Is this atrial fibrillation?

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ECG Education articles use real cases to illustrate the importance of knowledge about ECGs in relation to clinical situations in general practice. Management is not discussed.

A 77-year-old man well known to you felt unusually weak and tired after his morning walk. He had pneumonia several weeks ago, but apart from this he is usually well and is taking no medications. You feel his pulse and find that it is fast and irregular; the patient is not aware of this. He is otherwise clinically stable with no other symptoms. You perform an ECG immediately – see the ECG on this page.

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Q1. What ECG features are typical of atrial fibrillation?

The atria contract irregularly in patients with atrial fibrillation and so the RR interval is variable, the P-waves are absent and the baseline undulates. The ventricular response is variable and may be slow ('slow atrial fibrillation'), normal or fast ('rapid atrial fibrillation').

Q2. What ECG features are typical of atrial flutter?

The ECG features of patients with atrial flutter include classically regular 'sawtooth' (slow downslope, faster upslope) flutter waves in leads II, III and AVF and V1. The abnormal flutter waves may be best appreciated when the ECG is turned upside down. The QRS complex is usually less than 120 ms (in the absence of a pre-existing bundle branch block or accessory pathway or other aberrant conduction). Atrial flutter is usually suspected when the patient's heart rate is rapid (most commonly 150 beats per minute) and regular with the characteristic sawtooth waves as described. The atria typically contract at a rate of 300 beats per minute and conduction through the AV node usually blocks in a consistent fashion. If the block is variable, the rate may appear to be irregular.

Q3. What medical conditions are related to atrial fibrillation and atrial flutter?

Atrial fibrillation and atrial flutter are both supraventricular tachycardias and are similar in clinical presentation and management. Atrial fibrillation is the most common type of tachyarrhythmia. Atrial flutter with a 2:1 block is the next most common. Causes include ischaemic heart disease, congenital heart disease, rheumatic fever, valvular disease (especially mitral valve prolapse), cardiomyopathy, hypertensive heart disease, hyperthyroidism, myocarditis and pericarditis. They also occur after cardiac surgery, with pulmonary emboli or as a result of carbon monoxide poisoning, and can be due to drug and alcohol intoxication or severe metabolic derangements (especially relating to electrolytes and anaemia). Both atrial fibrillation and atrial flutter may occur spontaneously in the absence of heart disease or precipitants.

Q4. What electrophysiological dysfunction causes atrial fibrillation?

It is thought that there is an abnormal automatic focus of cells within the myocardium or locally at the base of the pulmonary veins that creates the electrophysiological dysfunction. This may be combined with a shortened atrial refractory period and delayed intra-atrial conduction, producing sustained atrial fibrillation from re-entrant conduction of multiple wavelets of electrical impulses.

Q5. What electrophysiological dysfunction causes atrial flutter?

Most cases of atrial flutter are due to a re-entry circuit in the right atrium (the minority

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are from the left atrium). The conduction ratio of electrical impulses through the AV node is altered (the 'degree of AV block'). As a result, there is an abnormal but regular ventricular rate and change in appearance of the QRS complex. For example, a 2:1 block indicates that every second impulse is transmitted through the AV node and the regular ventricular rate is about 150 beats per minute. A 3:1 block indicates that every third impulse is transmitted through the AV node and the ventricular rate is about 100 beats per minute. A 4:1 block indicates that every fourth impulse is transmitted and the ventricular rate is about 75 beats per minute.

Q6. What is the danger of a 1:1 AV block?

A 1:1 AV conduction block is uncommon and may result in severe haemodynamic instability and collapse due to heart rates up to 300 beats per minute. It may precipitate ventricular fibrillation and is more likely in cases of sympathetic nervous system overstimulation (use of amphetamines, cocaine, methamphetamines or high-dose salbutamol) and in patients with Wolff–Parkinson–White syndrome. It occurs especially in Wolff– Parkinson–White syndrome when the patient is treated with drugs that block the atrioventricular node (commonly, calcium antagonists, isoprenaline, digoxin and adenosine). These medications may also facilitate increased conduction through the abnormal pathway, worsening the tachycardia and resulting in ventricular fibrillation.

Q7. How do atrial fibrillation and flutter present clinically?

Atrial fibrillation in particular may be asymptomatic, especially if the patient's pulse rate is normal. Patients commonly complain of feeling nonspecifically unwell, physically exhausted, sweaty, short of breath and faint, especially with exertion, and of having 'palpitations'. Chest discomfort is common and both atrial fibrillation and atrial flutter may precipitate angina or heart failure. Atrial fibrillation may be sudden in onset and last minutes, hours or days or may be chronic (as usually occurs if the heart rate is controlled but the fibrillation does not revert). Atrial flutter is more likely to be intermittent and usually lasts less than a few days. Sometimes the patient will have atrial flutter alternating with atrial fibrillation.

Q8. What medications and management options are used in patients with atrial fibrillation and flutter?

Certain medications may revert the arrhythmia, maintain sinus rhythm and minimise symptoms and complications (such as emboli). The medication chosen depends on the clinical condition of the patient and the nature and cause of the arrhythmia.

Both electrical and pharmacological (e.g. amiodarone, sotalol) treatments and cardioversion may revert the arrhythmia, but the result may be temporary.

Ongoing use of medications such as sotalol, amiodarone and flecainide will maintain sinus rhythm and prevent reversion, but not in all patients. Amiodarone is very effective but limited in use by the risk of pulmonary fibrosis, liver and thyroid effects and bluish skin discolouration. Flecainide is uncommonly used due to adverse cardiac events, and is avoided in patients who have underlying coronary or cardiac structural disease, due to the risk of proarrhythmia. Quinidine is no longer used because of the possible increase in risk of mortality due to proarrhythmic effects.

Digoxin does not prevent recurrence of atrial fibrillation but works through slowing the heart rate. Similarly, verapamil, diltiazem and beta blockers (such as atenolol and carvedilol) are not effective for the maintenance of sinus rhythm, but are used to control the ventricular rate.

Cardiac pacemakers may be used in cases of sick sinus syndrome or if the patient cannot tolerate medication because of bradycardia. Catheter ablation of re-entry circuits may also be used in certain cases.

Outcome

The patient was referred to hospital by ambulance for management. Although he was stable, he had new symptoms, so recent or acute myocardial infarction needed to be excluded. He also had a known recent possible precipitant (pneumonia), so acute early cardioversion may have been the most appropriate management. He was tolerating the arrhythmia well and as you had no monitoring equipment and were unsure of the underlying cause, you decided against treating it in the general practice. In hospital, the patient had an echocardiogram that showed a mild cardiomyopathy, possibly postviral, possibly tachycardia-mediated. He underwent electrical cardioversion in the hospital and is now in sinus rhythm, and stabilised on carvedilol and appropriate anticoagulation. **CT**

Key points

- **Atrial fibrillation is the most common type of tachyarrhythmia and atrial flutter with a 2:1 block is the next most common.**
- **The atria contract irregularly in patients with atrial fibrillation and so the RR interval is variable, the P-waves are absent and the baseline undulates.**
- **Atrial flutter is usually suspected when the patient's heart rate is rapid (most commonly 150 beats per minute) and regular, with the characteristic sawtooth waves as described.**
- **A 1:1 AV conduction block is uncommon and may result in severe haemodynamic instability and collapse due to heart rates up to 300 beats per minute. It may precipitate ventricular fibrillation.**