

Ablation for atrial fibrillation (AF)



Providing information, support and access to established,
new or innovative treatments for Atrial Fibrillation

Glossary

Antiarrhythmic drugs Drugs used to restore the normal rhythm of the heart.

Anticoagulants Drugs which reduce the ability of the blood to clot. This is necessary if the blood clots too much, leading to a stroke or heart attack.

Arrhythmias A group of conditions in which the heartbeat is irregular, too fast, or too slow.

Atrial fibrillation (AF) An abnormal heart rhythm characterized by irregular and often rapid beating.

Cardiac tamponade A condition where the sac encasing the heart accumulates with fluid, putting pressure on the heart and reducing its ability to pump blood effectively.

Cardiologist A doctor who specializes in the diagnosis and treatment of patients with a heart condition.

Catheter ablation A treatment which uses fine wires emitting energy (often heat) to destroy a very small area in the heart that is responsible for certain arrhythmias.

Concomitant surgical ablation Destruction of diseased heart muscle responsible for arrhythmias performed in an open chest at the same time as another heart operation such as bypass or valve surgery.

Cryoablation Catheter ablation using freezing rather than heat energy.

Dyspnea A medical term for shortness of breath.

Echocardiogram A non-invasive procedure that images the heart using ultrasound.

Electrocardiogram (EKG) A non-invasive procedure that provides images of the heart using ultrasound.

Electrophysiologist (EP) A cardiologist who specializes in heart rhythm disorders.

Laser balloon ablation Destruction of abnormal heart tissue responsible for arrhythmias using a small laser inserted into the heart via a catheter.

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Left atrial appendage (LAA) A small pocket of the heart which in some at-risk patients may be the site of blood clot formation.

Non-Vitamin K antagonist oral anticoagulants (NOACs) A group of newer anticoagulant drugs, including apixaban, dabigatran, rivaroxaban and edoxaban.

Palpitations Awareness of the heartbeat which may be when the heart beats too quickly, (or too slowly) and sometimes irregularly.

Paroxysmal atrial fibrillation (PAF) episodes of atrial fibrillation, where the heart will go back into normal rhythm. The episodes may vary in frequency and duration.

Radiofrequency (RF) ablation The most common method of destroying the abnormal tissue responsible for irregular heart rhythms such as AF using heat energy.

Normal Sinus Rhythm (NSR) The normal, regular rhythm of the heart.

Stroke A serious, potentially life-threatening medical condition that occurs when the blood supply to part of the brain is cut off. Urgent treatment is essential because the sooner a person receives treatment for a stroke, the less damage is likely to happen. They can be caused by a blocked blood vessel supplying the brain with oxygen (ischemic stroke) or by bleeding within or around the brain (hemorrhagic stroke).

Tachycardia A fast heart rate of more than 100 beats per minute.

Video assisted thoracoscopic surgery (VATS) A method of performing surgery in the chest through very small "keyholes", instead of the conventional method of opening the chest.

Warfarin An oral anticoagulant (blood thinning medication) used to minimize the risk of heart attacks, strokes, and blood clots.

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What is atrial fibrillation?

Atrial fibrillation¹ (AF) is the most common heart rhythm disorder in the developed world and it is estimated that over six million people in the USA alone have this condition. It can affect adults of any age, but it is more common the older you get – about 10% of people over 75 years of age have AF. AF is one of the leading causes for stroke in the USA and can also cause heart failure in some patients.

It results from abnormal electrical activity in the atria, the top chambers of the heart, causing them to contract randomly and often very fast, resulting in the heart muscle not being able to relax properly between beats. This reduces the heart's efficiency and performance, and may lead to rapid, irregular palpitations, breathlessness, chest pain, light-headedness and fatigue. Some people with AF are asymptomatic and may only be diagnosed when they are having investigations for other reasons or have developed a complication such as a stroke.

Different types of AF

Paroxysmal AF

- The abnormal heart rhythm and subsequent symptoms are intermittent, and usually stop within 48 hours (although technically they can last up to 7 days)

Persistent AF

- Irregular heart rhythm lasting for longer than seven days
- Attempts will often be made to restore a normal heart rhythm and improve symptoms

Permanent AF

- AF is present all the time, and it is felt that normal rhythm cannot be restored/maintained (often only decided after attempts to revert the heart back into normal rhythm have been tried and failed)



¹ For more information please read the *Atrial Fibrillation (AF) Patient Information booklet*

Why treat AF?

Many people with AF have symptoms that are severe enough to cause them to seek medical attention. Even if you do not, it is still important to treat your condition as, over time, AF can cause other serious complications including increasing your risk of stroke, and heart failure, if left poorly managed. Heart failure occurs when your heart has lost its ability to pump effectively, leading to heart damage that can be irreversible. AF is just one of many causes of heart failure.

AF and stroke: When the heart pumps inefficiently due to the irregular rhythm seen in AF the blood may have an increased tendency to form clots in the heart. If part, or all, of the clot breaks loose it could travel to the blood vessels supplying your brain, block them, and cause a stroke. One third of patients with untreated or poorly managed AF may have a stroke in their lifetime.

How is AF treated?

There are a number of different treatment options and variations of these treatments. The main distinctions in the treatment of patients are whether they are managed medically, through other nonsurgical interventions (cardioversion or catheter ablation) or by surgical procedures (pacemakers, surgical ablation). All three management types aim to achieve one or more of the following goals for treating AF:

- Managing and controlling symptoms
- Restoring a normal heart rhythm
- Reducing the risk of stroke

No single treatment has been shown to be effective for all patients with AF, and the choice of which will depend upon the severity of symptoms, the likelihood that the patient will respond to a particular treatment, and consideration of the risk versus benefits of each treatment option. It is important to discuss these issues with your doctor.

Ablation strategies for AF

Successfully managing atrial fibrillation can be difficult. At some point, doctors will likely discuss the options for trying to treat the condition with you. The term ablation will be used frequently and in this context means the destruction of abnormal conducting tissue.

Using the various different types of ablation, the abnormal electrical signals within the heart can be blocked. The success of each approach varies and the type of AF you have can play a role in the options that are available. Surgical procedures also carry small but significant risks that the doctors will discuss with you.

Ablation is not suitable for everybody and is currently indicated for those who have failed to respond to two different drug strategies and whose symptoms impact severely on their lives. The procedure has not been proven to make a person live longer or specifically reduce the AF-related stroke risk but ongoing studies will hopefully answer these questions in the next few years.

The most frequently used form of ablation is catheter ablation. Trials and research have shown this style of ablation procedure to have relatively low complication rates and good success rates for the appropriately selected symptomatic AF patients.

In some circumstances, surgical ablation is a very effective treatment, however this is carried out by a cardiothoracic surgeon, and is usually considered for AF patients either already undertaking an open-heart procedure, or for whom catheter ablation may not be the most appropriate option. Both catheter ablation and surgical ablation seek to stop future occurrences of AF.

In some symptomatic AF patients, it may be judged that neither surgical nor catheter ablation is appropriate, and antiarrhythmic drug therapies may either be contraindicated or no longer effective. Therefore, an AV node ablation and pacemaker implant (pace and ablate) may be considered as a suitable option. Unlike catheter or surgical ablation, this procedure does not stop the AF or remove the stroke risk, but seeks to mask the unpleasant symptoms caused by the condition, particularly those related to the heart beating very fast.

Catheter ablation

The purpose of a catheter ablation is to stop the rogue electrical pulses that cause atrial fibrillation. These are found in the left atria, most commonly close to or around the pulmonary veins. To achieve this, small areas of the tissue within the left atria are destroyed, commonly using either heat or freezing techniques. Once these lesions (areas of ablated tissue) have been formed, the scarred tissue acts to block and isolate the rogue electrical impulses thus preventing them from causing AF.

Before the procedure, information will have been given to you about which of your medications to take and which to avoid, plus how long you need to fast for (avoiding anything to eat or drink) prior to admission. You must follow these instructions carefully as it may be necessary to cancel your operation if this is not done correctly, particularly regarding anticoagulation.

To assist with the procedure it may also be necessary to have a detailed scan of the heart, such as a transesophageal echocardiogram (TEE), CT, and/or MRI scan. These may provide useful information about the atrial chambers and pulmonary veins, which can make the procedure technically easier, and rule out a blood clot in the atria, which would make it too dangerous to proceed. You will be admitted into hospital either on the day of or the day before your procedure.

The ablation procedure usually takes a few hours and is performed with local anaesthetic and either sedation or a general anaesthetic. A thin, flexible tube (a catheter) is inserted into a vein in your groin, then carefully guided into your heart. The affected area/s inside your heart are identified and targeted with energy, destroying the tissue responsible for causing the abnormal heart rhythm. Catheter ablation can be done as a day-case procedure, or can often require an overnight stay in hospital.

What is the “best” catheter ablation procedure to have?

There is no one single option that is considered “best”. New methods are being developed and trialled all of the time and ongoing research has yet to show one being more successful than any other. What is important is that your cardiologist discuss with you the benefits and risks a catheter ablation might have for you and the likely success rates based on the type of AF you have (paroxysmal or persistent), how long you have had AF, and your general health and medical history.

What are the most common methods of catheter ablation?

Radiofrequency ablation:

Radiofrequency energy is applied from the tip of the catheter creating short bursts of high temperature heat to burn small areas of tissue. In order to isolate the electrical impulses causing the AF, a series of small dots are made around the pulmonary veins to create a ring which then completely isolates the area. In patients with more persistent symptoms, one or more lines may be also drawn within the atria to prevent the spread of these erratic signals and other areas ablated that might be possible causes of the AF.

Cryoablation:

This is often used for treating paroxysmal AF and can isolate the pulmonary veins. The catheter has a small balloon at the tip that is filled with liquid nitrous dioxide which is extremely cold. This causes freeze damage around the affected tissue at the entrance to the pulmonary veins. These are then isolated from the rest of the heart, blocking erroneous impulses responsible for AF. Cryoablation may speed up the overall time of a catheter ablation procedure as a ring around the affected areas can be made in one smooth action. In some cases, either radiofrequency or cryoablation alone will be sufficient. However, other patients require a combination of the two ablations to achieve a greater success level and benefit to the individual.

Laser balloon ablation:

This form of ablation can only be performed on individuals who are able to tolerate a general anaesthetic because the procedure requires the patient to be absolutely still. The catheter has a balloon positioned at the tip as well as a camera (endoscope) inside it which allows the doctor to see inside the left atrium. This then allows the electrophysiologist (EP) to use the laser energy under direct vision and create a circle of ablation around the entrance to each pulmonary vein predominantly for patients with paroxysmal AF. A potential benefit of this approach is that the inflated balloon pushes blood away from the heart tissue so that all of the laser energy penetrates the tissue. This technology is still not used in many hospitals, and the numbers of ablations performed with it to date are much smaller than those with either radiofrequency or cryoablation. Initial results both in terms of success and risk look promising, and more experience with its use in the future will determine whether it is used more widely.

The benefits of catheter ablation

The desired outcome of a catheter ablation procedure is to stop, or significantly reduce, debilitating symptoms caused by AF, by blocking the ectopic impulses travelling from the atria to the ventricles, restoring a normal heart rate and rhythm. Trial evidence suggests that the overall success rate in achieving this (i.e. stopping AF/symptoms caused by AF) is between 85-90% after two ablation procedures with paroxysmal AF and about 70-80% with persistent AF. There is a lower success rate when only one procedure is carried out – with approximately 40-50% not requiring further ablation procedures. More research is needed to provide stronger evidence for using cardiac ablation as studies so far are on a limited number of patients and follow-up is only over a relatively short period of time.

Safety of catheter ablation

By this we mean risks or complications involved in the procedure. When deciding whether or not to undergo the ablation, the risks need to be balanced against the potential benefits.

If there is very little to be gained, even the smallest risk may make a procedure unacceptable. When considering ablation for AF it should be remembered that the main reason for undergoing the ablation is to improve your quality of life by reducing or eliminating symptoms that result from the AF.

The amount of improvement you hope to achieve should, be a balance of the likelihood of success, the number of ablation procedures that may need to be undertaken, and the risk of complications that accompany each ablation procedure. Although some research suggests that AF ablation can improve the heart's pumping function in some patients, and reduce the risk of stroke, this is not clearly established. Improving symptoms and quality of life are the main reasons for having the procedure, and patients at high risk of stroke are strongly recommended to continue anticoagulation even after an apparently successful ablation.

Side effects of AF ablation

A side effect is an unintended consequence of the procedure. It is not necessarily the same as a complication. An example of a side effect may be chest discomfort during the first few days after an ablation, due to inflammation around the heart (pericardial inflammation), from the ablation burns. This is not unexpected as it is a natural consequence of the treatment, usually mild in nature and disappears after a few days treatment with simple pain killers.

Another side effect is the development of left atrial tachycardia which sometimes occurs in patients in whom AF is eliminated, but the ablation burns lead to a different rhythm disturbance. This may require treatment in the first few months after the ablation with drugs and/or cardioversion, but may then settle down and does not mean the ablation has been unsuccessful.

Unexpected consequences of AF ablation

By this it is meant a complication or side effect that is likely to have resulted from the procedure, but had not been reported or identified as a potential risk before.

It may not have been expected because it is extremely rare, has not been reported before in the medical literature, or has not been recognized as a complication of AF ablation. Of course, by chance, patients occasionally suffer illnesses and adverse events that follow AF ablation, but were not caused by the procedure. Sometimes it is impossible to tell if these adverse effects are linked to the procedure or just coincidence.

In other words, it would not have been mentioned as a potential complication during the consent process prior to the procedure. An example of an unintended consequence could be the discovery, after treating a patient with persistent AF, that the AF had been successfully eliminated, but the heart's natural pacemaker, the sinus node, does not function well and an artificial pacemaker is needed.

Because many patients undergoing ablation for AF need more than one ablation procedure (some eventually undergoing two, three or even four of them), the failure of the procedure to control the arrhythmia adequately is not classified as a complication.

The cardiologist or arrhythmia nurse must mention complications that are either frequent and/or serious as part of the informed consent process,

but it is impossible and indeed inappropriate to mention every conceivable complication, adverse outcome, side effect or unexpected consequence of the procedure. Most cardiologists will quote figures derived from national and international publications. Some institutions may be able to provide locally derived information based upon their own track record.

What happens during the procedure?

Catheter ablation is carried out in a cardiac catheter laboratory, a room which is similar to an operating area. The procedure may be performed under sedation and local anaesthetic or a general anaesthetic, depending on the local policy. This means that you may be conscious, but you can be given medicines to prevent pain and to make you drowsy. There will be a team of people present, some of whom you may have met before.

The doctor (or electrophysiologist) will carry out the procedure with the help of a physiologist (cardiac technician), who provides technical support. A nurse will also be on hand to look after you, and assist the doctor and a radiographer, who will assist with the x-ray equipment.

Before the procedure starts you will have adhesive patches attached to areas, such as your arms, back, chest and legs. These are necessary to monitor you and to allow all the equipment to work normally. There will be a blood pressure cuff on your arm, which will inflate during the procedure and a clip on your finger measuring the amount of oxygen in your blood. It may be necessary for you to wear an oxygen mask.

The procedure is performed with long thin wires called catheters, which are guided into your heart via tubes inserted in the groin veins. These are often inserted into either or both groins and sometimes into your neck or under your collar bone. First these areas will be cleaned and covered with sterile drapes (paper or cotton sheets), and then you will have local anaesthetic injected at these sites, similar to that used at the dentist. Although this will sting for a few seconds, it will cause the skin to become numb so that the insertion of these tubes is painless.

You may be asked to lie with your arms by your side during the procedure. If this is the case, you should avoid moving and ask a member of staff for assistance i.e., to scratch your nose or move things for you. This is to avoid disturbing any

of the equipment by lifting your arms from under the sterile drapes! The first part of the procedure is to introduce several wires into the veins of the leg (or neck), move them into the right atrium, and from there to the left atrium. This last movement is done by making a small puncture hole between the right and the left atrium.

This is called a “transseptal puncture” and it allows your specialist doctor to perform ablation in the left atrium. The catheters are then placed into the left atrium and ablation is performed. You may feel some chest pain at this point and if this is too unpleasant you should ask for more painkillers.

Throughout the procedure a nurse will be monitoring you closely and he/she will always be available if you need anything, such as painkillers or sedation.

What happens after the procedure?

Immediately after the procedure you will be returned to the cardiac floor where your heart rhythm and your blood pressure will be monitored closely, as will the puncture sites in your groin or neck.

The tubes in your groin and neck will be removed, either in the cardiac catheter laboratory itself or on the cardiac floor. It is usual to be discharged home the next day, again with instructions regarding your anticoagulation and other medications. It is important that these are followed carefully.

Most patients recover quickly from the procedure, however it may take up to one to two weeks to feel completely normal again, partly as a result of the sedative drugs or general anaesthetic used. Recovery from the procedure varies from one individual to another, but most normal daily activities can be resumed as soon as you feel able. It is best to avoid heavy lifting and strenuous exercise, such as going to the gym, for at least two weeks to allow your groin(s) to heal properly. Although there are no formal rules, it is generally advisable to avoid flying for at least one week after an AF ablation.

You should be given a phone number so that you can call for advice if you run into any difficulties.

Fleeting pains in the chest, shoulders or neck, which feel like a “stitch”, are quite common in the first few weeks and are related to inflammation from the ablation procedure. These symptoms should settle quite quickly,

often responding to simple painkillers such as Tylenol. If these pains continue for a longer period of time, or if you become very breathless after the ablation, you should contact the hospital that carried out your ablation for advice. If you feel very unwell for any reason you should go immediately to your nearest Emergency Department.

It is also common to be aware of extra or missed beats in the first few weeks. However, if you experience a prolonged period of palpitations (longer than 60 minutes) you should contact the hospital that performed your ablation for further advice. Prolonged palpitations do not necessarily mean that your ablation has been unsuccessful; but some patients may require a cardioversion to restore sinus rhythm. Any decision about the need for further ablations will generally not be made until three months after the first one.

Will I be able to stop my medication after the procedure?

Heart rhythm tablets:

If the procedure is successful you should be able to stop most of your heart rhythm drugs. Your specialist may wish to keep you on some of these medications for a few weeks or months to allow your heart to recover and get used to being in a normal (sinus) rhythm again. In some situations these drugs may be controlling another problem, such as blood pressure (e.g. beta blockers) in which case you may be advised to continue them.

Anticoagulants:

If you were taking an anticoagulant before the procedure you will need to continue this for a period of time afterwards, depending on your doctor's guidance. Even if your heart remains in sinus rhythm, you may still be advised to continue the anticoagulant to reduce your risk of stroke in the future.

The circumstances for each patient are different and you will need to discuss this with your doctor and/or arrhythmia nurse.

**DO NOT
CHANGE OR STOP
TAKING YOUR
MEDICATION
WITHOUT
CONSULTING
YOUR DOCTOR
FIRST**

Will the procedure work for me?

The success of this procedure depends on several factors:

- The type of AF you have (paroxysmal, or persistent)
- Whether or not you have any other heart disease
- The experience and the equipment available to the hospital where you have the procedure performed

You should discuss these factors with your heart rhythm specialist.

To achieve the levels of success for paroxysmal and persistent AF, it may be necessary to undergo two or more procedures. For persistent AF, the shorter the time you have been in AF, the better the results are more likely to be. Many hospitals feel that persistent AF present for more than three to five years has such a low chance of success that they will not recommend catheter ablation as an appropriate therapy option.

Current figures report that approximately 30-40% of people will require more than one AF ablation procedure, and this figure rises to 50% for those with persistent AF. The need for a second or third procedure is normally due to the recurrence of symptomatic AF or the development of left atrial flutter/tachycardia. This occurs in a small proportion of patients in which the fibrillation is abolished but the ablation lesions promote more organized rhythm disturbance.

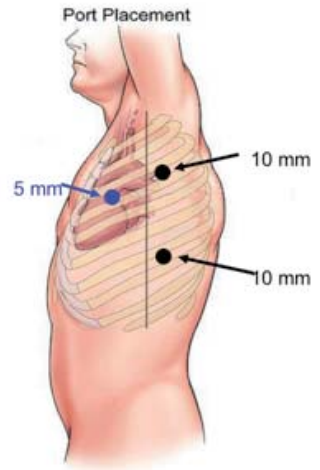
Surgical ablation

A surgical approach for the treatment of AF has been proven to be effective for a wide range of AF patients, even some with chronic AF. Surgical therapy for AF has until recently been reserved for a carefully selected group of patients who have failed medical therapy and are at risk of complications from medications or strokes. Recent advances in surgical therapy have changed this.

Criteria for selection have changed a lot in recent years, and surgical ablation is now established as a first or second line therapy. Collaboration between EP cardiologists and cardiac surgeons is also increasing, allowing a combined approach to the best treatment, and in some cases a hybrid procedure combining the advantages of surgical and catheter ablation.

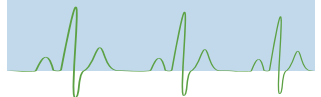
In recent years, the development of a range of alternative energy sources and techniques has made the surgical approach less complex and more widely available.

Surgical ablation approaches the heart from the "outside" under direct vision (as opposed to catheter ablation which approaches the heart from the "inside" via your blood vessels). As a result, it is much easier to demonstrate a complete conduction block, abolishing the AF.



"Life was becoming intolerable, my work, social life and fitness suffered. Minimally invasive surgical ablation offered me a chance of normality."

Tim, AF patient
Aged 55



Open-heart surgical ablation

Many patients have been treated successfully with an open-chest surgical ablation (cut and sew) operation often called a “Cox-Maze” procedure. It can be successful, but it is highly invasive, requiring open-heart surgery and heart-lung bypass. It is quite complex and has largely fallen out of favor with the advent of radiofrequency (RF) ablation and other modalities of ablation that do not require open heart surgery.

Ablation can now be performed in the open chest, but it does not usually need the heart to be stopped nor bypass to be used. It is almost always performed at the same time as another procedure requiring an open chest such as a bypass operation or a valve replacement. This is called concomitant ablation. There are now guidelines endorsing concomitant ablation for appropriate patients with AF undergoing other cardiac surgical procedures.

In addition to the ablation, it is usual for the surgeon to remove or close off a small outpouching of the heart, the left atrial appendage, that is believed to be the main site where AF-related stroke causing blood clots form during atrial fibrillation. This is one of the key advantages of surgical ablation over catheter ablation, as it greatly reduces the risk of an AF-related stroke whether or not the ablation is successful.

Minimally invasive surgical ablation

Doctors have developed a minimally invasive approach often called the “mini-maze”. It is similar to open-chest ablation except the surgeon gains access to the heart through three small “ports” (holes) on the chest. These ports are no more than 1cm in size and heal almost invisibly. This procedure is also called a “VATS” ablation (video assisted thoracoscopic surgery), and is only performed in a small number of specialist centers.

The VATS (or mini-maze) approach allows the surgeon to operate on the beating heart, avoiding the need for heart-lung bypass. As in the open-heart procedure, an energy source is then used to make precise scars, or ablations, on the heart to block the abnormal electrical impulses causing the AF.

Again, it is standard practice to remove the left atrial appendage, believed to be the primary site of AF-related stroke causing blood clots.

The procedure is performed under a general anaesthetic, and it is normal to go home within a few days. There is usually only a bit of discomfort and most people do not find it painful.

For people who suffer from AF, but are otherwise fairly healthy, a minimally invasive ablation procedure (VATS ablation) offers a low risk option with excellent results.

You may wish to discuss this procedure with your doctor if:

- You have AF symptoms that are severely interfering with your quality of life.
- Your medications are not working or you cannot tolerate their side effects.
- You are at risk for forming clots and having a stroke.
- You have had a catheter (lab-based) ablation that did not work or was unpleasant so you do not want to try it again.

An important paper was published comparing catheter and surgical ablation.

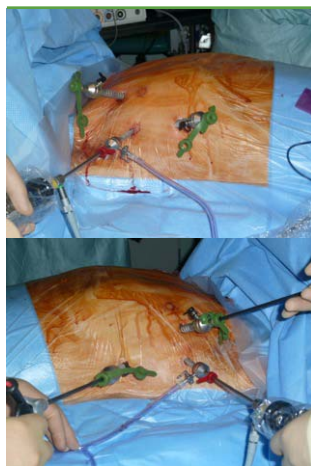
An online version of this paper is available at: <http://circ.ahajournals.org/content/early/2011/11/13/CIRCULATIONAHA.111.074047>

What to expect after a minimally invasive surgical ablation

You may have episodes of AF in the early, post-operative, period. These are caused by inflammation of tissue that has been ablated and usually stop within a few months.

During this time, you will be asked to continue taking your anticoagulant therapy and other medications prescribed to manage your AF. Your surgeon, cardiologist or primary care physician will decide and discuss with you when you should decrease or stop taking these medications.

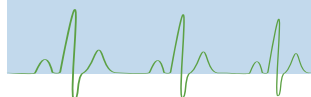
It is the intended aim of surgical ablation to achieve a complete control of the AF and, if successful, to enable patients to stop taking anticoagulation and antiarrhythmic medication. These can only be stopped if the AF is completely cured, so it is likely that you will need certain heart investigations such as an echocardiogram to determine this. It is also probable that you will be asked to wear a heart monitor for several days to monitor and ensure that your heart rhythm is normal. In some cases the residual risk will mean that you need to stay on anticoagulation even if the ablation is successful.



"The whole procedure was smooth and relatively painless."

I was home within a couple of days, took it easy for a while and then returned to work and full health after a relatively short time"

Tim, AF patient
Aged 55



Are there any risks associated with ablation for AF?

Unfortunately, all procedures that involve the heart have a small risk of a serious complication. It is important that you understand what these risks are, so you can make the decision of whether you want to have the procedure performed. These will always be discussed with you by your doctor before the procedure.

Minor problems that may occur are chest pain during the ablation (which may feel like severe indigestion) or bruising and soreness in the groin after the procedure. An x-ray is used during the operation, which could damage an unborn child. You must tell your consultant if there is any chance you could be pregnant. Serious complications are fortunately unusual. Overall there is a serious complication rate of between 2-4%, depending on your local center.

A **pericardial effusion** is a collection of fluid (usually blood) contained in the sack surrounding the heart. In the setting of an ablation it is usually the result of perforation of the heart muscle, with subsequent bleeding into the space around the outside of the heart. It is most likely to occur during the time of the ablation procedure, and is due to trauma from the wires or burns required to perform the ablation.

The blood thinners used to prevent blood clot formation contribute to the bleeding risk. A collection of blood around the heart can compress it and reduce its ability to pump effectively, causing a fall in blood pressure (cardiac tamponade). During the ablation procedure, continuous blood pressure monitoring is used to alert the medical team to the possibility of tamponade. Small pericardial effusions may not cause any disturbance. The diagnosis is confirmed by performing an ultrasound scan (echocardiogram). Small effusions usually don't require treatment but if tamponade occurs urgent action is required. A small tube (pericardial drain) is inserted under the ribs and breast bone into the pericardial space to drain away the excess fluid.

The drain may stay in for a day or so until the echocardiogram shows the blood has gone and there is no further bleeding. The drain may be uncomfortable, causing sharp chest pains, and painkillers are often required. The inflammation from the pericardial effusion may even provoke an attack of atrial fibrillation. Blood thinning medication is often withheld for a few days before being restarted. Very rarely, if there is ongoing bleeding which does not stop, urgent heart surgery is required to find the damage and repair it.

Pulmonary vein stenosis (PV stenosis) is a recognized complication associated with atrial fibrillation ablation. The PVs are blood vessels that drain blood into the left atrium from the lungs. Stenosis of the PVs means that the veins become abnormally narrowed as a result of the ablation treatment within the region of the pulmonary veins. One or more pulmonary veins need to be severely narrowed before symptoms are noticed. PV stenosis has become less frequent, as nowadays ablation is usually in the atrium around the veins, rather than inside the veins. However, modern techniques now involve burning in the atrium rather than the vein itself, and the incidence of PV stenosis has fallen and is now a very rare complication in most centers. Typical symptoms of PV stenosis include breathlessness, coughing and haemoptysis (coughing-up blood). The diagnosis is made using MRI or CT scans and nuclear perfusion scans. PV stenosis is often left untreated, but sometimes angioplasty (stretching open the narrowed vein with a balloon) is undertaken.

Stroke is perhaps the most feared complication of ablation for atrial fibrillation. It occurs when the blood supply to the brain is affected, usually by a blood clot blocking a blood vessel, but may also be due to bleeding within the brain. The ablation procedure takes place in the left atrium, from which blood is pumped out of the heart directly to the brain and other vital organs. If the ablation causes a blood clot, debris or air bubble this may be pumped into the head and block a blood vessel.

To minimize this risk great care is taken during the procedure and blood thinning medication (heparin) is infused to reduce the risk of clot formation. The cardiologist will also thin the blood with warfarin or another anticoagulant after the ablation procedure while the heart settles down. Currently, patients at high risk of AF-related stroke are recommended to continue anticoagulation indefinitely even if the ablation appears to have been successful. This is because "silent AF" which is not felt by the patient, is quite common, and the first sign of AF recurrence may be a stroke. Also the risk of stroke is possibly affected by age, the extent of the ablation procedure and the patient's other medical problems.

The need to anticoagulate the blood during and after AF ablation means that a slightly increased risk of bleeding complications is the price paid to protect against the much more devastating complication of stroke or heart attack.

A **false femoral aneurysm** is when blood leaks out of an artery in the leg at the site of the needle puncture, but is contained by the surrounding tissue, creating a pouch. It usually happens within a day or two of the procedure and may be the result of straining or movement. The blood thinning required after an ablation may contribute to its occurrence.

A false femoral aneurysm is usually painful (which may feel as though it is pulsating) and a lump may be found. Some of the blood will clot and dissolve, causing a dramatic bruise. The diagnosis is made by examining the puncture site and confirmed using an ultrasound scan.

Treatment varies depending on the extent of the leak. In some cases observation is sufficient, as the clot will reabsorb naturally. Occasionally a radiologist or vascular surgeon will treat the problem by injecting thrombin, a clot-forming drug, to seal the leak. Alternatively, surgical correction to sew up the hole may be required.

An **atrio-esophageal fistula** is an extremely rare but very dangerous complication. This is a hole that forms between the back of the left atrium and the esophagus (gut) which lies just behind. This hole allows air bubbles and esophagus contents into the blood circulation. It is caused by an inflammatory process triggered by the ablation burns. Signs and symptoms can appear without warning in the first few weeks after the ablation procedure: typically, patients are extremely unwell with high fever, chills, stroke, collapse or vomit blood.

Immediate recognition and treatment is vital. If you have the above symptoms you should seek emergency medical help and make sure this complication is considered. Because atrio-esophageal fistula is so rare (one in every 1000-2000 cases), it may not be suspected by doctors who do not undertake AF ablation. Diagnosis must be made urgently using a special scan (usually CT). Endoscopy (telescope of the esophagus) should generally be avoided as it may worsen the condition. If atrio-esophageal fistula is present, it is unfortunately usually fatal, but emergency chest surgery has occasionally saved the patient's life.

Phrenic nerve palsy The phrenic nerve controls the diaphragm, one of the important muscles involved in breathing. There is one phrenic nerve for each side of the diaphragm.

On the right, the phrenic nerve runs down immediately in front of the pulmonary veins and may be damaged during catheter ablation of AF. Phrenic nerve palsy is seen more commonly with cryoablation than radiofrequency ablation. During cryoablation of the right sided pulmonary veins, phrenic nerve function is monitored continuously and ablation can be stopped immediately if there are warning signs. Phrenic nerve palsy usually causes some degree of breathlessness. A chest x-ray confirms the diagnosis. There is no specific treatment, and in most cases recovery is complete, taking up to a year.

A **retroperitoneal bleed** is when there is a leak from the femoral artery that enters the area around the back and kidneys rather than around the groin. It causes pain, low blood pressure and may interfere with kidney function. Treatment usually involves blood transfusion and stopping blood thinning medication. In severe cases, vascular surgery may be required.

Pneumothorax (collapsed lung), is caused by accumulation of air or gas in the pleural cavity around the outside of the lungs. This occurs as a result of injury during insertion of the tubes into the subclavian veins, which lie under the collar bone. Many operators do not insert tubes into the subclavian veins, preferring to do everything from the femoral (leg) veins. Depending on the size of the pneumothorax, treatment varies from observation to insertion of a chest drain, which allows the lung to re-inflate.

Death is fortunately a very rare complication of ablation. It could potentially result from a number of mechanisms including stroke, cardiac tamponade, myocardial infarction (heart attack), aortic dissection or atrio-esophageal fistula. Extremely rare drug reactions or anaesthetic complications are also a remote possibility. The risk of death from AF ablation is about one in 1000.

Places where you can find out the risk of complications following ablation

1) Your own hospital's track record

Your specialist will be able to tell you the frequency of complications in patients who have undergone ablation in their hospital. Many hospitals will also publish their results and complication rates on the internet.

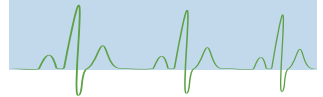
2) Case series and registries

Many large hospitals or groups of hospitals report their results in medical journals. These can be useful for determining risk of complications following ablations. By combining results from many hospitals and large numbers of patients, we can get a good estimate of the frequency of the less common but more severe complications (such as stroke and death) following ablation.

3) Published trials

Several scientific studies are carried out each year into AF ablation. The results of these studies are often published in scientific journals. These reports will almost always include details of complications experienced by the patients in the studies.

This procedure carries only small complications but is not suitable for everybody as permanent pacing of the lower chambers (ventricles) may not be good for long term pumping function and may not make them feel any better. It does not mean that anticoagulation can be stopped.



Summary

- The risk of suffering any major complication following ablation for AF is probably between 2% and 4% across the board.
- There is about a 0.5% risk of a stroke, although in around half these cases the symptoms resolve themselves. The risk of stroke may be higher in patients over 65 years of age.
- The risk of significant narrowing of one of the veins draining into the heart from the lung (pulmonary vein stenosis) is between 0% and 1.5% but seems lower in more recent studies.
- The risk of bleeding around the heart requiring the insertion of a drain (cardiac tamponade) is between 0.5% and 2%.
- The risk of a problem with the arteries or veins in the groin which are used to place catheters in the heart is between 1% and 2%.
- The risk of death as a result of an ablation is about one in 1000 procedures (0.1%).
- The incidence of atrio-esophageal fistula is probably around 1 in 1-2000, but this catastrophic complication is often diagnosed late as it may occur without warning up to two months following ablation. Emergency diagnosis and treatment are vital.

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Alternative procedures

Pacemaker and AV node ablation for AF

Often referred to as “pace and ablate”, this procedure is more commonly considered in patients who are symptomatic but assessed as unsuitable for catheter or surgical ablation, or whose previous ablations have been unsuccessful.

The approach allows the atria to remain in fibrillation but seeks to control the way this affects the overall heart beat which travels from the atria into the ventricles. The electrical link between the atria and the ventricles is known as the atrioventricular node (AV node).

AV node ablation may usually involve firstly implanting a pacemaker usually done as a day-case procedure. Once the pacemaker leads have settled (approximately six weeks after implant), you will be called back into hospital for a review and then prepared for AV node ablation.

Again, for this procedure you are usually only in the hospital for the day. AV node ablation involves destroying the AV node with heat (radiofrequency ablation) in order to prevent the abnormal, irregular impulses being transmitted to the ventricles. Once this has been done the ventricles will usually contract at a very slow rate. For this reason the pacemaker has to be implanted first so that it is in place and ready to begin pacing the heart rate at a level sufficient for normal activity – usually between 70-120 beats per minutes, although this can be adjusted to suit each individual’s needs.

Ablation of the AV node cannot be reversed so people who undergo this procedure are dependent on a pacemaker for the rest of their life. A “pace and ablate” strategy is most useful in those who suffer with moderate to severe palpitations and a high pulse rate when in AF.



Specific and strong heart rhythm drugs:

Drugs such as amiodarone and flecainide are used to keep the heart in its normal rhythm thereby aiming to minimize the episodes (paroxysms) of AF. Both drugs can also be used to return normal sinus rhythm when the heart has changed its rhythm to AF but does not revert back on its own. As with all medication, the side effects and its overall effectiveness vary from person to person. In addition, these drugs are not suitable for everybody. There are new drugs in development for AF treatment, and some drugs are available in other countries. Your own specialist should be happy to discuss drug treatment options with you.



Providing information,
support and access to
established, new or
innovative treatments
for atrial fibrillation

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Registered Non-profit 501 (c)(3)

© AF Association
Published July 2015
Reviewed September 2018

AF Association would like to thank all those who helped in the development and review of this publication. Particular thanks is given to Dr. Charlotte D'Souza, Dr. Nick Linker, Dr. Francis Murgatroyd, Dr. Kim Rajappan, Tara Meredith, Dr. Andrew Grace, Professor Richard Schilling, Dr. Tim Betts, Dr. Joseph De Bono, Angela Griffiths, Dr. Simon Sporton, Dr. Matt Fay, Dr. Oliver Segal, Mr. Jonathan Hyde and Mrs. Michael Lewis, Mr. Bob Dove and Mr. Tim Cross for their work on this particular booklet.

Founder & CEO:

Trudie Lobban MBE, FRCP (Edin)



If you would like further details on the sources of our information or would like to provide feedback please contact AF Association. Please remember that this publication provides general guidelines only. Individuals should always discuss their condition with their own doctor. This booklet is intended for individuals affected by atrial fibrillation. It provides information about assessment, the procedure and what to expect during and afterwards. Information within this booklet is based upon clinical research and patients' experiences.

