

Class Room

Radiofrequency Ablation of Cardiac Arrhythmias

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Introduction

Radiofrequency catheter ablation (RFA) is a therapeutic procedure usually done during Electrophysiological (EP) study that is performed to diagnose arrhythmias or abnormal heart rhythm. It is done to treat supraventricular and ventricular tachycardias which are abnormal, rapid heart beats starting in atria or ventricles.

The conduction system consists of sino atrial node (SA node), Atrio ventricular node (AV node), His bundle and Purkinje fibres (Fig.1). The electrical impulses are generated by the SA node which are a group of specialized cells. This impulse then spreads across both atria and to the AV node which is a specialized tissue located between atria and ventricles. The impulse momentarily slows down in the AV node to allow the left and right atria to finish their contraction. Thereafter this spreads into a system of specialized fibers called the His bundle and the right and left bundle branches and purkinje fibers. This specialized system distributes the electrical impulse rapidly to all areas of the right and left ventricles. This facilitates them to contract in a coordinated manner. The blood is thus pumped from the right ventricle to the lungs, and from left ventricle to all over the body.

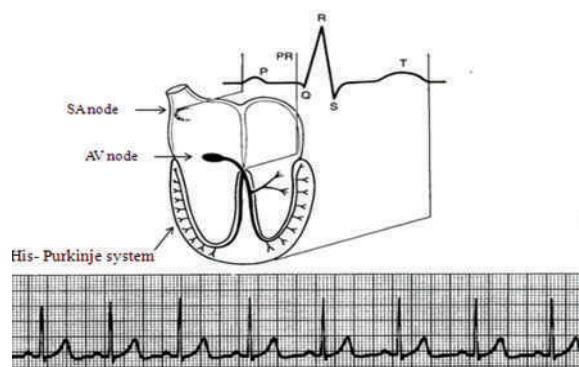


Fig 1 - Schematic representation of cardiac conduction system and corresponding wave forms in electrocardiogram.

What is an arrhythmia?

When the electrical impulses "short circuits" the normal pathway, they travel across the heart in an abnormal pathway. This can cause irregularities in the heartbeat called arrhythmias. They may also develop when areas other than SA node becomes active. It would then begin to send out impulses that take over the pacemaker function from SA node. The abnormalities that ensues results in a heartbeat that is too fast. This can arise within the atria, AV node, or ventricles. When it arises from the atria or ventricles they are known as supraventricular or ventricular tachycardias respectively.

What is radiofrequency ablation?

This is a procedure done to cure tachycardias or fast heart beats. It is done by small wires or catheters that are routed into heart usually from the groin through femoral veins. An EP study is done to identify the abnormal area generating the tachyarrhythmia. Radiofrequency energy is a low-voltage, high-frequency electricity which is targeted over the area causing abnormal heart rhythm. This permanently damages small areas of cardiac tissue with heat, thus preventing them to generate abnormal rhythms¹⁻³.

Which arrhythmias can be treated by RFA?

Radiofrequency ablation is the preferred method for treating various arrhythmias like 4:

1. Paroxysmal supraventricular tachycardia (Fig.2), which includes:
 - Wolff Parkinson White syndrome i.e accessory pathway mediated tachycardia
 - AV nodal reentrant tachycardia
 - Atrial tachycardia
 - Atrial flutter
 - Inappropriate sinus tachycardia
 - Atrial fibrillation with structurally normal heart

2. Ventricular tachycardia and premature ventricular contractions

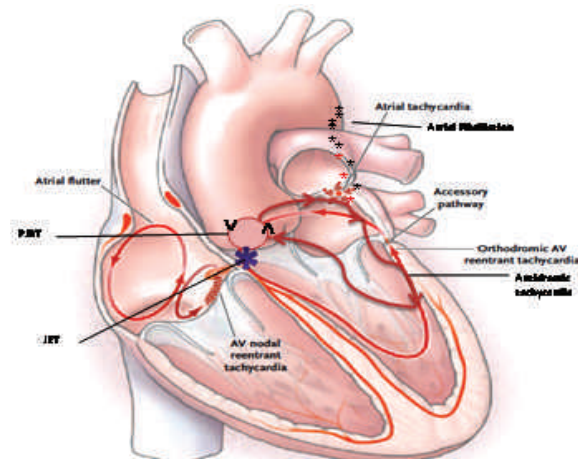


Fig 2 - Schematic representation of various supraventricular tachycardias

Procedure

Preparation - Patients are advised to discontinue antiarrhythmic drugs for 3-5 days before the procedure. A fasting state of 6 to 8 hours is required. A pregnancy test may be done before procedure in women of child bearing age because of the risk of radiation exposure. Generally, this procedure is avoided in pregnant women.

Procedure - Pre procedure the patient is given a sedative medication through an intravenous line to allay anxiety and apprehension.

Small catheters are then threaded up to the heart via the groin or jugular veins (Fig.3,4,5). They are usually positioned within the chambers of the heart under fluoroscopic guidance. During EP study the physician does manoeuvres to provoke arrhythmia.

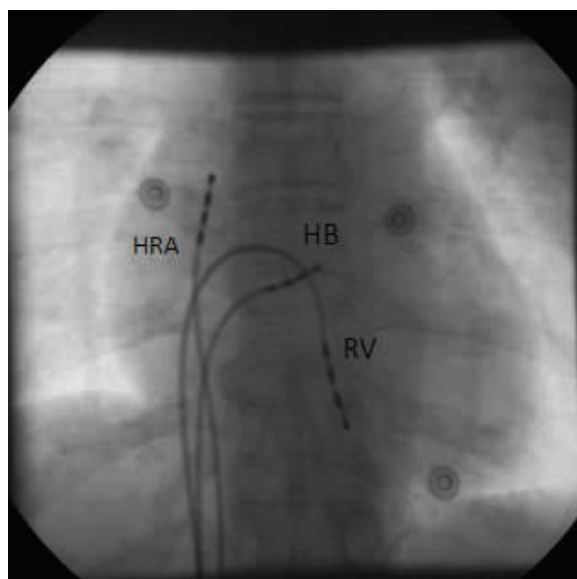


Fig 3 - Fluoroscopic image showing placement of catheters during EP study.

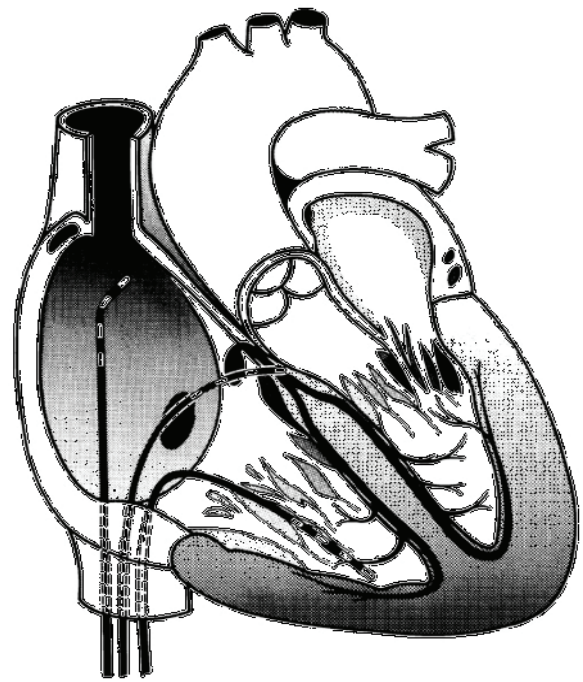


Fig 4 - Schematic representation of catheters inside the heart during EP study

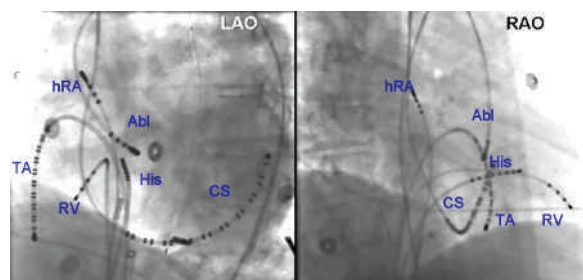


Fig 5 - Fluoroscopic image showing catheter placement during ablation

Once the site of arrhythmia is identified with the use of radiofrequency energy it is treated. This is generally mild and painless similar to microwave heat. A small area of cardiac muscle about 1/5th of an inch dies and stop conducting the abnormal impulses causing rapid heartbeats.

Continuous monitoring of the heart rate, rhythm, oxygen saturation and blood pressure is done throughout the procedure.

After EP study and RFA, an attempt is made again to initiate the arrhythmia. If arrhythmia is not reinitiated, procedure is considered to be a success. Additional radiofrequency energy is delivered if arrhythmia is provokable.

Typically, the procedure lasts between two to four hours or more. The length of procedure, depends upon the type of arrhythmia being treated and varies with each patient.

Post-ablation care - Patient is always monitored in a recovery area till the effect of sedative drugs is gone. Either the doctor or nurse would remove the sheath from groin and apply pressure on the puncture site to stop bleeding.

Bleeding from puncture site and the heart rhythm is observed closely in the recovery area. Patients are advised to stay in bed for 6-8 hours to avoid bleeding from catheter site.

Patients are generally observed overnight in the hospital and are advised to avoid straining the catheter site. Some patients are advised aspirin tablets every day for several weeks to prevent formation of blood clots.

Radiofrequency Ablation Complications

Like any invasive procedure, RFA carries a small risk (1-2%).

Possible complications include⁵:

- Problems related to manipulation of the catheters such as bleeding, infection, blood clots, bruising, and injury to the vessel.
 - Perforation of heart through the muscle or damage to one of the valves
 - Formation of blood clots that could travel to the lungs or brain causing pulmonary embolism and stroke.
 - Heart block due to damage to AV node results in failure of electrical impulse to travel from atria to ventricles. If permanent, requires implantation of a pacemaker.
 - Generation of new arrhythmias.
 - A very small increase in the risk of cancer or genetic defects due to radiation exposure in prolonged procedures.
- Death is extremely rare (0.1%).

Safety And Efficacy of RFA

RFA has a success rate of over 95%. It has a very low risk of complications and patient can resume normal activities usually the very next day. There is little or no discomfort as it is done under mild sedation with local anesthesia⁶. Hence it is now the first line and preferred treatment for most arrhythmias.

Conclusion

Medical treatment with drugs has limited efficacy and may cause undesirable adverse effects. Safety and efficacy of radiofrequency catheter ablation for treatment of most arrhythmias is now well established. Ablation with its low complication and high success rates is more cost effective and safer than antiarrhythmic drugs.

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