

Treatment Options for Atrial Fibrillation



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.

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

Atrial fibrillation (AF) A common heart rhythm disorder that causes an irregular and often abnormally fast heart rate.

Beta Blockers A drug that blocks the sympathetic nerve endings, thus slowing the heart rate.

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

Catheter Ablation A treatment which destroys a very small (microscopic) area of tissue inside the heart which is causing an arrhythmia.

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 a bypass or valve surgery.

Cryoablation Catheter ablation using freezing rather than heat energy.

DCCV (Direct Current Cardioversion) Technique using an electrical shock to convert the rhythm of the heart to normal sinus rhythm.

Contents

The Heart in Normal Sinus Rhythm

Why treat AF and what are your options?

Drug treatments for AF

Rate or rhythm control

Cardioversion

Ablation Strategies for AF

- Preparing for an ablation
- Recovering from an ablation

Pacemaker & AV Node Ablation

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

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

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 sinus 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.

Sinus rhythm Normal rhythm of the heart.

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

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

The heart during normal rhythm

The heart is a muscular pump which delivers blood containing oxygen to the body. It is divided into two upper chambers, or “atria”, which collect blood returning via the veins; and two lower chambers or “ventricles”, which pump blood out through the aorta (main artery) and to the lungs.

The pump has a fuel supply (blood delivered to the heart muscle via the coronary arteries) and an ignition or timing system (the electrical system of the heart). Normally, the heart beats in a regular, organised way, at a rate of 60-100 beats per minute.

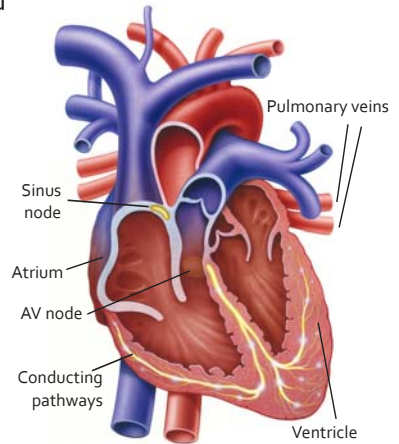
This is because it is driven by the “sinus node”, an area of specialised cells in the atria which emit electrical impulses that then travel through the atria, causing the muscle cells to contract.

These electrical impulses spread through the right and left atria in a smooth and uniform manner, and then into the ventricles via a single connecting junction (the “AV node”) as shown in the picture.

The sinus node is the body’s natural pacemaker, triggering each heart beat according to the needs of the body. During exercise, the heart rate speeds up.

When the heart is beating normally like this, we refer to it as “sinus rhythm” or “normal sinus rhythm”. For the heart to maintain a normal sinus rhythm it needs both a working sinus node, and for the cells of the atria to be able to conduct the electrical impulses smoothly.

The heart and normal conduction



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The heart in atrial fibrillation (AF)

During a burst of AF, the heart beat is often rapid, irregular and of varying intensity. This can cause unpleasant symptoms of palpitations, light headedness, breathlessness, chest pain and may even lead to fainting. If these episodes are intermittent, then it is termed paroxysmal AF (PAF).

In many patients however, the heart is in the irregular rhythm continuously, when it may be termed persistent or permanent AF. In this situation some patients complain of constant tiredness and lack of energy. AF occurs when the sinus node loses control of the heart rhythm.

Paroxysmal AF is due to other areas of the atrium producing rapid, uncontrolled electrical impulses, often from the four pulmonary veins, which bring blood back to the atria from the lungs.

In permanent or persistent AF, the electrical activity of the atria is continuously chaotic, because the cells of the atria do not conduct electrical activity smoothly. Because of this rapid activity, the sinus node has no opportunity to control the heart rhythm.

While the mechanisms of paroxysmal and persistent AF are slightly different, the end result in both situations is rapid and chaotic quivering of the atria.

The connecting junction (the AV node) protects the lower pumping chambers (the ventricles) from going too fast; however, it may conduct extra impulses and as a result the heartbeat (which is produced by the ventricles) can sometimes be very fast and erratic. Normal heart rhythm can often be restored either by using drugs or resetting the heart with a shock (cardioversion).

However, AF usually returns at some point in the future. In some patients the symptoms of AF can be controlled with drugs that control the rate at which the ventricles beat (digoxin, calcium channel blockers, or beta blockers), combined with an anticoagulant to prevent an AF-related stroke. If these measures have failed, your doctor may advise you to undergo an ablation procedure.

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 an AF-related 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 a 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.

Drug treatment for AF

Commonly, the initial treatment of AF is with drug therapy. Other non-drug therapies, such as cardioversion, ablation and pacemakers are generally used for AF patients whose quality of life is affected by AF. It is best to discuss the available treatment options with your doctor. The drugs used to restore the normal heart rhythm are known as antiarrhythmic drugs. They work by blocking specific electrical conduction channels in the heart. Some drugs slow the activation of the heart muscle, and others slow the recovery of the heart muscle.

Drugs of a certain class are effective for particular rhythm disturbances, so your doctor will make an assessment based upon your symptoms and the details of your diagnosis.

Although different classification schemes have been proposed for antiarrhythmic drugs, the one that most physicians use is the Vaughan-Williams classification. This describes seven different classes of antiarrhythmic drugs (Table 1).

Table 1:

The 'Vaughan-Williams' classification for antiarrhythmic drugs

Class	Kind of drug	Examples
Ia	Sodium channel blockers	Disopyramide
Ib	Sodium channel blockers	Lidocaine, mexiletine
Ic	Sodium channel blockers	Flecainide, propafenone
II	Beta blockers	Bisoprolol, atenolol
III	Potassium channel blockers	Sotalol, amiodarone
IV	Calcium channel blockers	Verapamil, diltiazem
V	Direct nodal inhibitors	Digoxin

Rhythm or rate control

A rhythm control strategy aims to use medication to return the heart to its normal rhythm. It is a major goal of AF management, because symptoms can be relieved, and the risk of stroke and other complications can possibly be reduced, but not eliminated. A number of drugs are available to restore the normal heart rhythm. Sometimes your doctor might decide to accept that rhythm control drugs will not work. In the case the doctor may use antiarrhythmic drugs to prevent your heart rate from going too high. Drugs are usually effective with either rhythm control or rate control but have side effects, so they need to be monitored. Ask your doctor if you have any concerns prior to commencing treatment.

Class I drugs work by blocking the sodium channel in the cardiac cell.

- **Class IA** drugs are called membrane stabilising agents which decrease excitability of the heart cells. The action potential is lengthened by class 1a agents. Disopyramide is still used for some forms of AF.
- **Class IB** drugs are not commonly used in AF, because they are rarely effective. They lengthen the duration of the action potential, thus decreasing the heart rate.

RATE CONTROL FOR AF

Rate control refers to slowing the irregular heart rate without attempting to restore the normal heart rhythm.

Rate control is not inferior to rhythm control and is an attractive alternative in patients with a high risk of AF recurrence.

Drugs used to slow the heart rate aim to improve symptoms and prevent the effects of an uncontrolled irregular fast heart beat.

- **Class IC** drugs are commonly used to treat AF, and are very effective. They are used in patients with no history of a previous heart attack and normal heart function. These include flecainide and propafenone. However, rare side effects include unstable cardiac rhythms or excessive slowing of the heart rate. They are generally reserved for younger patients with AF and no structural heart disease. Patients taking these drugs should be monitored carefully by their doctor.

Class II drugs, beta blockers, are commonly used to slow the heart rate and are effective in active patients. These include bisoprolol, atenolol, metoprolol, etc. They act by blocking the effects of adrenaline and other similar hormones, thereby decreasing sympathetic activity on the heart. They can only be used with great care in patients with asthma or emphysema and in patients with slow heart rates. Patients taking these medications will need their blood pressure and heart rate checked regularly by their doctor. The most commonly reported side effect is tiredness. Beta blockers will also stunt your heart rate response to exercise. You should be aware of this if you monitor your heart rate during exercise.

Class III drugs work mostly by blocking the potassium channel in the cardiac cell. These drugs include sotalol and amiodarone. Sotalol is also a beta blocker and slows the heart rate, but at higher doses can act to stabilise the heart rhythm. The main side effects are related to slow heart rate and low blood pressure, causing symptoms of tiredness or fatigue, dizziness or fainting.

Sotalol can be dangerous if a patient has an illness with diarrhoea and vomiting. Sotalol should not be used if potassium losing diuretics are prescribed. Studies have shown amiodarone to be one of the most effective antiarrhythmic drugs. It is also safe to use in the elderly and in patients with underlying heart conditions. Amiodarone has many side effects (pulmonary fibrosis, thyroid abnormalities, corneal deposits, abnormal liver function tests, and skin sensitivities) so needs regular monitoring by health care specialists.

Class IV drugs

Verapamil and diltiazem are class IV drugs which also slow the heart rate. They have to be used with caution in patients with heart failure. Adverse side effects relate to flushing, headaches, low blood pressure and ankle swelling. Any adverse side effects should be reported to your doctor immediately. Patients taking these medications should have their blood pressure and heart rate checked by their doctor. Combinations of beta blockers and calcium channel blockers can only be used with great care, bearing in mind the underlying heart pumping function. Diltiazem is a calcium channel blocker which acts by interfering with calcium in the heart cells. It works by affecting the cells calcium channels which influences the heart's electrical activity. The tablets can come in a huge variety of doses and types (slow-release/modified release/retard/long-acting).

Class V drugs

In less active patients, digoxin can be used. Digoxin decreases conduction of electrical impulses through the AV node and increases vagal activity leading to an overall decrease in speed of conduction. The result is a decrease in heart rate. Combinations of digoxin and beta blockers may be required to achieve effective rate control. However, given its ineffectiveness during activity, it is not routinely used for rate control.

Rate vs rhythm

Unfortunately, there is no 'one size fits all' answer to the management of AF. Multiple drugs may be tried and adjusted until one is found that achieves the desired goal of optimal rate or rhythm control with minimal side effects. Physicians and patients must tailor the choice of drug to each individual. All drugs have the potential to cause side effects.

It is important to consult your physician if you experience any side effects related to your treatment and to have regular follow up to check your blood pressure, heart rate, ECG and any blood tests required to monitor progress. Exercise testing or ambulatory ECG monitoring may be used to check the quality of rate control.

Other medication

AF may occur in association with other disorders (but by no means always), so you may be taking a number of drugs. These drugs are necessary, so must be continued, however you must inform each doctor you see of all the drugs you are currently taking. Always remember to take your prescription or the original packets / boxes for ALL your tablets whenever you visit a nurse or doctor. This will help reduce mistakes in prescribing and helps when the doctors and nurses need to communicate about your treatment.

When taking a complicated 'cocktail' of drugs it can be hard to remember which tablets to take and when. It may be worth considering getting a tablet box which sets out all the tablets you need for the day or week, and helps you to take them correctly and on time. It is also wise to check your tablets every time you have a new prescription – mistakes can be made. Sometimes your tablets may look different because they have come from a different manufacturer (even though the drug is the same).

Medication for infrequent/ paroxysmal AF

In some patients with infrequent or intermittent AF, a 'pill in the pocket' approach may be used so that patients can simply take a single dose of the drug when episodes occur. However, this approach is reserved for a select group of patients. The NICE guidelines recommend a 'pill in the pocket' strategy

DO NOT GET PREGNANT ON ANY OF THESE DRUGS

When drugs are tested, pregnant women are not enrolled in the studies. We simply do not know for many drugs what the effect would be to the baby. Therefore if you are trying to get pregnant, are pregnant, or are breast feeding, it is important that you consult a specialist.

can be considered for those who: i) have no history of cardiac or coronary disease, ii) have a history of infrequent symptomatic episodes of AF, iii) have a systolic blood pressure > 100 mmHg and a resting heart rate above 70 beats per minute, and iv) are able to understand how and when to take the medication. You must consult your physician to discuss whether you may be suitable for this treatment option. Also, using the drug this way will not prevent attacks and the inconvenience caused by them. In addition, it will not affect the natural history of AF which is of more frequent, longer-lasting attacks leading to persistent AF. Please see AF Association's Pill in the pocket factsheet for more information.

What should I do if I feel really ill with my tablets?

Contact your physician BEFORE stopping any medication, as sudden cessation of treatment can sometimes result in an unpleasant return of your AF, perhaps worse than before treatment. Your doctor will arrange to see you or give advice about what to do. If you feel too unwell to contact your GP, you should consider visiting A&E, taking all of your medication with you.

Some medication used to control AF stays in the body long after you may have stopped using the medication; and side effects take a while to diminish. Amiodarone (Cordarone X) often causes this problem; it takes many weeks to reach stable levels in the body and takes at least three months to be removed from your body once stopped. This means that changes in dose will take some time to take effect as well as side effects continuing for some time after stopping the drug. Most other drugs are not as persistent as this, but it may take several days for a change in dose to have effect.

**IF IN DOUBT CONTACT YOUR GP, CARDIOLOGIST,
ELECTROPHYSIOLOGIST OR ARRHYTHMIA NURSE.**

How long will I take these tablets?

Unlike antibiotics or some other drugs, medication prescribed to control atrial fibrillation is not 'course', the drugs prescribed are intended to suppress, rather than cure, your AF. Therefore, you should expect to continue these tablets indefinitely unless your GP/doctor changes them or recommends another form of treatment.

Remember that new treatments for AF are being studied all of the time, so there may be other options in the future.

What happens if these tablets do not work?

If your first drug does not work or results in intolerable side effects, there are others available and it may be that your GP/doctor will need to try several drugs before finding the right one for you. This is not trial and error – he/she will know the right type of drug to use, but predicting which one gives you least side effects whilst controlling your AF is rarely possible with an individual patient!

When suitable drugs have been tried, but have had limited or no success, your physician may consider alternative treatments. This may include cardioversion or catheter ablation, or possibly a pacemaker. Catheter ablation is a specialist treatment so it may be necessary for you to be referred to a specialist cardiologist called an electrophysiologist (EP), possibly at a different hospital. Your cardiologist will discuss this with you if the situation arises.

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 minimise 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 but not in the UK. Your own specialist should be happy to discuss drug treatment options with you.

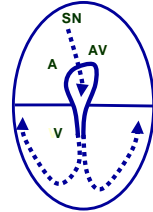
Cardioversion for AF

If AF has been present for only a relatively short time (usually less than one year), if the heart has not been damaged by disease or by the AF itself and if the cause of AF has been treated, is transient or is relatively mild, it may be possible to convert the heart rhythm from AF (or atrial flutter) to the normal heart rhythm (sinus rhythm). This procedure is called cardioversion; it may be achieved by giving the patient a rhythm control medicine (antiarrhythmic drug) by mouth (relatively slow response) or through the veins (relatively quick response). However, an electrical shock treatment, which at first sounds rather frightening, is usually the quickest and the most effective treatment.

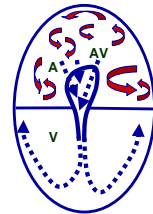
Who should be considered for cardioversion?

During normal rhythm, the electrical impulse that activates the heart starts in the sinus node (natural pacemaker of the heart) and spreads through the atrium towards the AV node (electrical conduction pathway linking the atrium to the ventricle). The impulse passes through the AV node and down into the ventricles, leading to contraction of the ventricles which can then be felt as a pulse (Figure 2, panel A). When AF occurs, the atria are activated electrically 500 – 600 times each minute. At such a fast rate it is not possible for the atria to beat mechanically, but some of the electrical activations penetrate the conduction pathway (AV node) and activate the ventricles (the main pumping chambers of the heart) in an irregular fashion (Figure 2, panel B).

A: Sinus (normal)



B: AF



SN: sinus node (natural pacemaker); A: atrium; V: ventricle; AV node (normal electrical conduction pathway from atrium to ventricle).

Figure 2: Diagrams of the activation of the heart during normal (sinus) rhythm (Panel A) and during AF (Panel B)

The result is often a rather rapid (up to about 180 beats per minute) and irregular pulse rate which the patient may sense (palpitations) or feel because of the chest pain, breathlessness, light headedness or fatigue that this rapid pulse may cause.

Patients with AF may be treated in one of two ways: Either by allowing AF to continue and controlling the pulse rate so that the heart operates at a rate which is close to the normal rate and causes none of the symptoms mentioned above. Alternatively, the physician and the patient may choose to try to convert the AF back to the normal rhythm by cardioversion.

This is usually appropriate if the patient is relatively young (a cardioversion may be considered for older people if criteria are met) and active, suffers from the symptoms of AF despite controlling the pulse rate, has had AF for a relatively short time (usually less than a year) and has no underlying heart or other disease that might be expected to restart the AF.

The treatment options should be thoroughly discussed by the doctor and patient in order to establish the best approach for the individual patient. When AF has only just started but shows no sign of stopping spontaneously, and when the patient is otherwise fit and well, it is easy to decide that cardioversion is the best treatment. However, in most cases before making this decision, a number of tests may be needed.

Preparing for cardioversion

During AF blood may stagnate and clot, particularly in the left atrium. When the normal rhythm resumes and the atria begin to beat mechanically, a blood clot that has formed in the atrium can be ejected into the moving blood stream and circulate to the brain or another vital organ. The blood clot may obstruct an artery, for example in the brain, and the patient may suffer a stroke.

Cardioversion is often considered shortly after the onset of AF. The longer the atria fibrillate, the more likely a blood clot will form. Most physicians use a '24 or 48 hour' rule – if the AF has been present for less than 24 (or 48) hours, the patient does not need to be anticoagulated before cardioversion, although heparin will be injected into the veins at the time of cardioversion in all patients.

Most patients will then be recommended to use an anticoagulant for at least four weeks after the cardioversion procedure. Some who are at more risk than others will be strongly advised that they should never stop taking anticoagulation unless they develop serious side effects.

If AF has lasted for more than 24 or 48 hours there are two approaches to cardioversion. If it is necessary to restore the normal rhythm as quickly as possible, the patient may be offered another test – a trans-oesophageal echocardiogram (TOE) – (see image) performed using a probe which the patient swallows so that it lies in the oesophagus (gullet) at the correct level to look directly into the left atrium. In this way it can be seen whether a clot has formed and whether it is safe to proceed with cardioversion without prior anticoagulation. If a clot is not present, cardioversion may proceed as described earlier with heparin used during the procedure and anticoagulation given after the procedure.

However, if a clot is present or if the patient and physician choose not to use a trans-oesophageal echo test, the patient must be adequately

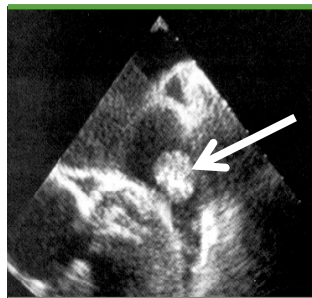


Figure 6: A trans-oesophageal echocardiogram (TOE) showing a blood clot (arrow) in the left atrium.

anticoagulated for at least three weeks (but it often takes much longer) before a cardioversion is attempted. For this the patient may be initiated on anticoagulation treatment by a GP who has established a special service to do this, or at the hospital by a cardiologist working with the anticoagulation clinic. In this clinic, specialist doctors and nurses prescribe and monitor treatment with warfarin and provide literature and advice relating to anticoagulation.

If a patient is anticoagulated with warfarin, the treatment involves taking a carefully prescribed dose of warfarin and checking its anticoagulant effect by measuring a value known as the international normalised ratio (INR). This is a measure of how effectively the blood will clot; the normal value is 1 and higher values indicate 'thinner' blood. An INR level above 2 must be achieved for at least 3 continuous weeks before cardioversion. In order to improve the chance of this, many physicians routinely advise that the patient should aim at values of 3 (or between 2.5 and 3.5) for a period prior to cardioversion. However, the higher the value of the INR, the greater the danger of bleeding, so treatment with warfarin must always be carefully discussed with the prescribing doctor, particularly because alcohol, diet, as well as medicines may interfere with the action of warfarin.

For more information about anticoagulation, please see "preventing an AF-related stroke booklet" by AF Association.

Electrical cardioversion

While this may sound terrifying, it is very simple in principle and a highly effective treatment in carefully chosen patients. The idea is to use an electric shock to activate the whole heart at once. This prevents the continuation of AF rhythm, so after the shock the normal heart beat (sinus rhythm) will be able to emerge.

On the day of the procedure the patient should arrive at the hospital and follow the centre's guidelines on registration and admission.

In the cardioversion unit the patient will meet the nurses and doctors involved with the procedure that day. The cardioversion procedure will again be explained in detail and a consent form may be completed by the person performing the treatment. The patient will be asked to sign the consent form confirming that the cardioversion can proceed and that they have been fully informed about the procedure and its potential complications.

The patient may then move from the waiting area to the room where the cardioversion will take place – often a specialist cardioversion area, but sometimes a recovery area or an anaesthetic room. The cardioversion itself involves connecting the patient to an ECG monitor which in turn is connected to the cardioverter/defibrillator (Panel A). Electrode patches or plates are positioned on the back and front of the chest, or on the upper right and lower left or the chest (Panel B). A drip is positioned in a vein and an injection of short acting anaesthetic or powerful sedation is given. The patient is then asleep and/or totally unaware of the procedure.

The cardioverter/defibrillator is charged and set to deliver a shock simultaneously with the next heartbeat. Often the first shock is successful (see image) but sometimes several shocks at increasing energy levels or with different electrode patch positions are needed to convert the rhythm.

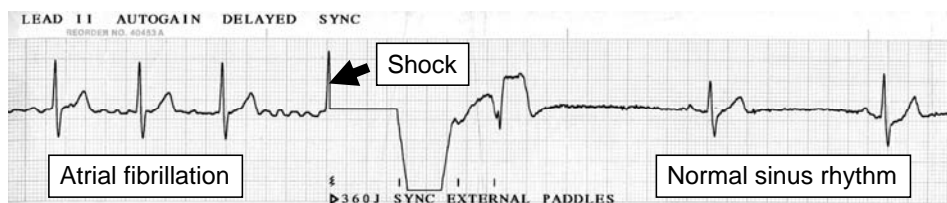


Figure 8: ECG showing the conversion of AF to sinus rhythm after a shock to the heart.

The normal rhythm is restored in about 90% of patients, but a small proportion immediately return to AF.

Over the next few days, 10% - 20% lapse back into the arrhythmia but this can be reduced when necessary by asking the patient to take an antiarrhythmic drug.

After the procedure, the patient is awake within a minute or so and, although groggy for a while, quickly regains full consciousness and will be ready to go home after a few hours. The ECG is monitored until the patient is fully recovered, a 12-lead ECG is recorded and the patient is then allowed to get up and move around.

A friend or partner should come to hospital with the patient as they cannot drive for 24 hours after the procedure and should be accompanied home. Someone should also stay with them on the night after the procedure in case they have a complication.

Risks of cardioversion:

- Slow heart rhythm (bradycardia) – usually very transient and at most needing treatment with an intravenous medicine (atropine) or a short period of pacing (electrical stimulation of the heart to initiate heart beats).
- Fast heart rhythm (such as ventricular tachycardia) which may need a follow-up shock before the patient regains consciousness.
- Stroke, which is very unusual if the patient has been fully anticoagulated before the procedure, if the duration of the AF is short, or if a TOW has not demonstrated a clot in the heart.
- Skin burns or irritation from the electrodes (patches) – this is unusual with modern patch electrodes but can happen more frequently with older metal paddle electrodes.
- Early reversion of the normal rhythm back to AF – this may require further shocks (when still under anaesthetic/sedation).
- General anaesthetic risks – the anaesthetist will address any patient's specific concerns.

Internal electrical cardioversion

Sometimes, if your BMI is high, or the external cardioversion has not worked, your cardiologist may suggest another form of electrical cardioversion called internal cardioversion. In essence it works in a similar way to standard electrical cardioversion except the shock is delivered via a catheter placed temporarily inside the heart rather than via paddles placed on the chest.

The catheter is a narrow plastic tube which is passed in to the heart from a small puncture at the top of your leg and the shock is delivered from the catheter. The environment where internal cardioversion takes place can also be different in that equipment is required for the cardiologist to position the catheter in the heart. The procedure is usually conducted in a room which looks similar to an operating theatre called a cath lab.

When you arrive in the cath lab you will be asked to lie on a bed in the middle of the room and a special large moving camera will be positioned above your heart. This camera is part of a system called a fluoroscopy system which allows the cardiologist to see a moving X-ray of your heart and the catheter which needs to be positioned correctly within the heart. When the cardiologist is ready to proceed he will inject a local anaesthetic into the top of your leg and pass the catheter into a vein. The catheter is then passed up the vein and into the heart, a process which takes only a few minutes and is not felt at all.

Once the catheter is in position the cardiologist or an anaesthetist will inject a sedative which will make you temporarily fall asleep. They will then deliver a shock through the catheter, the purpose of which will be to reset the rhythm of the heart back to normal sinus rhythm in much the same way as previously described for electrical cardioversion. You will be then transferred to a recovery area and be allowed to leave the hospital later that day. The whole procedure usually takes about 30 minutes most of which time is spent positioning the catheter in the correct place to deliver the shock.

Complications

These are essentially the same as for electrical cardioversion with the exception of skin burns and the addition of complications inherent in any catheter procedure described more fully by your cardiologist.

Medical cardioversion

Intravenous (injected through the veins) medicine

Several antiarrhythmic drugs can be used to convert AF into sinus rhythm. Flecainide, sotalol, ibutilide (ibutilide is not available in the UK) and amiodarone can be used. If this procedure is selected, no anaesthesia or sedation is necessary. The injection is usually (depending on the drug chosen) given over a period of ten minutes to several hours.

During this time the ECG is monitored continuously and may be recorded from time to time. Usually the arrhythmia will terminate within minutes or at most one to two hours after the injection. The ECG is often monitored for some minutes to hours after the drug has been administered, to be sure that any abnormal rhythm which may emerge may be quickly detected and treated. When the situation is stable the patient is allowed to go home. If the AF has not been converted to normal sinus rhythm, another treatment strategy will be discussed with the patient.

Medicines by mouth

It is possible to convert early onset AF by taking antiarrhythmic medicines by mouth. However, at normal doses, this may take several days or weeks to occur. Amiodarone is usually the most effective agent although sotalol and other drugs such as flecainide and propafenone may be effective in some patients. Administration of a higher than normal dose of antiarrhythmic medication is usually more successful, but this must be done initially in hospital to test the effect and safety of the technique.

Pill-in-the-pocket technique

Patients with AF often ask their doctor whether it might be possible to take a medication only at the time that they get AF in order to restore the normal rhythm, rather than taking it all the time to ward off attacks which might only occur rarely. In fact, it is not unusual for patients to forget to take medication when they have the normal rhythm and if they suddenly develop AF, they may then remember to take the medicines and often take a higher dose than normal. This is not recommended without full discussion with the physician, to ensure that it can be safely done.

Only some patients are suitable for this method of treatment. They should:

- be able to recognise the onset of the AF
- have attacks that happen no more frequently than at weekly or preferably monthly intervals
- have no significant underlying heart disease
- have no disabling symptoms during an attack (fainting, severe chest pain or breathlessness)
- be able to understand the proper way of taking the medication

The usual way to begin treating a patient in this way is by asking the patient to report to the nearest Accident and Emergency (A&E) department, as soon as possible after the onset of an attack. The patient will have been given a letter to inform the A&E staff about the procedure. A routine 12-lead ECG should be performed to check the rhythm and the general state of the heart.

The patient should then be connected to an ECG monitor from which recordings can be taken if needed. The patient will be rested and given the appropriate dose of the antiarrhythmic drug which has been selected for use. This is taken with a small sip of water and the patient then lies down and relaxes, reads or watches the TV. The staff keep an eye on the situation and the ECG monitor is alarmed, to alert the A&E staff of any change of the rhythm. From time to time, the blood pressure is taken.

In some cases, the technique does not work and the patient is discharged after about four hours, often after being given medication to control the heart rate and with an appointment to see the physician in charge. In most patients, the AF does convert to sinus rhythm and the patient is allowed home after an hour of additional ECG monitoring.

Provided that the technique was shown to be effective and safe (no abnormal rhythm has developed and the blood pressure has been stable), the patient is then allowed to self-administer the same dose of the same medication whenever AF re-occurs. Progress is monitored in the out-patient department and in conjunction with the family physician. Antiarrhythmic drugs that have been used in this way include flecainide, propafenone, sotalol and ranolazine, although none of them are specifically licensed for this mode of treatment.

What happens after cardioversion?

An hour or two after a routine cardioversion, the patient is allowed home after appropriate assessment. Preferably, the patient should be accompanied by a friend or relative and certainly should not drive, operate machinery or do anything requiring concentration and skill that day. The patient will be given anticoagulation medicine to take (usually warfarin) and may be informed about the likely duration of treatment with this medicine. Often an antiarrhythmic drug is recommended, to be taken at least for some months after a successful cardioversion. The patient will receive an appointment for the out-patient department to discuss subsequent management.

Patients whose cardioversion has been unsuccessful are checked to ensure that they are well and then scheduled for an early out-patient visit.

If a complication has occurred, it may be necessary for the patient to remain in hospital depending on the nature and extent of the complication.

Ablation

Successfully managing atrial fibrillation can be difficult. At some point, doctors will likely discuss term ablation, and in this context, it 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 your operation may be cancelled 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 transoesophageal echocardiogram (TOE), 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 discusses 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

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.

Preparing for an ablation

The following advice was written by patients, for patients to help them prepare for a catheter ablation. It is intended to provide general, non-medical information that will help the patient understand what is likely to happen during and after the procedure so that they can be prepared for the time they will be in hospital.

The procedure can be performed either under general anaesthetic, or under sedation, and the time it takes may vary depending upon several factors including the technique used, how long the AF has been present, and other individual patient characteristics.

A short time before the procedure it is normal for the patient to attend a pre-operative assessment to ensure that they are prepared and understand the medical aspects of the procedure. It is advisable if possible, to take someone with you as it may help you to remember the information provided and for them

to take notes. Also take along a recent prescription of current medications. You will be asked about your medical and surgical history as well as any allergies you may have and medications you take. An ECG and blood tests may be done. You may be given a fact sheet about the procedure to take home with you. It is important to make a note of any adjustments to medication you must make before the procedure takes place.

Preparation

Obviously, situations will differ between hospitals but generally you will be asked to attend in good time to prepare for the procedure. Do not worry if you are in sinus rhythm as the Electrophysiologist can induce AF as and when required. You should also be prepared to shave your groin(s) in preparation for inserting the catheter(s). The pre-operative assessment will have informed you of their 'nil-by-mouth' policy (what you can eat and drink and when) and what medications to take and/or omit that day.

Try to take as little "luggage" as possible but there are some items that you may find helpful and they will be covered later. For patients opting for sedation, once preparations on the ward are complete, you will be taken to the Catheter Laboratory where you will meet the team performing the procedure. For some, all the equipment can be quite intimidating but the team will make sure you are comfortable before the procedure begins.

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 control 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. Again, experiences vary but generally any pain or discomfort is minimal but should you begin to feel uncomfortable, you should tell the Consultant and he will adjust the sedation accordingly.

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. Patients opting for general anaesthetic will, of course, be unaware of anything until they regain consciousness in the recovery ward.

Back in the ward

Once the procedure is completed and you are returned from the recovery room to your ward you will be asked to lie still and flat for several hours. This is to prevent any strain on the groin so that the healing process can begin as soon as possible. Your groin area will be monitored closely, as will your blood pressure and general condition. Normally, water will be provided but you might find it useful to take sports style bottles so that you can drink with minimum movement.

Restricting movement for several hours can be challenging so consider taking a tablet computer or books/magazines, but also take earphones so that you do not disturb other patients who may wish to sleep. Some people suggest taking lip balm to keep your lips moist and also disposable underwear as bedpans may be used during this period. A charger for your phone is also useful, as well as money for the hospital television and radio service.

Once the nursing staff are happy with the condition of the groin wound you will be asked to gently walk in the ward and also be encouraged to test your bowel and bladder movements. Normal hospital meals are provided, and it is quite normal for some people to be discharged the same day whilst others stay at least one night in the hospital.

Discharge

All being well, it is normal to be discharged later the same day or the following morning. You will be provided with details of any changes to your medication and information about protecting the wound in your groin. Make sure you have contact details for the Arrhythmia Nurse or anybody else that can give you medical advice, should you require it.

When leaving the hospital, it is very important that you are escorted by family member or a friend. You must not carry anything or use many flights of stairs as this could cause damage to the groin. If possible, avoid using public transport as it will be more difficult to deal with any issues should you feel unwell. It is much better to go home in a car.

Back home

Of course, you will be relieved when it is all over and you are in the safety of your own home, but it is very important that you do not do anything strenuous for the first week and not much more for the second. It is therefore useful to arrange to have the freezer topped up and plenty of bread and milk available. If you live on your own try to arrange some help for the first week at least. Do not be tempted to do too much, even if you feel well and able, as it can put a strain on both your groin and heart. It is easy to overlook the trauma your heart has experienced. If your groin is bruised consider how your heart must feel! Additionally, organising adequate childcare if appropriate is also important.

The DVLA forbid driving a car for a minimum of 48 hours after the procedure. But many hospital teams will advise people not to drive for up to a week. This is mainly to minimise problems with the puncture sites in the leg(s). If you drive a bus or lorry or another large vehicle then you should check with the arrhythmia nurse/ablation team about when you can drive those again.

Remember it can take up to three months or even longer for the heart to properly heal. During this time you may experience runs of AF, ectopic beats (missed heartbeats) and a heart rate faster than before. It will be helpful if you record such events so that they can be discussed at your review appointments.

Recovering from Ablation

This section has been written and prepared by patients, for patients, in the hope of allaying many of the fears and anxieties which often occur following ablation for atrial fibrillation. It is the result of peer discussion and hopefully includes many of the “things nobody told me” which had caused worry in the weeks and months following an ablation.

Rest

Although you may not have a great scar to show it, your heart has suffered some trauma and will take time to recover. The general recommendation is to take things very easy for the first week (short walks and only a single flight of stairs, generally within the house, or not very far outside), and a slow gentle progression following that. Some very fit or younger patients may find that they can return to work quite quickly, but many others take much longer. Above all listen to your body and don't push yourself too hard. If you are still working then discuss your condition with your employer and explain that the situation may be fluid. Do not lift anything heavy for at least a week. Above all, you are not a failure and everyone's recovery is very individual, so do not be rushed.

Palpitations

Because the heart does not heal immediately you may experience some palpitations, ectopic beats (missed beats) or even runs of AF in the time after your ablation. **THIS DOES NOT MEAN IT HAS FAILED.** If you experience pain, difficulty breathing or are passing out, then please contact the arrhythmia nurse and/or team where your ablation was carried out. Palpitations and other symptoms should gradually fade over time. In fact, many patients found that even six to nine months later their quality of life was still improving.

Sore Throat

You may find that you have a sore throat after your procedure. This is probably due to having had a transoesophageal echocardiogram (TOE) during the procedure to check for any clots which may be present in your heart. It may also be caused by breathing equipment if you had a general anaesthetic. Treat as any other sore throat and it will soon pass.

Migraine Aura

A migraine may shock and worry you but is perfectly normal. Not everybody suffers from this but it is quite common usually about two to three days after the ablation. It results from the transeptal puncture needing to gain access from the right to left atria. You may find vision disturbance with either flashing lights or blind spots in your sight often with a following headache. Don't worry, you are not having a stroke or going blind, and the symptoms will pass after a week or so. However, if you are concerned then contact the team who did your ablation/arrhythmia nurse, your GP, or if you feel very unwell then go to A&E.

Ectopic Beats

Ectopic beats, which feel like missed beats, can be common following ablation. They are considered harmless but can be distressing when frequent. This does not mean that your ablation has failed. Try slow deep breathing. Use your diaphragm rather than shoulders and breath slowly and deeply for at least five minutes, slowing your breathing down to less than six breaths a minute.

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.

Groin/Leg Bruises

You may find that you get a colourful bruise where the entry wound for the catheter is. You may even find a hard lump there. Don't worry as this is quite normal. When it finally fades away you know that your heart is beginning to heal so it can be a useful guide to when you can start pushing your recovery a little more. However, if you are concerned at all about infection (pus, increasing redness of the area, temperature, poor wound healing), or the wound site in general, contact your arrhythmia nurse/ablation team or GP.

Fast Heart Rate

It is not uncommon to find that your heart rate is a faster than before your AF started and you had your ablation. Typically, this may be around 85-90 bpm which is a common side effect of the ablation. It may take six to eight months (or even longer) to return fully to earlier levels but don't worry, it will normalise. Again, it does not mean that the ablation has failed.

Bloating and Digestive Problems

Some people find that they suffer from abdominal discomfort post-ablation. This is probably caused by irritation to the oesophagus during the procedure, or sometimes to a nerve near the heart known as the vagus nerve. It will usually disappear within a few days but can be alleviated with normal indigestion remedies. Alternatively, see your GP for other medication if needed.

Depression, Anxiety, Worry

Many patients suffer with anxiety post-ablation worrying that it has not worked due to some of the above-mentioned symptoms. This can be a highly emotional time and these feelings are not uncommon, so please do not worry if you fall into this category. Try to remain positive but if you find that you have such difficulties, then do talk to your doctor and look into things like mindfulness and cognitive behavioural therapy which can be helpful.

When to seek medical help

There are a few rare but potentially serious complications that can occur after an AF ablation. These will have been discussed with you before the ablation is done. If you feel very unwell or experience any new or unusual symptoms such as sudden weakness in an arm/leg and/or unexplained fevers it is worth seeking medical attention urgently. If you are just not sure about some symptoms that do not bother you too much then you can always seek help less urgently from the arrhythmia nurse/ablation team or your GP.

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.

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

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.

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.

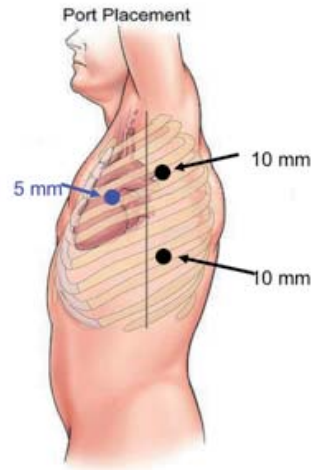
Many hospitals feel that persistent AF present for more than three to five years has such a low chance of success that they will not recommend catheter ablation as an appropriate therapy option. Current figures report that approximately 30-40% of people will require more than one AF ablation procedure, 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 organised 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.

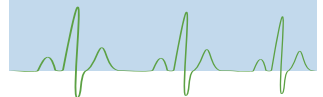
Criteria for selection have changed a lot in recent years, and surgical ablation is now established as a first or second line therapy. Collaboration between EP cardiologists and cardiac surgeons is also increasing, allowing a combined approach to the best treatment, and in some cases a hybrid procedure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

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>

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.

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 centre.

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 anticoagulant used to prevent blood clot formation contributes 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 problem. 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. Anticoagulation 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 recognised complication associated with atrial fibrillation ablation. The PVs are blood vessels that carry 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 centres. 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 minimise 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 be anticoagulated 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 anticoagulation 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 of the arterial perforation may be required.

An **Atrio-oesophageal fistula** is an extremely rare but very dangerous complication. This is a hole that forms between the back of the left atrium and the oesophagus (gullet) which lies just behind. This hole allows air bubbles and oesophageal 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 vomiting 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-oesophageal fistula is so rare (one in every 1-2 thousand 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 oesophagus) should generally be avoided as it may worsen the condition. If atrio-oesophageal 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.

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 anticoagulation 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-oesophageal fistula. Extremely rare drug reactions or anaesthetic complications are also a remote possibility. The risk of death from AF ablation is about 1 in 1000.

How to 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.

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 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.

Summary

There are many ways to treat AF. Some may suit you better than others and you should discuss your options with you doctor or electrophysiologist who will know your medical history and be able to advise which is best for you as an individual.

Providing information,
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for atrial fibrillation

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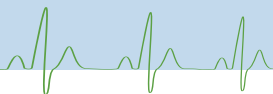
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Please remember that this publication provides general guidelines only. Individuals should always discuss their condition with a healthcare professional.

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