The Normal Heart

*The heart is a blood pump with 4 chambers*

**Two Atria:** Receive blood *from* the body and lungs  
**Two Ventricles:** Pump blood *to* the body and lungs

Red = Oxygenated Blood  
Blue = Deoxygenated Blood

LA = Left Atrium  
RA = Right Atrium  
LV = Left Ventricle  
RV = Right Ventricle

In order for the heart to work properly as a pump, its electrical system needs to organize the pumping in a very precise way - like the ticking of a clock. The normal beating of the heart is called **sinus rhythm**
The Electrical System of the Heart

There are some important aspects of the heart’s electrical system that we will review below:

• The **Sinus node** is the natural pacemaker. It keeps the heart in sinus rhythm by sending out a signal every 60-100 seconds that tells the heart to beat.

• This electrical from the sinus node spreads to both atria and tells them to contract at the same time. This pumps the blood to from the atria into the ventricles.

• The electrical signal then reaches the AV node which slowly sends the signal from the atrial to the ventricles. This gives the ventricles enough time to fill with blood.

• After the AV node, the signal spreads through the conducting pathways. This tells the ventricles to pump blood to the body.
What is Atrial Fibrillation

We just learned that the heart stays in sinus rhythm because the electrical signal telling it to beat comes from only one place - the Sinus Node.

In some people, other parts of the heart start to send out electrical signals that compete with the Sinus Node.

These competing signals cause a chaotic heart beat.

We call this chaotic rhythm: **Atrial Fibrillation (Afib)**

![ECG Strip](image)

There are two types of Afib:

1. **Paroxysmal or Intermittent Afib**
   - Symptoms come and go on their own
   - Each episode can last from minutes to hours

2. **Chronic or Continuous Afib**
   - Symptoms continue unless drugs or electrical conversion are used
   - Each episode can last from weeks to years
Patients with Afib may develop symptoms such as:

- Heart Palpitations—rapid pounding
- Shortness of breath
- Chest discomfort
- Fatigue
- Dizziness

For people, these symptoms get worse the longer that they have Afib. This happens because episodes of Afib can start to change the structure of the heart. These changes can then cause the heart to lose its ability to pump enough blood to the body, potentially leading to heart failure.
Risks of Afib: Stroke

During Afib, the signals competing with the Sinus Node can stop the atria from contracting fully. This causes blood to pool in the atria. Over time, this can form a blood clot.

Blood clot stops the flow of blood to an area of the brain

If the clot gets bumped into the blood circulation, it can block blood flow to a part of the brain. This causes a stroke.
When a stroke occurs, brain cells that are blocked from the blood supply are not able to receive oxygen and nutrients. This causes brain cells to die. Because different parts of the brain control different functions (images below), the impact of a stroke depends on where it occurs in the brain.
Treatment Options

In general, treatment for Afib has 3 major goals:

1. **To restore the heart’s normal rhythm** - if Afib is not treated, it can eventually weaken the heart muscle and cause permanent damage. Restoring the heart’s regular rhythm can relieve the symptoms of Afib and may prevent dangerous blood clots from forming. This can be accomplished by anti-arrhythmic medications and/or an ablation procedure.

2. **To slow the heart rate and relieve some symptoms without stopping the irregular heart rhythm** - Controlling rapid heart rates allows the heart to pump oxygen-rich blood efficiently, relieves some or all of the symptoms of Afib, and protects against weakening of the heart muscle.

3. **Prevent clots from forming, thus avoiding strokes** - For most patients with Afib, anticoagulant (blood thinning) medication is used along with other treatments. This medication is an important way of preventing clots and reducing the risk of stroke.

Dr. Florin makes use of all available technology in the care of arrhythmia patients.
There are now many options for the treatment of Afib. Each option is associated with its own risk and benefits. We will review the following treatment for Afib:

Catheter Ablation with Radiofrequency

The following options are not FDA approved and are included for completion. They are completing their evaluation. Cryoballoon will hopefully have approval soon. The Watchman will require a follow up study.

Catheter Ablation with Cryoballoon

Implantation of a Watchman device
Radiofrequency Ablation

I. Paroxysmal/Intermittent Afib

Paroxysmal Afib is triggered by competing electrical signals that come from other areas of the heart. The most common location is the pulmonary veins.

At the beginning of an ablation with radiofrequency (RF) energy, a catheter is inserted into blood vessels in the groin and is advanced into the heart. Once the catheter is in the left atrium, it uses radiofrequency energy to ablate (cauterize) along the circular region where each of the pulmonary veins meets the left atrium of the heart. Each spot that radiofrequency energy is applied is called an RF application. RF applications are placed side by side, in a circular fashion, around the pulmonary veins.
This electrically seals off the pulmonary veins from the heart. Thus, after an ablation, the pulmonary veins can still deliver blood to the heart, but the competing signals can’t reach the heart and trigger Afib.

Most people have four pulmonary veins - 2 on the left side and 2 on the right side.

On page 3 we reviewed the electrical signals that compete with the sinus node to make the heart beat. These signals are represented with the ⭐ in this image. These abnormal signals help to cause the chaotic waves pictured.

Each ⭕ represents one ablation lesion with radiofrequency energy. These lesions form an electrical barrier around the pulmonary veins.

The pulmonary veins are labeled as:

- **LS** - Left Superior
- **LI** - Left Inferior
- **RS** - Right Superior
- **RI** - Right Inferior
II. Chronic/Continuous AFIB

Like Paroxysmal AFib, Chronic Afib is also triggered by competing electrical signals that come from the pulmonary veins. But in Chronic Afib, competing signals also come from the atria. This happens because the changes have occurred in the heart due to Afib.

Catheter ablation of chronic Afib is very similar to what was described for Paroxysmal Afib. The main difference is that in addition to electrically isolating the pulmonary veins, ablation lesions need to be placed in the atrium itself. This helps to stop the pulmonary vein signals as well as helping to remodel the electrical nature of the left atrium.

Procedures in the left atrium require “trans-septal catheterization.” This is a procedure that punctures the divider between right and left atrium and allows the passage of catheters into the left atrium.

If you compare this image to the earlier image for the ablation of paroxysmal Afib, you can see that additional ablation lesions are now placed within the left atrium.
Another major difference between the two stages of Afib is the treatment of Chronic Afib often requires two ablation procedures. The first ablation may organize the rhythm enough so that it becomes **Atrial Flutter**.

Atrial Flutter is caused by an electrical wave that circulates very rapidly in the right and/or left atrium of the heart. It causes a very fast heartbeat in most people. However, because Atrial flutter is very organized, most people still have a steady heartbeat.

Patients typically require a second ablation procedure-to ablate atrial flutter. This is done by placing ablation lesions at a region that crosses the path of the circuit that causes atrial flutter. The circuit can’t complete its circular parts and atrial flutter is usually eliminated.
III. What to Expect

(1) Before The Procedure

A. The night before the procedure, you will be asked not to eat or drink anything after midnight.

B. Check with your doctor about which medications should be continued until the ablation and which should be stopped several days prior to the procedure.

(2) During The Procedure

A. Your ablation will be done under general anesthesia and you will be completely asleep.

B. You will be given heparin, a blood thinning medication to avoid clots that may cause a stroke.

C. The ablation procedure can last from 2-6 hours.

D. A urinary catheter will be used to drain your bladder.

E. You may need to undergo a trans-esophageal echocardiogram. This is a procedure where a special ultrasound probe is placed in the stomach and esophagus to get a good look at the atrium to make sure that there aren’t any clots.

(3) After the Ablation

After the procedure, you will be taken to a cardiac recovery unit. Here, doctors will monitor your heart closely and perform tests to make sure that you are doing well. Everyone stays in the hospital overnight for monitoring and most people can go home the next day.
• You will continue taking warfarin (coumadin) for a minimum of two months after your procedure to protect you from a stroke.
• You may be required to take blood thinner injections in addition to the warfarin
• You may be asked to start (or continue) antiarrhythmic medication to suppress and atrial fibrillation that may occur early after the procedure while your heart is healing. Afib can occur after the procedure secondary to the extensive inflammation that exists after the ablation.
• In the week after your procedure, it is normal to see bruising in the groin area where catheters were inserted.
• You will be asked to avoid lifting anything heavier than 10 pounds for one week. You can drive after 5 days.

RISKS

Thousands of RF ablations have been performed safely around the world. However, there are rare, but serous risks that you should be aware of *

These include:

- Atrial perforation-The ablation can cause the tissue to tear and leak blood around the heart
- Stenosis-Damage (narrowing) of the pulmonary veins
- Thromboembolism - A blood clot can cause a stroke
- Atrial-esophageal fistula-RF energy can overheat the esophagus (tube that connects mouth to stomach). This can create a hole from the esophagus to the heart. This can introduce air and bacteria into the blood. This is very rare, but can be fatal.

* Many of these complications can be treated during the procedure
The Cryoballoon

This device is still awaiting FDA approval. It’s inclusion in this booklet is for completion and educational value only.

An Ablation procedure with the cryoballoon (cryoablation) is very similar to what has been described with Radiofrequency ablation. The main difference are:

• Cryoablation freezes tissue to electrically isolate the pulmonary veins, while RF burns tissue
• RF ablation of each pulmonary vein requires spot lesions placed side by side in a circular fashion. The cryoballoon fits at the opening of the vein, touching all the points in the circle at once
• Cryoballoon ablation will only for paroxysmal Afib
The Watchman Device

This device is still awaiting FDA approval. It’s inclusion in this booklet is for completion and educational value only.

Blood clots, especially those that form in an area of your heart call the Left Atrial Appendage (LAA), increase your chances of having a stroke. Medications like warfarin (Coumadin) are drugs that thin your blood and have been shown to reduce the risk of stroke. However, there can be many serious side effects from taking blood thinning medications for long periods of time.

Closing your LAA by implanting the Watchman device is another option that may protect you from a stroke. The watchman is a small filter that is designed to keep blood clots from forming in your heart and entering into the blood stream. The goal is to eliminate the need to take the blood thinning medications

When the FDA reviewed the initial data, they felt that the complication rate with implantation appeared too high. A future trial is pending.
Dr. Todd Florin is currently the Director of Cardiac Electrophysiology at Aventura Hospital and Medical Center. He is board certified in Cardiology and in Cardiac Electrophysiology. He graduated from New York University School of Medicine and completed his Internship and Residency at the University of Michigan, where he remained on the faculty. He went on to complete his Fellowships in Cardiovascular Disease and Cardiac Electrophysiology at the University of Maryland in Baltimore. Most recently, Dr. Florin was fundamental in bringing robotic electrophysiology to the state of Florida. Dr. Florin is active in the fields of complex ablation, including atrial fibrillation and ventricular tachycardia ablation as well as in medical device implantation and follow up.