

Case 16 A 76-year-old woman with blackouts

A 76-year-old woman is referred urgently to the Cardiology clinic. She had a myocardial infarction 4 years earlier, percutaneous coronary intervention with a stent for angina 12 months earlier and has had two blackouts in the last month, 3 weeks apart.

volume. The JVP is raised by 2 cm, her apex beat is displaced to the lateral clavicular line, sixth intercostal space and there is a systolic murmur heard all over the precordium and in the carotids. The lung fields are clear and there is mild pitting oedema at the level of her shins.

What are the key questions in the initial history?

- In what setting did the blackouts occur? Were they exertional or at rest? Were they postural?
- Was there a prodrome or was there no warning?
- What was she like on recovery? Groggy or alert?
- Were there any associated symptoms, e.g. palpitations?
- Does she have any other symptoms, e.g. angina, breathlessness, dizzy spells, etc.?
- Are there any witnesses who can describe the attack?
- Was there any tongue-biting or incontinence to suggest a seizure?

She tells you that on one occasion she was gardening and trying to lift a heavy plant pot and on the other occasion she was carrying shopping from her car into the house. She had no warning and suddenly found herself on the ground. She was alert on recovery. There was no seizure-like activity. There were no other associated symptoms. She does have exertional breathlessness although she can manage 400m on the flat and a single flight of stairs. She has not had angina since her coronary stent 12 months earlier. Occasionally, she feels light-headed if she stands up too quickly. She is currently taking aspirin, a beta blocker, an angiotensin-converting enzyme (ACE) inhibitor, a loop diuretic and a statin.

Her physical examination reveals blood pressure 130/55 mmHg; resting pulse 55 bpm, regular, normal

What are the differential diagnoses?

- **A bradycardia.** 'Stokes-Adams' attacks are the result of ventricular standstill during intermittent complete heart block. They typically occur with no warning, are short-lived and have a prompt recovery with the return of AV-node conduction. Sinus pauses or sinus arrest can result in similar symptoms. Patients typically appear very pale at the onset and then flushed on recovery. Long episodes of asystole may result in seizure-like activity due to cerebral hypoxia. The elderly are more prone to conduction disease, particularly if there is a history of ischaemic or other heart disease. Bradycardia may be made worse by medications such as beta blockers, verapamil, diltiazem and antiarrhythmic drugs.
- **A tachycardia.** Ventricular tachycardia may cause syncope, particularly if it is very rapid, occurs in the upright position or during exertion. Syncope tends to occur at the onset before compensatory vasoconstriction can occur, therefore there may not be any associated awareness of palpitations. Ventricular tachycardia is usually (although not always) associated with structural heart disease, particularly myocardial infarction. It may be sustained (in which case if the patient does not suffer a cardiac arrest they recover consciousness and develop immediate symptoms such as palpitations, breathlessness, chest pain and shock) or non-sustained (in which case they regain consciousness within a few seconds with the return to sinus rhythm).
- **Aortic stenosis (AS).** She has a systolic murmur that radiates to the carotids and has exertional syncope, features consistent with severe AS. However, the reasonable exercise capacity, normal pulse character and the lack of a narrow pulse pressure argue against this.

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- **Orthostatic hypotension.** Postural drops in blood pressure are particularly common in the elderly and those taking antihypertensive or heart failure medications. The clue is usually the sudden move to an upright, standing position preceding the collapse and often there is a short prodrome. Lying and standing blood pressures should be performed.

Her description is typical of a cardiovascular cause rather than a neurological cause. In patients with known heart disease a cardiac cause should always be sought first, as syncope in this group carries a worse prognosis and a high likelihood of recurrence, necessitating prompt diagnosis and treatment.

Witness accounts to syncopal episodes are extremely useful as patients often have poor recollection of the event. Features such as pallor, flushing, twitching or seizure-like activity, impaired consciousness before or after the event are all helpful in making a diagnosis and some witnesses may even feel and record a pulse.

KEY POINT

Syncope accounts for 11% of A&E visits and up to 6% of acute hospital admissions. Around 10% of all syncope cases have a cardiac cause – such cases have an increased mortality risk. Syncope in patients with NYHA class III or IV heart failure is associated with a 1-year mortality of 45%.

What are the appropriate immediate investigations?

The following tests should all be performed during the consultation

- **12-lead ECG.** Perform to look for signs of old or recent myocardial infarction, left ventricular hypertrophy and strain and evidence of conduction disease (bundle branch block, heart block, sinus pauses or bradycardia).
- **Chest X-ray (CXR).** Look for cardiomegaly and pulmonary congestion (signs of heart failure and left ventricular failure) and heavy calcification of the aortic valve (suggesting significant aortic stenosis)
- **Echocardiogram.** This is an important test as the risk of this being due to a life-threatening arrhythmia are directly related to left ventricular function. It will also reliably report on aortic valve function.
- **Lying and standing blood pressure** to assess for orthostatic hypotension.

- **Carotid sinus massage.** This is a test for carotid sinus hypersensitivity, which is an abnormally strong bradycardia reflex that results in sinus pauses, sometimes complete heart block and a fall in blood pressure with stimulation in the neck region. Carotid sinus massage is performed by massaging the carotid pulse for 5 seconds with the patient in a supine position, recording the ECG and blood pressure. A positive result is a 3-second pause or 50 mmHg drop in blood pressure. Care should be taken if there is a carotid bruit and massage should probably not be performed.

What does her ECG show?

The 12-lead ECG (Figure 15.1) shows sinus bradycardia at 54 bpm. There are anterior Q waves with poor R-wave progression across the chest leads consistent with her old anterior myocardial infarction. There is left-axis deviation. The PR interval is prolonged (0.24 seconds) indicating first degree heart block. The QRS of 120 ms is at the upper limit of normal, although the morphology suggests incomplete left bundle branch block (LBBB).

A CXR shows mild cardiomegaly (cardiothoracic ratio [CTR] 0.54), some upper lobe blood diversion and minor calcification in the aortic valve region.

The transthoracic echocardiogram shows a dilated left ventricle. The anterior wall and septum are thin and akinetic (i.e. do not contract), consistent with an extensive old anteroseptal myocardial infarction. The left ventricular ejection fraction is estimated as 27% (severely impaired). The aortic valve is calcified but opens well. The peak gradient is 20 mmHg with an estimated valve area of 1.6 cm². There is moderate central mitral regurgitation (MR).

Lying and standing blood pressures showed only a mild drop in systolic pressure (135 mmHg to 125 mmHg) immediately after and 3 minutes after standing.

Carotid sinus massage did not result in any significant pauses.

How do these tests impact on the differential diagnoses? Do further tests need to be performed or can appropriate therapy be given?

- The ECG confirms the prior myocardial infarction. The first-degree heart block and left-axis deviation are relatively common findings in this situation and do not necessarily suggest a bradycardia cause although they do increase the likelihood.

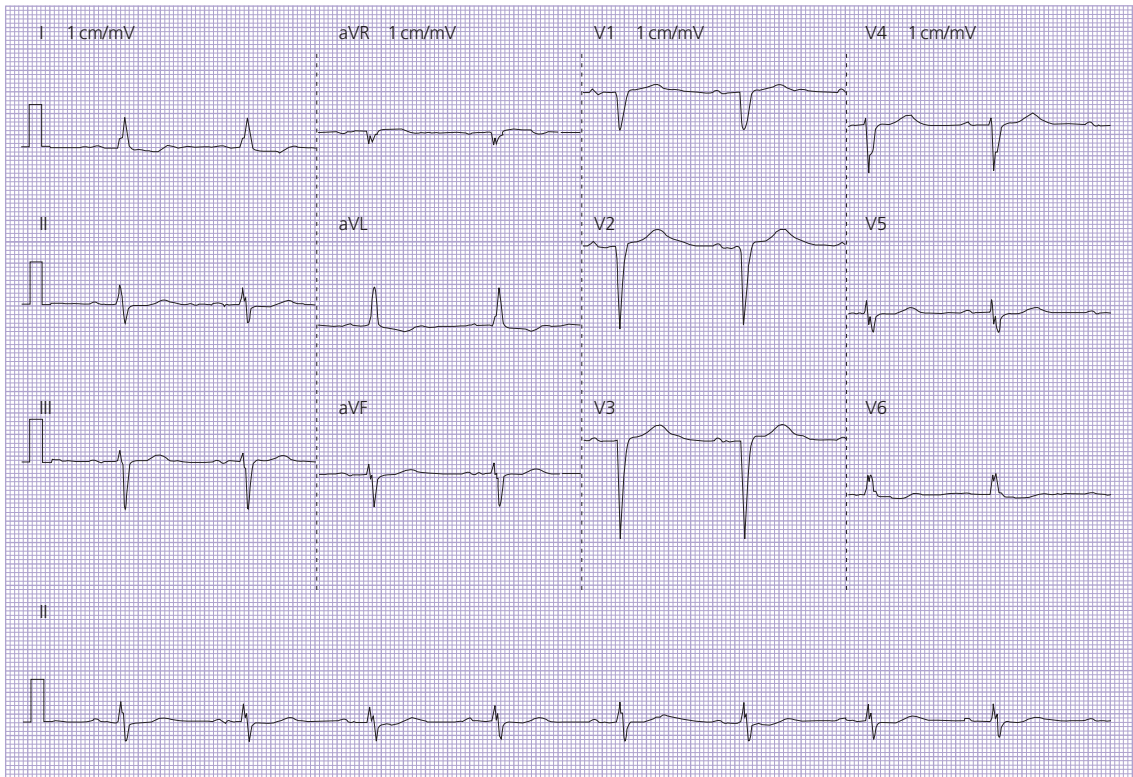


Figure 16.1 The patient's 12-lead ECG.

- The echocardiogram rules out severe AS and identifies significant left ventricular scarring and dysfunction. This increases the likelihood of a ventricular arrhythmia being the cause.
- The likely differential diagnoses now rest between intermittent complete heart block or ventricular tachycardia.

If the country and health service in which this is taking place follows American and European Cardiovascular Society guidelines, the patient satisfies the criteria for a primary prevention implantable cardioverter defibrillator (ICD). The Multicenter Automatic Defibrillator Implantation Trial 2 (MADIT 2) trial showed a survival benefit in patients with ischaemic heart disease and left ventricular ejection fraction (LVEF) $<30\%$ who were given a prophylactic ICD by preventing sudden cardiac death from ventricular arrhythmias. ICDs also provide bradycardia pacing therapy, so both the potential diagnoses would be addressed.

However, in the UK primary prevention ICDs are only approved for patients with ischaemic heart disease, LVEF $<30\%$ and a QRS duration >120 ms, which this woman does not have. Further evidence of ventricular arrhyth-

mias is required before an ICD is indicated. It is therefore important to try and correlate rhythm with symptoms (which requires a further episode of syncope) or perform provocative or diagnostic tests that strengthen a particular diagnosis. Empirical implantation of a pacemaker would not protect her from ventricular arrhythmias and increasing antiarrhythmic drug therapy could worsen bradycardia.

What tests should be performed next?

Correlation of rhythm with symptoms:

- **24- or 48-hour Holter monitor.** This is unlikely to record another syncopal episode as her attacks are infrequent. However, it may demonstrate asymptomatic intermittent heart block or non-sustained ventricular tachycardia.
- **7-day event monitor.** Patient-activated recorders in this situation would be unhelpful unless the recorder has a memory loop so that activation after the event documents the rhythm at the time of collapse.
- **Implantable loop recorder.** This is the most useful method, but also the most invasive and expensive.

The concern with prolonged recording is that the next attack may be fatal and an opportunity to prevent this has been missed. An alternative strategy is provocative testing.

- **Exercise testing.** Both her events occurred with physical exertion, albeit mild. A carefully supervised treadmill test (now that AS has been excluded) may provoke a further event and may also reveal critical ischaemia (despite the lack of angina symptoms). The risk is that the treadmill provokes an attack with syncope that causes collapse with subsequent injury.

- **Electrophysiological study (ventricular stimulation study).** This is an invasive study performed in a cardiac catheterisation laboratory. Under sedation a pacing wire is inserted into the right ventricle via a femoral vein. The ventricle is paced at a constant rate and additional paced premature beats are added at progressively shorter intervals to try and provoke ventricular tachycardia. It is a moderately sensitive and specific test, particularly if sustained monomorphic ventricular tachycardia is induced. It is less specific if ventricular fibrillation is induced. It is also more sensitive and specific in ischaemic heart disease compared with non-ischaemic cardiomyopathies. During the same procedure, AV node and His bundle conduction can also be assessed; however, this is not very sensitive or specific for heart block as a cause of syncope.

How urgently should further testing be performed?

There remains concern about the urgency to obtain a diagnosis. There have been two events in the past month already and the likely diagnosis is an arrhythmia. The patient should be offered immediate hospital admission for telemetry and subsequent provocative testing with an electrophysiological study. At the very least, these should be organised as urgent outpatient and day-case investigations. As the patient has no exertional symptoms consistent with angina (whereas her previous coronary stent was inserted for exertional angina) it is unlikely that there is significant myocardial ischaemia precipitating her syncopal attacks. Repeat coronary angiography is not mandatory; however, as she is being scheduled to have an invasive catheter laboratory procedure it may be prudent to image the coronary arteries at the same time, just in case there is a critical coronary AS that should be treated

to try and reduce the frequency or consequences of subsequent events.

The patient refuses immediate hospital admission but agrees to have a 24-hour Holter monitor attached and is scheduled for an elective day-case electrophysiological study the following week.

What additional advice should be given?

She should be told to call an ambulance and be brought straight to hospital if she has a further syncopal episode. She should be told not to drive her car until a diagnosis has been reached and appropriate treatment given.

She returns the Holter monitor 2 days later. There is not significant bradycardia (no pauses >3 seconds). There is infrequent ventricular ectopy and one asymptomatic four-beat salvo of non-sustained ventricular tachycardia.

She attends for her invasive electrophysiology study 5 days later. Coronary angiography demonstrates a chronically occluded LAD artery (present at the time of her stent insertion and the cause of her myocardial infarction) and a patent stent in her RCA. AV node and His bundle conduction is within normal limits. Programmed ventricular stimulation is then performed (Figure 16.2), inducing monomorphic ventricular tachycardia at 200bpm with loss of consciousness and is promptly cardioverted with a single external 150J biphasic shock.

What is the most appropriate treatment and is there any additional adjunctive treatment that could be offered?

The presence of inducible haemodynamically compromising sustained monomorphic ventricular tachycardia in a patient with syncope of unknown origin, ischaemic heart disease and poor left ventricular function is a class I indication for ICD implantation. Even if she had not suffered syncope as a presenting complaint, she would now satisfy primary prevention criteria as she has ischaemic heart disease, LVEF <35%, non-sustained ventricular tachycardia on a Holter and inducible VT with programmed stimulation (entry criteria for the original MADIT trial and an indication recognised by American, European and UK guidelines). ICDs (Box 16.1) are superior to standard drug treatment and amiodarone treatment at preventing sudden cardiac death in these patients.

ICDs treat ventricular arrhythmias after they occur, but do not stop them from happening in the first place.

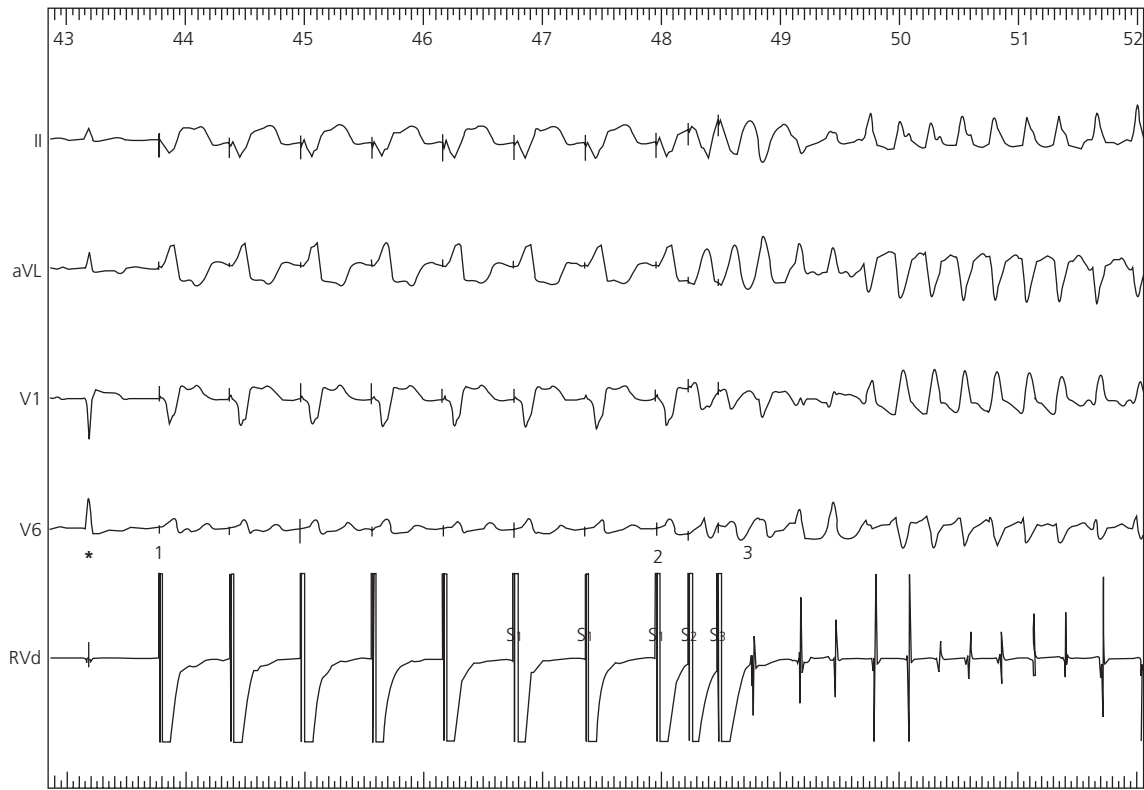


Figure 16.2 VT stimulation study showing induction of ventricular tachycardia. Four ECG leads are shown (II, aVL, V1 and V6) and the electrogram from the bipolar catheter placed in the right ventricular apex (RVd). The tracing shows a single beat of sinus rhythm (*) followed by eight paced beats (1) and two extra stimuli (paced premature beats, 2), which initiate ventricular tachycardia (3).

Box 16.1 Implantable cardioverter defibrillators (ICDs)

ICDs can be inserted under local anaesthesia. They consist of a generator (or 'can') that is implanted subcutaneously above the pectoralis muscle. One or two leads then enter the subclavian vein and are attached to the inside of the right ventricle (and right atrium if a dual-chamber device), which allows the device to monitor the heart rate. They are typically programmed to act if the ventricle exceeds a programmed heart rate, e.g. 180 bpm. When this happens there may be a choice of therapies delivered, depending upon the rate. Antitachycardia (overdrive) pacing is painless and terminates ventricular tachycardia in 75–80% of events. It is ineffective for polymorphic ventricular tachycardia or ventricular fibrillation. Shock therapy (typically 35 J) is painful but

terminates ventricular tachycardia and ventricular fibrillation in over 97% of events. If the first treatment is unsuccessful, the device recognises this and has further attempts often using more aggressive treatments. Occasionally, the ventricular rate may exceed the programmed detection rate due to sinus tachycardia or atrial arrhythmias (e.g. atrial fibrillation). The ICD will try to discriminate between a ventricular tachycardia and supraventricular tachycardia but if in doubt will administer a shock inappropriately rather than withhold treatment for a potentially life-threatening ventricular arrhythmia. ICD battery life lasts for 4–6 years, after which the generator needs to be changed. There are also small risks of lead fracture or device infection.

There remains a role for beta blockers and amiodarone therapy to try and reduce the frequency of device therapies. All patients should take beta blockers; however, the benefits of amiodarone need to be weighed up against the potential risks (thyroid dysfunction, photosensitivity, pulmonary and hepatic toxicity and peripheral neuropathy).

What lifestyle issues need to be addressed in ICD recipients?

Most patients can continue to lead active and fulfilling lives. The UK DVLA imposes driving restrictions (e.g. no driving for 1 month after primary prevention ICD or 6 months after secondary prevention ICD implant, or

for 6 months after appropriate shock therapy from an ICD). Patients need to avoid strong electromagnetic fields, but cellular phones and microwave ovens do not present any problems if used sensibly. Patients can travel and pass through airports but should declare their device to avoid going through large metal detectors. If a patient receives a shock therapy while in contact with another individual there is no danger to that other person. Following a shock, patients usually make a prompt recovery. As treatments occur within 10–12 seconds of the arrhythmia onset, many may not have been aware of the tachycardia preceding the therapy. Patients require regular follow-up, usually at device clinics on a 6-month basis.

CASE REVIEW

This 76-year-old woman with a known history of ischaemic heart disease and prior myocardial infarction was referred after suffering two episodes of syncope. Both blackouts had worrying features, such as a lack of prodrome and occurrence during exertion, that make arrhythmias a likely cause. The physical examination and echocardiogram demonstrated poor left ventricular function resulting from

her old myocardial infarction and excluded significant valvular heart disease. The potential severity of her symptoms necessitated prompt investigation using coronary angiography and provocative testing with a ventricular stimulation study. The finding of easily-inducible haemodynamically-compromising ventricular tachycardia led to insertion of an implantable cardioverter defibrillator.

KEY POINTS

- Syncope in a patient known to have heart disease should always be viewed with concern. Cardiac causes carry a worse prognosis.
- Usually the key to getting a diagnosis is to correlate rhythm with symptoms using Holter recordings or loop recorders; however, high-risk cardiac patient require urgent specialist referral.
- Secondary prevention with a defibrillator is advised in all heart failure patients who present with successful resuscitation from a cardiac arrest or haemodynamically-compromising ventricular tachycardia as there is a high chance of a recurrent event and no antiarrhythmic drugs have been shown to improve prognosis.
- No test has been shown to be an ideal predictor of sudden death. Perhaps the best risk-stratifier is left ventricular function and a history of myocardial infarction. The MADIT II trial showed that an ICD reduces total mortality by a third (20% to 14%) during an average follow up of 20 months.
- ICDs treat ventricular arrhythmias after they occur, but do not stop them from happening in the first place.

Reference

Moss AJ *et al.* Multicenter Automatic Defibrillator Implantation Trial 2 (MADIT 2). *New Eng J Med* 2002; **346**: 877–83.