Complications of atrial fibrillation ablation

Is catheter ablation safe?

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

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**Glossary**

**Antiarrhythmic drugs** A group of drugs used to restore or maintain the normal heart rhythm

**Anticoagulant** A group of drugs which help to thin the blood

**Arrhythmia** Heart rhythm disorder

**Arrhythmia Nurse Specialist** A nurse who is trained in heart rhythm disorders

**Atrial fibrillation (AF)** Irregular heart rhythm

**Cardiac tamponade** An accumulation of fluid in the pouch containing the heart

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

**Catheter ablation** A treatment using a catheter (a thin flexible tube) which destroys the very small area inside the heart which is causing the AF

**Cryoablation** Ablation through freezing rather than heating

**Electrophysiologist (EP)** A cardiologist who has specialised in heart rhythm disorders

**Radiofrequency ablation** Ablation using heat introduced by a high frequency alternating electrical current

**Sinus rhythm** Normal rhythm of the heart

**Contents**

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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. You may be prepared to undergo a ‘high-risk’ operation if the consequences of not having the operation are very severe or potentially fatal.

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. There is increasing evidence that catheter ablation of AF may reduce stroke risk and improve left ventricular function, although improving symptoms and quality of life remain the main reason for having the procedure.

Complication

Here, a complication means an additional medical problem that occurs as a direct or indirect result of the ablation procedure, and is felt to be harmful. Complications may be described by how common or rare, mild or severe, benign or life-threatening they are. It is important to discuss potential complications when considering ablation as a treatment for atrial fibrillation as the risks involved need to be balanced against the benefits that could be gained.

No procedure is completely free of complications and risk. The risk of a complication is usually described as a percentage of the chance of it happening. These percentages are derived from a variety of sources.
Sources of information

The main source is from medical journals which publish data gathered from extensive and systematic studies of AF ablations on hundreds or thousands of patients, in which the complications from the procedures are listed.

It should be remembered, however, that individual degree of risk of particular complications may differ from the norm due to factors such as age, weight, diabetes and cardiac health. Other factors may be the various types of ablation procedure, the type of equipment used, the nature of the AF itself, the experience of the cardiologist, and the hospital.

Examples of complications of AF ablation

These include stroke (which is infrequent and may be mild or severe), bruising at the groin entry sites (common, usually mild or benign) and death (very rare).

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 48 hours after an ablation as a result of 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 could be the development of post-operative left atrial flutter, which is recognised in very few patients whose AF is eliminated but the ablation lesions lead to a different rhythm disturbance. Neither of these would be regarded as complications.
Unexpected consequences of AF ablation

By this 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. Reasons why it was not expected might be because it is incredibly rare, has never happened before, has not been reported in medical literature, or has not previously been recognised as a consequence of AF ablation. 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 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.
Common but serious complications arising from AF ablation are known to include the following:

**Pericardial effusion**

A collection of fluid (usually blood) contained in the sack surrounding the heart. In connection with ablation, this might be a result of perforation of the heart muscle with subsequent bleeding into the surrounding area. It is most likely to occur during the ablation itself, due to trauma from the wires or burns required to perform the ablation. Anticoagulants used to prevent blood clot formation may also contribute to the bleeding risk. A rapid collection of blood around the heart (cardiac tamponade) can compress it and reduce its ability to pump effectively, causing a fall in blood pressure.

During the ablation procedure, continuous blood pressure monitoring informs and alerts 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 do not usually require treatment, but tamponade requires urgent action.

A small tube (pericardial drain) is inserted under the ribs and breastbone into the pericardial space to drain away the excess fluid. This may stay in for a day or so until the echocardiogram shows the bleeding has stopped and the blood has dispersed. The drain may be uncomfortable, and painkillers are often required. The inflammation from the pericardial effusion may even provoke an episode of AF. 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 surgery is required to find the damage and repair it.
Pulmonary vein stenosis (PV stenosis)

This is a recognised complication associated with AF ablation. Pulmonary veins are blood vessels that drain blood into the left atrium from the lungs. PV Stenosis means that the veins become abnormally narrowed after the ablation treatment. One or more pulmonary veins need to be severely affected before symptoms are noticeable. The incidence of PV stenosis has fallen because modern techniques involve burning in the atrium rather than inside the veins.

Typical symptoms of PV stenosis include breathlessness, cough and coughing up blood (haemoptysis). The diagnosis may be made using MRI or CT scans. PV stenosis can be treated by a procedure called angioplasty where a small balloon is inflated in the vessel to broaden it.

Stroke

This is perhaps the most feared complication of ablation for AF. It occurs when the blood supply to the brain is affected, usually by a blood clot blocking a blood vessel, but it may also be due to bleeding within the brain. The ablation procedure takes place in the left atrium, which pumps blood to the brain and other vital organs. If the ablation causes a blood clot, debris or air bubble, this may cause a stroke.

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 may also thin the blood with warfarin after the ablation whilst the inflammation in the left atrium is settling down.

The risk of stroke can also be affected by age, the extent of the ablation procedure and also the patient’s other medical problems. As the brain is essential for all bodily functions, damage to it can have variable consequences. The effects of a stroke may be very short-lived (if a complete recovery is made within 24 hours it is called a transient ischaemic attack or TIA). If the effects last for days or weeks, they may leave a permanent disability, or even cause death.
Physical effects may be problems in vision, difficulty with speech, altered sensation or function in the limbs and in the worst cases, paralysis and coma. Strokes are diagnosed using CT or MRI brain scans and may be treated by specialist teams.

**False femoral aneurysm**

This describes blood leaking out of a leg artery at the site where the catheter was inserted, contained by the surrounding tissue in 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 lump (usually painful and perhaps pulsating) can be felt. This may cause a dramatic bruise. The diagnosis is confirmed using an ultrasound scan. Treatment varies depending on the extent of the leak. Sometimes just keeping an eye on it is enough, as it will heal naturally. A radiologist or vascular surgeon may treat the problem by injecting thrombin, a clot-forming drug, to seal the leak. Alternatively, stitches may be required.

**Retroperitoneal bleed**

This 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)**

This is caused by accumulation of air or gas in the area outside the lungs, and occurs as a result of injury when inserting the tubes into the veins which lie under the collarbone. Many operators prefer to do everything from the femoral (leg) veins instead. Depending on the size of the pneumothorax, treatment varies from observation to insertion of a chest drain, allowing the lung to re-inflate.
**Atrio-oesophageal fistula**

A very rare but extremely serious complication, this is a hole which occurs between the back wall of the left atrium and the oesophagus (food pipe), as a result of the heat of the ablation treatment. Signs and symptoms appear days to weeks after the ablation and are typically fever, chills, stroke, septic shock (collapse), vomiting blood, and unfortunately in most cases, death. Diagnosis is made using a CT scan or special x-ray. Treatment is difficult and often involves major chest surgery.

**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. The diagnosis is confirmed by a chest x-ray. There is no specific treatment, and in most cases recovery is complete, taking up to a year.

**Death**

This is a very rare complication of catheter ablation and could be a result 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.
# Findings from studies of complications of AF ablation

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<td><strong>Access site complications (%)</strong></td>
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<td><strong>Atrio-oesophageal fistula (%)</strong></td>
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<td>Permanent phrenic nerve palsy 0.17, sepsis, abscesses or endocarditis 0.01, pneumothorax 0.09</td>
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<tr>
<td>Pericardial effusion (%)</td>
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</tr>
<tr>
<td>Pericardial effusion requiring drainage (%)</td>
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<td></td>
</tr>
<tr>
<td>Access site complications (%)</td>
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</tr>
<tr>
<td>Pulmonary vein stenosis (%)</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Haemothorax (%)</td>
<td>0.2</td>
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</tr>
<tr>
<td>Atrio-oesophageal fistula (%)</td>
<td>0</td>
<td></td>
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<tr>
<td>Death (%)</td>
<td>0</td>
<td></td>
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<tr>
<td>Other complications (%)</td>
<td>Mitral valve injury 0.1, complete heart block 0.1, phrenic nerve palsy 0.3, Respiratory compromise 0.4</td>
<td></td>
</tr>
</tbody>
</table>
What are my risks of suffering a complication if I undergo AF ablation?

Before most people agree to undergo an ablation they want to know what the chances are that they will suffer a complication so they can weigh up the risks and benefits of the procedure. Although it can be very difficult to find out the precise risks in your particular case, information based on the incidence of previously reported complications helps to estimate them.

There are various methods and sources you can look at to establish the risks of complications following AF ablation and we have set these out below. Interpreting these data can be problematic, particularly when using them to compare results from different centres. The table on pages 10 and 11 shows the reported risks of complications from published studies by large institutions.

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. Data from individual hospitals should be interpreted with caution for the following reasons.

a) Small numbers
Many of the most serious complications are rare, perhaps affecting one patient in every 100 to 200 patients. This means that one extra patient suffering a particular complication affects the statistics quite significantly. For example, if one hospital does 50 ablations in a year and no patients have a stroke, their complication rate is zero. If another equally good hospital performs 50 ablations in a year and has one stroke, their complication rate is 2%, even though the difference between the two hospitals in that year is probably purely down to chance.

The following year the situation may be reversed, so over a two year period both hospitals have one patient with a stroke after 100 ablations and
therefore a 1% stroke rate. Thus any individual hospital’s statistics for rare complications are more reliable when collected over many years and when a high number of ablations (e.g. more than 300) are taken into account. The few hospitals that do more than 200 AF ablations per year can provide the most reliable, up-to-date statistics.

b) Changing techniques and the learning curve
As clinicians learn more about AF and AF ablation, their experience leads to a steady improvement in outcomes, and this makes it difficult to compare data from procedures carried out even a few years ago. Improvements in procedures mean that more complex ‘riskier’ situations are taken on, for example patients who have long been in AF, those with other heart conditions, in the very elderly or very overweight. These ablations may incur more complications, so they may skew a hospitals’ statistics, making them look worse than for hospitals which only do procedures on very low risk patients.

c) Under-reporting
Hospitals can only report complications if they know about them. Most ablations for AF are performed at large hospitals to which patients have been referred from local hospitals. Complications occurring after a patient has been discharged may be managed by the smaller hospital and the hospital where the ablation had been performed might be unaware of them and it may not appear in their results.

d) Defining the complication
The complications of an ablation can vary enormously in their severity. Mild complications may cause no symptoms and resolve themselves on their own. It is then difficult to know whether they should be counted as complications or not.
Different hospitals or published reports may have different definitions of which complications to include in their results, so two equally good hospitals might have apparently very different rates of complications. An example of this is pericardial effusion. Often this is extremely small, causes no trouble to the patient and is only detected by chance, disappearing without any treatment. Large pericardial effusions, however, are much more serious (potentially causing cardiac tamponade), and often require immediate attention. When looking at a hospital’s complication rate it is therefore important to try and distinguish between these two situations. They may, however, be reported as a single figure. Also, some hospitals check for this routinely, whilst other hospitals may only perform scans if patients become unwell. So there may be large differences in the number of detected small pericardial effusions.

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. Bear in mind that interpreting these reports carries many of the same pitfalls as reports from individual hospitals described above.

It is also important to be aware of so-called ‘reporting bias’, whereby the reported complication rate is lower than the ‘real world’ complication rate. Such bias can take two forms. Firstly, when publishing data, those centres with the largest number of patients will often be the very biggest centres where the techniques for ablation were first developed. This means that the procedures will have been carried out by the most experienced electrophysiologists who might be expected to have the lowest complication rates. Secondly, hospitals and doctors are more likely to publish their results if they are considered impressive and show their hospital in a good light. If a hospital has more complications than expected, they may be less likely to contribute their data, even if they are purely the result of chance. In order to get round this, large
registries and case series have been collected containing data from hundreds of hospitals. Unless reporting of complications is compulsory as part of national or regional policy, these reports may still be inaccurate.

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.

The advantages of data from these published reports are that patients in studies are usually followed up extremely closely even after they have left hospital, so it is less likely that complications will be missed. Also, the results are more likely to be specific to the kind of ablation performed on the patients in any given study. In addition, studies will have been reviewed and assessed by experts at the centre and from other centres prior to publication to ensure the data and conclusions are accurate and reasonable.

The downsides of using randomised controlled trials to assess the risk of complications are firstly that most of these studies only involve small numbers, so it is very difficult to use them to assess the risk of rarer complications. Next, trials are usually performed using very specific techniques or equipment which may vary from hospital to hospital. Finally, most trials are performed by the most experienced centres that will have performed the most ablations and so are likely to have the fewest complications.

It is important to understand whether figures quoted are per ablation procedure, or per patient (many patients undergo two or more ablation procedures over a period of time and subsequent ablations tend to be more successful). The more important statistic is the risk of a complication occurring per ablation procedure.
As described above, risk of complication is estimated by looking at large groups of patients and seeing how often a particular complication occurs. The percentage risk derived from this applies to that group, but patients are individuals. A particular individual’s risk is significantly affected by their own characteristics, such as age, weight and comorbidities (other medical conditions) including high blood pressure, diabetes, heart failure or previous stroke.

A hospital may report its overall risk of stroke as 1%, but that hospital may have performed 500 ablations; 400 in younger patients with only one having a stroke, and 100 elderly patients with comorbidities, with four of them having strokes. The young patients may have a 0.25% (one in 400) stroke risk, the elderly a 4% (four in 100) risk, but the overall risk in that hospital’s series is 1% (five in 500).

Giving a precise risk of a particular complication to an individual undergoing
Conclusion

Ablation for AF is challenging. The best estimate is taken by looking at a large published series of patients, then an individual hospital’s own record of complications, and then modifying this risk, if appropriate, based on an individual’s characteristics. We have summarised some of the largest case series looking at the risk of complications following AF ablation in the table on pages 10 and 11.

Summary

- The risk of suffering any major complication following ablation for AF is probably between 4% and 6% across the board.

- There is about a 1% risk of a stroke, although in around half these cases the symptoms resolve. 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%).
AF Association produces a wide range of publications about the diagnosis, treatment and management of AF including factsheets, booklets, checklists and online tools.

Some of these are listed below:

**Patient information booklets**
- Atrial fibrillation: patient information
- Atrial fibrillation: drug information
- Anticoagulation (blood thinning) in atrial fibrillation
- Cardioversion of atrial fibrillation
- Catheter ablation for AF
- Surgical ablation
- Frequently asked questions
- Laser balloon ablation for AF
- The heart, the pulse and the ECG

**Checklists**
- Atrial fibrillation checklist
- Patient and primary care checklist

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This publication is designed to help patients to consider the risks associated with AF ablation, and balance them with the benefits that could be gained by undergoing the procedure.

If you would like further 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.