Atrial fibrillation (AF) is the most common cardiac arrhythmia, with a prevalence of 4.7% for people aged 65 years or over in UK general practice. AF is found predominantly in the elderly and the prevalence doubles with each decade of age. Overall, about 80% of the population with AF is older than 70 years of age. Because of the ageing population, it is believed that the prevalence and incidence of AF is increasing.

AF is associated with significant morbidity and mortality. One in five patients with AF go to hospital at least once each year. Of all patients admitted acutely to hospital, 3–6% have AF.

**Pathophysiology**

AF is a supraventricular tachycardia characterised by disorganised atrial electrical activity. This electrical disorganisation results in the absence of substantial atrial depolarisation, which is characterised by absence of P waves on the electrocardiogram (ECG).

Instead there are rapid oscillations or fibrillatory “wavelets” that vary in size, shape and timing. These lead to a lack of co-ordinated atrial contraction and progressive deterioration of atrial function. The resulting ventricular rate is usually rapid and irregular (however, a slower ventricular rate can occur and this may represent atrio-ventricular conduction disease or be caused by rate-controlling drugs such as beta-blockers).

The initiation and subsequent continuation of AF is caused by a complex combination of mechanical, structural and signalling abnormalities within the atrial tissue. It is thought to involve an interaction between initiating triggers and atrial tissue changes capable of maintaining the arrhythmia.

**Trigger factors for AF**

Ectopic beats that originate in atrial tissue (other than the sinoatrial or atrioventricular...
nodes) are frequently the trigger for the initiation of AF. This non-nodal tissue that is the focus of rapid ectopic activity is often located in the muscular sleeve that extends from the atria into the pulmonary vessels (particularly the pulmonary veins in the left atrium).

In younger patients with relatively normal hearts and short paroxysms of AF, pulmonary vein triggers are likely to be the dominant cause whereas persistent or permanent AF in patients with structural heart disease is usually caused by atrial tissue abnormalities.

Less common triggers include sympathetic or parasympathetic stimulation, bradycardia, atrial premature beats or tachycardia, accessory AV pathways and acute atrial stretch. Triggers do not necessarily cause AF in the absence of other contributors, particularly conditions in which the effective refractory period or conduction velocity are decreased.

Maintaining factors for AF Perpetuation of AF occurs when several independent wavelets propagate through the atrial musculature in a seemingly chaotic manner. The propagation requires certain conditions to exist within the atrial cells, which allow the alterations in the action potential that are characteristic of AF.

Simplistically, atrial strain causes acute or chronic stretch of atrial cells, which, in turn, increases intracellular calcium by:

- Opening stretch-activated channels (SACs)
- Opening L-type calcium channels
- Causing calcium release from the sarcoplasmic reticulum

These effects also reduce transient outward potassium currents. Within 24 hours of AF onset, calcium channels are downregulated and in long-standing AF potassium channels increase. This maintains the higher levels of intracellular calcium.

Increased intracellular calcium levels decrease the action potential duration and reduce the activation threshold, thereby shortening the effective repolarisation period. This leads to more rapid firing of the cells and the appearance of multiple re-entrant wavelets (the culminating feature of AF regardless of underlying cause).

Maintenance of AF, even without continuation of the initial triggers, results from electrical and structural remodelling, characterised by atrial dilation and shortening of the atrial effective refractory period. This may explain why patients with structural atrial disease are more likely to develop permanent AF.

Risk factors Hypertensive, valvular, ischaemic and other types of structural heart disease underlie most cases of persistent and permanent AF.

Thyroid disease may be a cause of AF and, although it is uncommon, patients should have their thyroid function checked to exclude this.

Other diseases that cause atrial damage, for example, diabetes, are associated with AF. Sleep apnoea may also be a contributing factor because of apnoea-induced increases in atrial pressure and size, or autonomic changes.

Lifestyle and dietary factors are associated with AF, including excessive alcohol consumption (even over a short period), caffeine consumption and emotional or physical stress.

Symptoms AF is not a symptomless disease — about half of patients notice palpitations. Moreover, loss of atrial function and poor ventricular response causes dyspnoea, fatigue, syncope and chest pain. This results in patients with AF having reduced quality of life. Restoration of sinus rhythm improves quality-of-life score and exercise performance.

Many patients are only diagnosed with AF when they present with ischaemic stroke or transient ischaemic attack. Therefore, it is reasonable to assume that many patients experience asymptomatic, often self-terminating, episodes of arrhythmia before their AF is first diagnosed.

Diagnosis AF is often diagnosed as a result of symptomatic patients presenting to their GP or hospital. However, some patients are opportunistically diagnosed when undergoing monitoring for other conditions.

An irregular radial pulse may raise suspicion of AF, but diagnosis can only be made from a 12-lead ECG. Patients with paroxysmal AF may require ECG monitoring for 24 hours to detect paroxysm.

Classification The classification of AF is based on the temporal pattern of the arrhythmia. The National Collaborating Centre for Chronic Conditions, on behalf of the National Institute for Health and Clinical Excellence, has adopted the following classification scheme, which is a basis for treatment decisions (summarised in Box 1).

Lone AF A single episode of AF in patients with a structurally normal heart and normal clinical examination can be classified as “lone” AF. These events may be self-limiting or amenable to cardioversion, which may be required if associated with haemodynamic instability. Patients with lone AF are often considered lower risk for developing thromboembolic complications.

### Box 1: Classification of AF

<table>
<thead>
<tr>
<th>TERMINALogy</th>
<th>CLINICAL FEATURES</th>
<th>PATTERN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial event</td>
<td>Symptomatic</td>
<td>May or may not recur</td>
</tr>
<tr>
<td></td>
<td>Asymptomatic (first detected)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Onset unknown (first detected)</td>
<td></td>
</tr>
<tr>
<td>Paroxysmal</td>
<td>Spontaneous termination (within seven days and most often within 48 hours)</td>
<td>Recurrent</td>
</tr>
<tr>
<td>Persistent</td>
<td>Not self-terminating</td>
<td>Recurrent</td>
</tr>
<tr>
<td></td>
<td>Lasts more than seven days (or requires cardioversion)</td>
<td></td>
</tr>
<tr>
<td>Permanent</td>
<td>Not terminated</td>
<td>Established</td>
</tr>
<tr>
<td></td>
<td>Terminated but relapsed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No cardioversion attempt</td>
<td></td>
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</tbody>
</table>
Chronic AF — Recurrence of AF, even self-limiting episodes, changes the patient’s thromboembolic risk and is designated chronic AF. Chronic AF can be further subclassified into:

- Paroxysmal: episodes are termed paroxysmal if they terminate spontaneously (usually within seven days)
- Persistent: persistent AF occurs when the arrhythmia does not terminate spontaneously (therefore requiring electrical or pharmacological cardioversion)
- Permanent: if cardioversion is not successful, or not indicated, the AF is termed permanent

Postoperative AF — It is worth noting that AF occurs in about a third of patients who undergo cardiothoracic surgery. This type of AF is associated with a greater morbidity and mortality and predisposes people to a substantially increased risk of stroke and thromboembolism. Therefore, patients with AF after cardiac surgery should be anticoagulated if it persists for more than 48 hours. Treatment with antiarrhythmics is indicated for those patients who remain symptomatic, become haemodynamically unstable or develop cardiac ischaemia or heart failure.1

**Prognosis**

AF is associated with an odds ratio for death of 1.5 for men and 1.9 in women, which does not vary by age, but most of the excess mortality attributed to AF occurs early after diagnosis of AF.12

In AF the atrial “rate” is greater than 400 beats/min, which does not translate into any meaningful contractile function. This results in stagnation of blood which predisposes patients to the formation of clots. This explains the high risk of thromboembolism in AF and the need to anticoagulate patients deemed at risk (see accompanying article, p358).1

Patients with AF are five times more likely to have a cardioembolic stroke than similar patients not in AF.13

Cardioembolic strokes carry a worse morbidity than embolic strokes from other sources: there is twice the likelihood of being bedridden after the event compared with other embolic strokes.14

The lack of meaningful atrial contraction reduces the ventricular filling pressures, which reduces cardiac output by 10–20%. In particular, this can affect patients who have pre-existing:

- Left-ventricular dysfunction — because it can precipitate cardiac decompensation
- Coronary ischaemia — because ventricular tachycardia (that compensates for reduced cardiac output) can worsen the ischaemia

The recognition of the poor prognosis and high level of symptoms has prompted the European Society of Cardiology to revise its guidance for treatment of AF (see accompanying article, p358).15

**References**