Sick sinus syndrome

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Articles in this section are inspired by, but not based on, real cases to illustrate the importance of knowledge about ECGs in relation to clinical situations in general practice. Management is not discussed in detail.

Margaret, aged 77 years, was commenced on amiodarone 200 mg daily and apixaban several months ago. She had been experiencing frequent intermittent 'flutters' of her heart lasting several minutes, and results of 24-hour Holter monitoring showed that these episodes were rapid atrial fibrillation. She is taking no other medications and has no other medical conditions. An echocardiogram and thyroid function and lung function tests were performed recently and all were normal. A few days ago she was taken to hospital because she suddenly felt very faint, passed out and fell over, sustaining a right radial head fracture. This is the second time in the past few weeks she has felt suddenly faint for no reason. She now sees you, her GP, for follow up. The hospital has also suggested a cardiology review. You repeat the ECG (see Figure) as there is no copy in the discharge summary from the hospital.

Q1. What does this ECG show?

The ECG shows sinus bradycardia with a first-degree heart block. The heart rate is 45 beats per minute. Bradycardia is defined as a resting heart rate of under 60 beats per minute. First-degree heart block is due to delayed conduction of the electrical impulse through the AV nodal conduction system and the PR interval is longer than 0.2 seconds.

Q2. What diagnosis would you suspect, given the history?

The episodes of sudden severe light headedness suggest bradycardia, which may be caused by a slow sinus rate or high grade AV block. The episodes are less likely to be due to the rapid atrial fibrillation because Margaret has not experienced faintness with these arrhythmias before. That she has had both presyncope/syncope and rapid atrial fibrillation suggests sick sinus syndrome. Sick sinus syndrome causes profound pauses after atrial fibrillation spontaneously terminates. This 'post-reversion pause' could also cause her symptoms.

Q3. What is the definition of sick sinus syndrome?

Sick sinus syndrome is group of disorders of cardiac rhythm that includes sinus bradycardias, sinus pauses and sinus arrest. It may also include supraventricular tachycardias and tachy-bradycardia syndrome (in which there are alternating abnormally fast or slow heart rates).

Other conditions that cause bradycardias or syncope by affecting other parts of the conduction system such as the AV node must also be excluded. The bradyarrhythmias, by definition, should not be caused by medication (such as amiodarone in this case). If antiarrhythmic medication induces excessive pulse slowing, this usually implies a pacemaker may also be needed for the proper

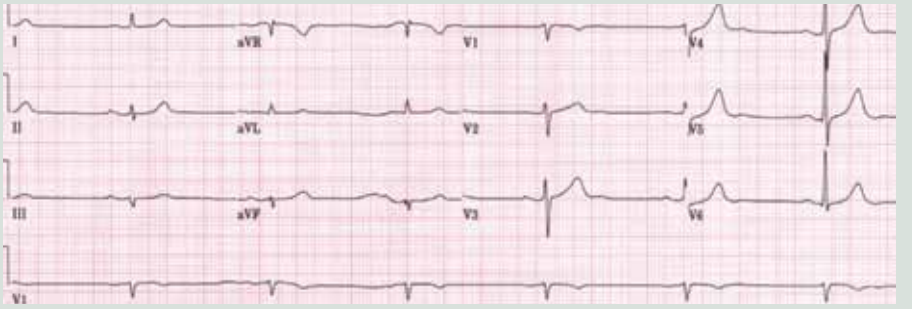

Figure. ECG showing sinus bradycardia with a first-degree heart block.

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Electrocardiographic criteria for sick sinus syndrome

The diagnosis of sick sinus syndrome includes the presence of one or more of the following on electrocardiography:

- sinus bradycardia below the heart rate expected for age (under 100 beats per minute [bpm] in an infant, under 80 bpm in a preschool child, under 60 bpm in a school child and under 50 bpm in an adolescent or adult
- sinus pauses or the absence of an expected P wave for more than 3 seconds. This may be due to sinus arrest (failure of the sinus node pacemaker cells to depolarise) or the result of sinoatrial exit block (depolarisation of the sinus node but failure to conduct to the atria)
- slow escape rhythms that originate within the atria, bundle of His or ventricles
- marked sinus arrhythmia with constant variation in the P–P interval (likely to be accompanied by sinus bradycardia)
- presence of both bradyarrhythmias and tachyarrhythmias (sinus node re-entry tachycardia, atrial tachycardias from an ectopic focus, atrial flutter and atrial fibrillation)

management of the arrhythmias. Other differential diagnoses include increased vagal tone, gastrointestinal disorders (such as dumping syndrome) and neurological conditions (such as autonomic dysfunction, epilepsy and transient ischaemic attacks).

Q4. What are the symptoms and signs?

There may be no symptoms of sick sinus syndrome or the symptoms may be quite nonspecific. Symptoms are mostly caused by a reduced cardiac output. Patients may complain of intermittent severe fatigue, flushing of the face, light headedness, dizziness, palpitations, shortness of breath with exercise, poor exercise tolerance, generalised weakness and intermittent chest discomfort.

The signs of sick sinus syndrome include presyncope and syncope, intermittent confusion, intermittent worsening of stable congestive cardiac failure, frequent episodes of angina, and transient ischaemic attacks or stoke if there is pre-existing vascular disease. There may also be documented ECG or Holter monitor changes.

Q5. In what ways might the ECG be abnormal?

Many of the ECG abnormalities in sick sinus syndrome are intermittent. This, plus the variation in clinical presentation, may make the diagnosis difficult (see Box). Common ECG manifestations include: bradyarrhythmias (such as inappropriate sinus bradycardia, poor heart rate response to exercise, sinus arrest, junctional bradycardias, ectopic atrial bradycardias), atrial fibrillation with bradycardia, and sinoatrial exit block, such as Mobitz type I (Wenckebach).

More than half of patients with sick sinus syndrome have supraventricular tachyarrhythmias such as atrial fibrillation (the most frequent abnormality), atrial flutter and atrial tachycardia.

Q6. What are the causes?

Sick sinus syndrome is often idiopathic, most likely caused by degeneration (fibrosis and fatty infiltration of the cardiac electrical pathways and sinus node) due to age, particularly in the very elderly. Medication use (e.g. beta blockers, calcium channel blockers and antiarrhythmic drugs) is a common cause.

The syndrome may be associated with ischaemic heart disease or hypertensive heart disease, but these are not direct causes. It may occur after myocardial infarction and, in this situation, may resolve over time. It may occur after cardiac surgery to the atria. Very rare associations include Kawasaki disease, diphtheria, haemochromatosis, amyloidosis and muscular dystrophy.

Q7. What are the indications for implanting a permanent pacemaker?

Pacemakers do not usually affect mortality in people with sick sinus syndrome, but are used to alleviate the symptoms, especially fatigue and syncope. Not everyone with sick sinus syndrome requires a pacemaker. If the tachyarrhythmias require that the patient takes a medication which then causes bradycardia (such as calcium antagonists or beta blockers), a pacemaker may be necessary to allow titration to an effective dose without the development of symptomatic bradycardia or heart block. An atrial pacemaker may be chosen to ensure the atrial rate avoids bradycardia, but most devices implanted will be dual chamber because there is a higher chance that these patients will develop AV node disease. It is rare for a patient to receive atrial-based pacing alone. In the very elderly or moribund, a ventricular-based pacemaker may be used to ensure minimum pacing, even at the expense of atrial and ventricular synchrony.

Key points

- **Sick sinus syndrome is group of disorders of cardiac rhythm that include sinus bradycardias, sinus pauses and sinus arrest. They may also include supraventricular tachycardias and tachy-bradycardia syndrome.**
- **Sick sinus syndrome may be asymptomatic, but symptoms are mostly caused by a reduced cardiac output, such as intermittent severe fatigue, flushing, light headedness, dizziness, palpitations, shortness of breath with exercise, generalised weakness and intermittent chest discomfort.**
- **Signs include presyncope and syncope, intermittent confusion, intermittent worsening of stable congestive cardiac failure, frequent episodes of angina, and transient ischaemic attacks or stoke if there is pre-existing vascular disease.**
- **The condition is idiopathic most likely caused by degeneration of the cardiac electrical pathways and sinus node due to age, but beta blockers, calcium channel blockers and antiarrhythmic drugs are also frequently implicated.**

Outcome: Margaret saw the cardiologist and decided to have a dual chamber pacemaker inserted. She declined any testing for ischaemic heart disease. As she was asymptomatic with a normal echocardiogram, the cardiologist was in agreement with this. CT