

Treatment of Atrial Fibrillation

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I. INTRODUCTION

Thesis: Atrial Fibrillation is a medical condition that can become an onset at any age. The best treatment option depends on factors such as age, type of Atrial Fibrillation, other medical conditions, etc.

II. ATRIAL FIBRILLATION

- A. History
- B. What is Atrial Fibrillation?
- C. Ongoing medical issues Atrial Fibrillation can cause

III. DIAGNOSIS AND TREATMENTS

- A. Diagnosis
- B. Electrical Cardioversion
- C. Cardioversion with Drug Therapy
- D. Catheter Ablation

IV. BEST TREATMENT BASED ON PATIENT FACTORS

- A. Catheter Ablation vs. Drug Therapy
- B. Overview of an Atrial Fibrillation patient's experience with Catheter ablation

V. CONCLUSION

Objectives

At the conclusion of this paper, the reader will be able to:

- Define Atrial Fibrillation and explain factors that relate to whom it can affect, the causes, symptoms, and how it compares to a normal heart rhythm
- Explain the diagnosis & treatments of Atrial Fibrillation
- Describe and differentiate the techniques used in diagnosing and treating Atrial Fibrillation
- Discuss and compare the best treatment options based on patient factors
- Learn about a patient's experience with atrial fibrillation and his chosen treatment option.

Introduction

Cardiac arrhythmias, or more specifically, any abnormal heart rate or rhythm, affect millions of people every single day. Atrial Fibrillation is a specific type of arrhythmia that affects the lives of 2.7 million Americans. Catheter ablation is a suitable method for treating patients that present with Atrial Fibrillation. Unfortunately, the efficiency of the procedure depends on many clinical aspects and varies between patients. There are a number of treatment options for patients with AF depending on the diagnosis, signs, and symptoms.

Atrial Fibrillation

Atrial Fibrillation (AF) is one of the most common arrhythmias. Over 2 million Americans have intermittent or chronic AF⁸. There are different types of Atrial Fibrillation. In some patients, AF occurs paroxysmally, which means it may only last minutes, hours, or days. Some patients may experience only one episode or occasional episodes; whereas others have multiple reoccurrences. Paroxysmal AF may occur spontaneously, or it may be associated with excessive alcohol or caffeine consumption, stress, or lack of sleep.⁸ In such cases, the arrhythmia often reverts to its normal rhythm, or is converted easily with pharmacologic (drug) therapy alone. In other patients, AF is more permanent or persistent. In this case, AF is occurring almost constantly and patients are always affected. With these fibrillatory episodes, some patients are quite symptomatic. The symptoms can consist of palpitations, dyspnea, light-headedness, fatigue and even syncope or chest pain. However, some patients may not have any complaints. Asymptomatic patients usually do not realize they have AF until they go in for a routine examination, or they present with heart failure or stroke.

AF is also one of the most seen arrhythmias in patients who have organic (structural) heart disease.⁴ As patients age, the prevalence of this type of arrhythmia increases. A common pathological influence may be coronary artery disease. Patients with coronary artery disease may experience AF for the first time during an acute mitral infarction (MI) or, more commonly, as a consequence of chronic ischemic myocardial disease, possibly because of associated atrial dilation or fibrosis.⁴

Numerous other diseases can also lead to AF. For example, AF is very common post-cardiac surgery. Also, patients who have hyperthyroidism, lung disease, obstructive sleep apnea,

pulmonary emboli, cardiomyopathy, congenital heart disease and other forms of heart disease are susceptible.³

During AF, the two upper chambers of the heart, or atrias, contract chaotically and out of order compared to the two lower chambers, also known as ventricles. The atria are stimulated at a very rapid rate, which can run from 100-350 bpm. Because of rapid atrial depolarization, the AV junction has increased stimuli from the atria. AV junction is refractory to most of the impulses and allows only a fraction of the up to 350 pulses to reach the ventricles. The faster the heart rate, the more time there is for inadequate ventricular filling and greater the decrease in output. An example of this is if a patient's heart rate is running at 150 bpm vs. 100 bpm, he/she is more likely to become hypotensive. When a patient has AF, it produces irregular undulations, which causes false P waves on an Electrocardiogram (EKG).⁹ After the P wave, the atria normally contract and pump blood into the ventricles. With AF, normal atrial depolarization is suppressed to a wavier line. This occurs because of the atria "quivering" instead of fully contracting. This results in inadequate ventricular filling and can further lead to thromboembolic complications. ^{Fig 1} While a patient is in an AF episode, it increases the chance of an atrial thrombi to develop and dislodge into atrial circulation, potentially causing a peripheral embolism. These thrombi can cause a cerebral vascular accident, or stroke, blockage in an extremity, and other complications.

Irregular waves are called fibrillatory waves (F waves). In some cases, the waves are "course" and in others, they are a faster "fine" pattern of fibrillation.⁹ If every atria stimulus (each F wave) penetrated the AV junction, the ventricles would beat at a rate of up to 600 times per minute, which would have catastrophic consequences. To prevent this, the AV junction only allows a fraction of these impulses to reach the ventricles. In patients that have what is considered "normal" AV junction and suddenly develop AF, the heartrate will run anywhere from 100-180 bpm in an episode.

There are two definite ways to identify AF on a EKG; the first is an irregular, wavy baseline produced by the rapid F waves. It is hard to recognize a definite P wave due to the "quivering" of the atria. Secondly, the QRS waves that represent ventricular depolarization, are very irregular due to the ventricular rate being rapid.

Treatments

The treatment type that is most appropriate is dependent on how long the patient has had atrial fibrillation, how bothersome the symptoms are to the patient, and the underlying cause of AF. Generally, the treatment goals for AF are to reset the rhythm and control the heart rate, and to prevent blood clots, which decreases the chance of a future stroke. The strategy that is chosen for treatment will depend on a few factors and if the patient is able to take medication to control it. In some cases, the patient may have to undergo a number of more invasive procedures that involve catheters or surgical intervention.

There are a number of steps that are used to properly diagnose a patient that is suspected to have AF. The physician will review signs and symptoms that the patient may be experiencing. Then the physician may start with a test that is known as an Electrocardiogram or EKG. This test uses a low-voltage electric current that enters the body through electrode patches that are placed on the patient's chest wall and arms to sense and record the electrical signals as they travel through the heart. This test is a primary tool for diagnosing AF. The patient will also have a chest x-ray and blood tests will be performed to check if something inside the heart is causing arrhythmias, and to rule out thyroid issues or other substances in the blood that can lead to AF.

If the physician sees an AF EKG pattern, then the patient will wear a portable EKG device, known as a Holter monitor, or more modernly known as a Zio Patch. This monitor can be worn on the chest, carried in a pocket, or worn on a belt, depending on the type of monitor. Also, depending on the type of monitor, it can record the heart's electrical signals anywhere from 24 hours to 14 days. This data provides the physician with an extended look at the heart's rhythms.⁴ If AF still persists in the data recorded, the next test that can be ordered is an Echocardiogram. This test uses sound waves from an ultrasound machine to create dynamic pictures of the heart. The physician can use this test to hear the heart rhythm, watch blood flow through the chambers of the heart, and to detect structural heart disease or blood clots in the heart. The different tests that the physician will choose depends on many factors, including if the patient has any other medical issues with the heart or if he/she is able to take medicines to control their heart rate.

The goal of treating AF is to reset the heart rate and rhythm back to normal. To correct the irregular rhythm, the physician may be able to reset the heart to regular rhythm by a procedure known as electrical cardioversion. Electrical Cardioversion is performed on patients with emergent and non-emergent AF.⁶ In non-emergent cases, its preformed to stop AF that has not

been stopped on its own and with patients whose AF has recently developed. In emergent cases, electrical cardioversion is performed when AF is causing the heart to pump dangerously fast, which causes the blood pressure to drop dramatically. The procedure uses an electrical current to send shocks through pads placed in the middle and one on the side of the patient's chest to reset the heart's rhythm back to its regular pattern (sinus rhythm).^{Fig 4} Transient delivery of an electrical current causes a momentary depolarization of most cardiac cells, thereby allowing the sinus node to resume normal pacemaker activity.

In the presence of a reentrant-induced arrhythmia (type of paroxysmal tachycardia), such as a paroxysmal supraventricular tachycardia (PSVT) and ventricular tachycardia (VT), electrical cardioversion interrupts the self-perpetuating circuit and restores sinus rhythm.⁶ The patient is usually under sedation so that the heart's rhythm is not affected by any patient influences, such as heightened emotions. Once the heart rate is back in its normal rhythm, the physician will prescribe medications to make sure it remains in rhythm. Electrical cardioversion is more than 90% effective, although electrical cardioversion is much less effective in treating arrhythmias caused by increased automaticity (ex. Digitalis-induced tachycardia, and catecholamine-induced arrhythmia).

The chance of AF occurring again after the procedure is common.^{6,5,4} The success rate of the procedure can depend on the size of the patient's left atrium, as well as how long the patient has been in AF. For example, if the patient has a large-sized left atrium and has had AF episodes for the past year or two, the chance of AF being cured is lower compared to a patient with a new onset of AF.⁴ Although most people have a successful electrical cardioversion, it does have certain risks. The patient's own risks may vary based on age, the type of abnormal heart rhythm he/she has, and other medical conditions. Rarely does the procedure cause a more dangerous heart rhythm. If that happens, the patient can receive specific medications or a stronger electrical shock to stop the rhythm. Some other risks include other less dangerous abnormal rhythms, temporary low blood pressure, heart damage, heart failure, skin damage, dislodged blood clot (which can cause stroke), or pulmonary embolism. In certain situations, healthcare providers lower the last risk by administering blood thinners to help prevent clots for up to three weeks post-cardioversion.

The goals of drug therapy for patients with atrial fibrillation (AF) are to maintain sinus rhythm, avoid the risk of complications, and minimize symptoms. The usual sequence in treating AF with pharmacology is first to control ventricular response with a beta blocker.¹¹ Beta blockers are a class of medications commonly used for heart rate control. These medications block some of the effects of adrenaline, which tends to make the heart beat faster. Metoprolol is an example of a commonly used beta blocker.

Calcium channel blockers are another frequently used medication for heart rate control. These medications affect a channel in heart cells that controls the flow of calcium in and out of the cells. Blocking the transport of calcium through these channels slows the rate of the heart. Diltiazem is one type of a calcium channel blocker.

Antiarrhythmic medicines also help return the heart back to normal sinus rhythm, maintain rhythm after it has been achieved, and/or reduce the heart rate while the patient is in atrial fibrillation. These medications stabilize the heart muscle tissue. Antiarrhythmics, such as amiodarone or sotalol, also slow the heart rate by blocking impulses that pass through the AV node in the heart.

Atrial ablation therapy is based on the finding that many cases of AF originate with ectopic stimuli from around the pulmonary veins in the left atrium. The aim of an ablation procedure is to achieve isolation of all the pulmonary veins and to restore sinus rhythm.¹ During a catheter ablation, the patient is transported to the department with constant cardiac, blood pressure and oxygen levels monitored. The femoral vein is the most common site of access; this area is sterilized and prepared for the procedure. To start, a catheter is introduced to perform a coronary angiogram with the Seldinger technique.⁸ Using CT scans previously done on the patient, comparisons are made from the scan to the real time angiogram. Next, a different type of catheter with an ultrasound based tip is introduced through the heart into the left atrium.^{Fig 2} The ultrasound is used to collect data in pieces until a full 3-D image is produced of the left atrium.^{Fig 3} This ultrasound image compares the differences in stimuli compared to different areas of the atrium to show where the impulses from the AV node are traveling and/or have the most activity, which is directed to be the cause of atrial fibrillation. Next, the spots with the most activity are the places of most interest for the electrophysicist. The electrophysicist will purposely “excite” those particular areas to try to start atrial fibrillation. If the area reacts and starts to fibrillate, it is known as a trouble area. The physician uses data from the troubled areas to determine where to

ablate. Once all the areas are located, the physician will either ablate using radiofrequency (heat), or cryotherapy (cold) on the areas to prevent any signals to be transported through those tissues. Once the tissues are ablated, the physician will try and “shock” the heart into atrial fibrillation again, and if no reaction, the procedure is complete.

Treatments based on Patient Factors

The usual sequence in treating AF with drug therapy is first to control the rate of ventricular response using a beta blocker or a calcium channel blocker. If the sinus rhythm is not spontaneously restored in association of rate slowing, an antiarrhythmic drug is often considered. Electrical cardioversion is generally reserved for patients who fail to respond to drug therapy since it is sometimes used without antiarrhythmic drug therapy. Not all patients with AF are candidates for electrical cardioversion. Patients with persistent or recurrent AF who cannot be converted to or maintained in sinus rhythm are candidates for ventricular rate control, along with long-term anticoagulation using warfarin or aspirin.⁶ Antiarrhythmic drug therapy of AF has a high failure rate and the toxicity of the agents cause a risk of potentially fatal ventricular arrhythmias.

Some patients with chronic AF and rapid ventricular rates cannot be converted to sinus rhythm despite drug therapy. There is a more useful approach option involving an ablation of the AV node with Radiofrequency (RF). A current is delivered by a special cardiac catheter. This procedure is designed to eliminate tissue and signal pathways that cause the arrhythmia and return the heart to a normal sinus rhythm.⁹ To eliminate the pathology-causing tissues, RF energy is targeted to the specific tissue using a catheter under fluoroscopic guidance or a 3-D mapping system. Single-procedure success rates for catheter ablation of paroxysmal AF are in the 60% to 80% range.¹ However, the procedure is technically demanding, highly operator-dependent, and carries a substantial risk of complications.¹ Atrial ablation therapy is based on the finding that many cases of AF originate with ectopic stimuli from around the pulmonary veins in the left atria. Therefore, compared to drug therapy, catheter ablation therapy does not show significant reduction in the primary endpoint of death, stroke, serious bleeding or cardiac arrest. Catheter ablation continues to evolve, with advancements in tools, techniques, and anticoagulation management. However, it should be considered that 90% of patients undergo catheter ablation when initially recommended for the procedure. Of the patients who started treatment with drug therapy, 27.5% of them ultimately undergo the catheter ablation. Fig 6

After talking to a patient who went through the catheter ablation procedure, it is easy to understand why his experience is an example of the reason of how it can be different than the “standard” treatment. This patient was 22 years old when the signs and symptoms of atrial fibrillation began. The signs and symptoms were present in attending school and doing rigorous homework every day, playing on a sports team, and keeping a social/family life. When the signs started, the patient did not think much of them. The patient started out having shortness of breath after excursion and episodes of the heart racing excessively after drinking caffeine or not getting enough sleep. These signs did not become alarming to the patient until he had an intense episode of his heart rate racing at 140-180 beats per minute while laying down in bed. This caught his attention and a few weeks later, he scheduled an appointment with a cardiologist. On the day of the appointment, the patient went into the cardiologist’s office where he explained all the signs and symptoms he was experiencing. Because of the patient history provided, the cardiologist ordered a number of tests which included blood work, EKG and a chest x-ray. After receiving the results of the tests, the cardiologist recommended that the patient wear a Holter monitor (Zio Patch) for 10-14 days and then send in the results.

After about 3 weeks the results were submitted and the patient was called in for another appointment. The cardiologist further informed him that he was diagnosed with Paroxysmal Atrial Fibrillation. The Zio Patch data had proven this diagnosis. The data showed a number of AF episodes, one lasting up to 8 hours long. The cardiologist believed that the patient’s history of heart disease in the family, stress from school and sports, and caffeine intake all were reasons leading to the diagnosis.

The cardiologist then proceeded to explain the options to patient. One option mentioned was taking medication 1-2 times per day to control the heart rhythm. At this patient’s young age, it was very rare to develop this diagnosis, and the idea of taking medication for the rest of his life was not appealing. He asked for another option and the cardiologist recommended the catheter ablation surgery. He would have to be referred to a different provider and facility to have the procedure. After some thought and research, the patient felt this was the best option for him.

Three days before the procedure, the patient had to take anticoagulants twice a day to prepare. He also had to be NPO (nothing per oral) for 8 hours before his scheduled surgery time. Once the patient arrived to the hospital, he had a CT angiography scan of the chest for the physician to use later during the procedure. After the CT, he was sent to the pre-operation unit to prepare for

surgery, which included shaving around the femoral vein access sites and changing into a hospital gown.

When it was time for the patient to go into the operating room, they brought him in, laid him on the table and gave him mild sedation. Next, the physician came in to get access through the femoral vein with a local anesthetic to see how the heart was functioning without the patient being fully asleep.

After the initial tests were done, the patient underwent general anesthesia. Once asleep, the physician performed the remaining surgery which included tests, finding the area that was initiating the atrial fibrillation, ablating the area with radiofrequency (heat), and running more tests to ensure all the correct tissue was ablated.

After the procedure, the patient was brought to a post-operation care unit to slowly wake up from the anesthesia. During this time, nurses were constantly monitoring him. The patient still had the tubes (sheaths) in the femoral vein access points from the procedure. The nurses were checking the blood clotting levels of the patient's blood every 10 minutes to confirm the levels were high enough to safely remove the sheaths. Once the sheaths were removed, pressure was manually applied by the nurse for 15 minutes to ensure no hematoma. At this time, the patient was fully awake and aware of what was happening. After the sheaths were removed, the patient was brought to an inpatient room where he would have to lay flat for 4 hours post-sheath removal and to be monitored overnight. Nurses were instructed to check on the access sites every 30 minutes to check for any hematoma or of leaking.

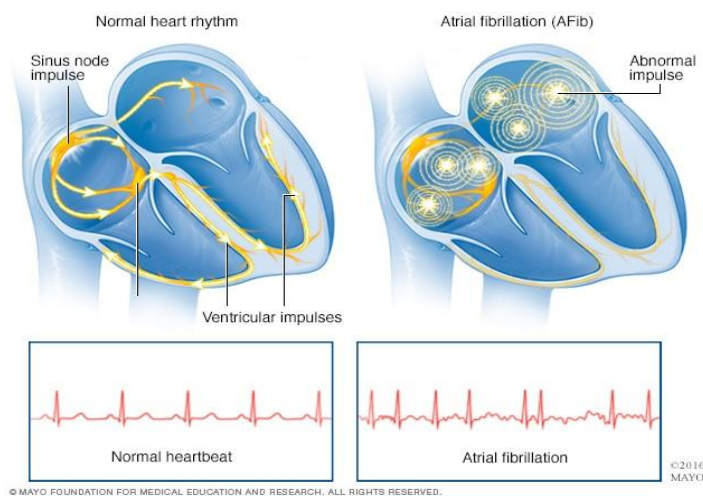
The next morning, the physician came into the room to discuss the procedure one last time, give the patient instructions to follow post-operation, and approve his discharge from the hospital. The patient was instructed to take Plavix, an anti-coagulant, every day for 4 weeks post-operation. Following the 4 weeks, he was instructed to take a baby aspirin for 12 more weeks post-ablation.

Conclusion

With atrial fibrillation being the most common type of arrhythmia, millions of people deal with it every day. Treatments can vary from taking antiarrhythmics to having the catheter ablation. The right treatment option is dependent on the type of AF that the patient has and the different symptoms he/she presents with. The catheter ablation is a very promising option, with the success rates of 50% of AF reforming post-ablation. The patient experience that is shared is a

good example of how the best treatment is determined depending on the symptoms and history of the patient.

Fig 1- Image showing the differences between a normal heart rhythm and a heart with Atrial fibrillation, showing where the impulses are. Also, the differences in what EKG will look like in comparison.

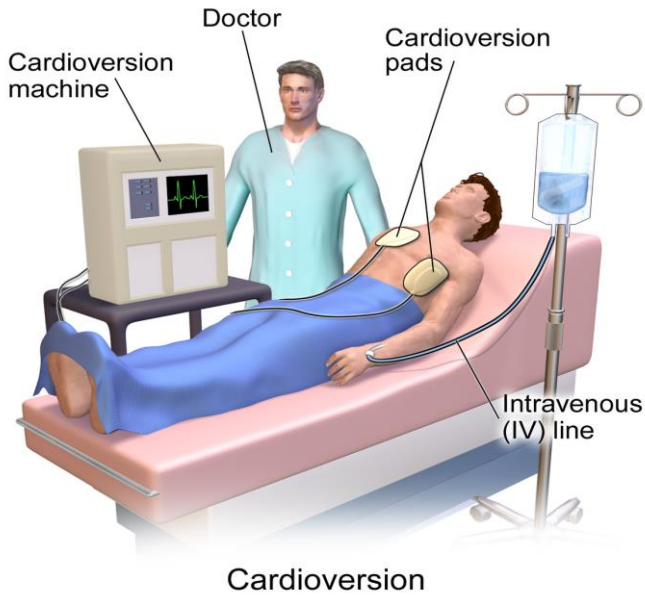


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Fig 4. Image shows patient who is hooked up to an Electrical Cardioversion machine.



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Fig 5. This video shows a catheter ablation animation.

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Fig 6. This chart shows the comparison between catheter ablation and drug therapy.

<u>Catheter Ablation</u>	<u>Drug Therapy</u>	<u>Result</u>
5.2%	6.1	All-cause mortality
51.7%	58.1%	For death/cardiac problems while in hospital
49.9	69.5%	AF recurrence

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