸部 X 光检查。还可能在第二天做心电图以检查程序的结果。

与电生理测试一样，患者需要在床上平躺 4 至 6 小时。回到病房时，可能会感到困倦。如愿意，可以吃进食和喝水。

## 电生理测试后的复诊

由患者常规的心脏医生复诊。如有下列症状请与医生联系：

- 有心动过速
- 感到头昏
- 感到头重脚轻
- 感到可能会晕厥

## 如植入了除颤器

- 任何时候患者从除颤器受到电击时，请立即致电给医生。
- 心脏病诊断中心的计算机程序员需要每 3 或 4 个月检查一次患者的设备。我们会告诉患者要遵循的时间表。

### 您有疑问吗？

我们很重视您的提问。有疑问或顾虑时、请与您的医生或医疗提供者联系。

心脏科：206.598.4300

电生理程序室：206.598.4555

下班后请致电：

206.598.6190，请接线生传呼当值的电生理培训医生或主任医生

# 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?

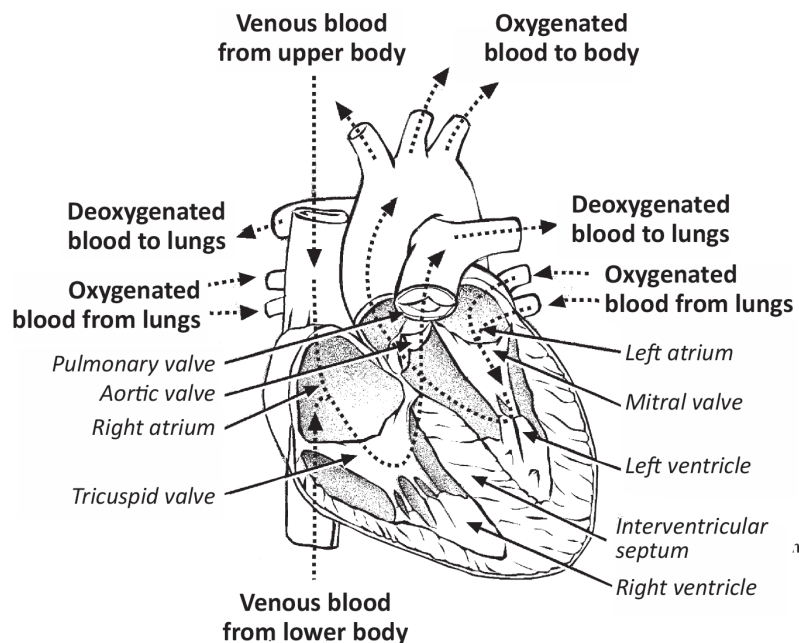
The word *electrophysiology* is made up of 2 words: *electro*, which means “electric” or “electricity,” and *physiology*, which is the study of how a physical body works. An electrophysiology (EP) study measures the electrical signals inside the heart.

### 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

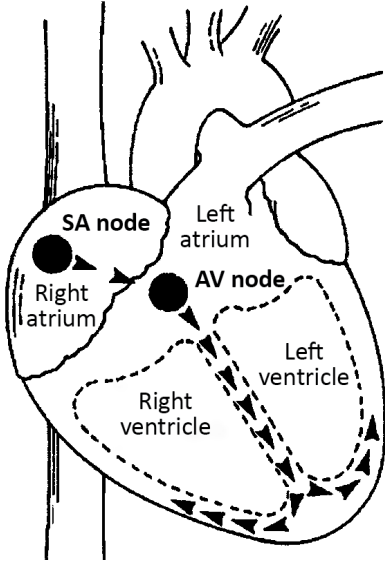
*Tachycardia* (rapid heart beat) may start above the ventricles, producing *supra ventricular tachycardia* (SVT) or, within the ventricles, producing *ventricular tachycardia* (VT). Patients with tachycardia may have symptoms such as:

- 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.