# Palpitations following pacemaker insertion

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*Articles in this section use cases to illustrate the emergency management of patients presenting in general practice with cardiac problems. They are inspired by, but not based on, real patient situations.*

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***Mrs RW is a 65-year-old woman who presents for a scheduled follow-up appointment one month after elective implantation of a permanent pacemaker. She is married with adult children and enjoys painting art outdoors. Today, you do not expect any issues because you have received the report of her postimplantation device interrogation, which showed a normal functioning dual-chamber pacemaker. Her indication for pacing was symptomatic Mobitz type II atrioventricular block with a ventricular rate of 30 beats per minute. Before pacemaker implantation, she had reported frequent episodes of presyncope but no syncope. She has a past medical history of type 2 diabetes mellitus, which is controlled with metformin 1000 mg daily.***

***In your consultation, Mrs RW reports new episodes of presyncope over the preceding week. The episodes lasted between 15 minutes and two hours and occurred while she was sitting or standing. There was no association with exertion. You enquire about palpitations, and she quickly agrees that she has felt her heart racing. She denies having chest pain or dyspnoea.***

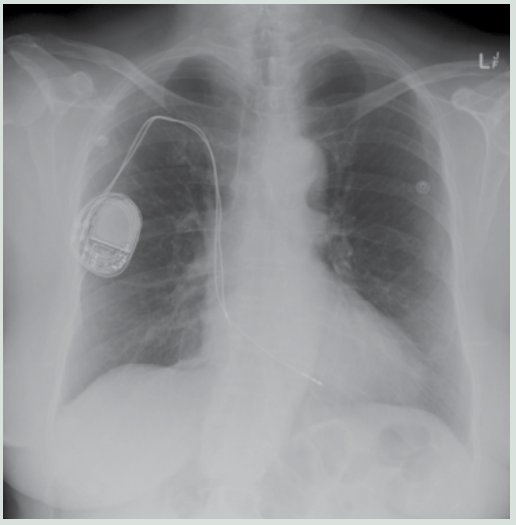
### *What do you find on clinical examination?*

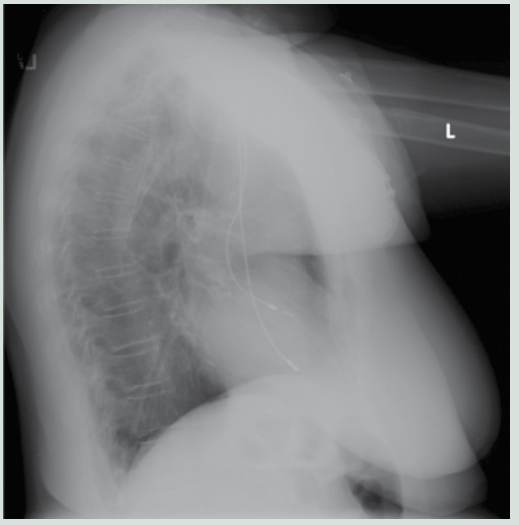
Your clinical examination reveals that Mrs RW has normal lying and standing blood pressures with no postural change. Her pulse rate is 66 beats per minute, and her temperature is 36.7°C. There is no tremor or thyroid mass. The jugular venous pressure is not elevated. Chest auscultation reveals normal vesicular breath sounds, with no cardiac murmurs or added heart sounds. There is no peripheral oedema. An ECG shows sinus rhythm with ventricular pacing. Her postoperative chest x-ray shows a dual-chamber pacing system, but appears otherwise normal (Figures 1a and b).

### *What types of permanent pacemakers are available and what are the indications?*

Permanent pacemakers comprise single-chamber, dual-chamber or biventricular (cardiac resynchronisation) devices. There are many modes available to program the pacemakers; common modes are described in Box 1. They include VVI (ventricular pacing and sensing plus inhibition of the pacemaker when it senses appropriate ventricular activity) and DDD (dual pacing and sensing and inhibition when the pacemaker senses appropriate ventricular activity).

All modern pacemakers can detect physical activity and respond by increasing





**Figures 1a and b.** Posteroanterior (a, left) and lateral (b, right) chest x-rays showing Mrs RW's dual-chamber pacemaker.

the pacing rate (rate response). They can also shift automatically from DDD to VVI mode (also known as automatic mode switch) when atrial tachyarrhythmias such as atrial fibrillation are detected, to avoid unwanted fast ventricular pacing.

There are well established American and European Guidelines that assist decision making in cardiac pacing.[1,2] The decision to proceed with cardiac pacing is influenced by factors that may include symptoms, severity of bradyarrhythmia, reversibility and quality of life. Common indications for pacemaker insertion in adults are summarised in Box 2.[3] They are also discussed in a feature article in this issue of *Cardiology Today*.[4]

### 1. Common pacing modes for permanent pacemakers

- AAI = atrial-pacing (A), atrial-sensing (A) and inhibition (I) of the pacemaker when it senses appropriate atrial activity
- VVI = ventricular-pacing (V), ventricular-sensing (V) and inhibition (I) of the pacemaker when it senses appropriate ventricular activity
- DDD = dual atrial- and ventricular-pacing (D), dual sensing (D) and dual modes (D) to inhibit atrial pacing when the pacemaker senses appropriate atrial activity and to trigger a ventricular output. A programmable delay simulates the PR interval

***What are the short-term complications of pacemaker implantation?***

Serious complications following pacemaker insertion are uncommon but when present, must be recognised quickly. Complications are summarised in Box 3.

***What does pacemaker interrogation involve?***

Patients with cardiac pacemakers are recommended to have their devices interrogated and if necessary reprogrammed at regular intervals, either at a pacing clinic or via remote monitoring. Interrogation of the device provides information regarding the function of its various components, including the leads, and the appropriateness of the programmed parameters. It also allows access to stored information to determine whether any significant cardiac arrhythmias have occurred and their nature.

***What is the next step for Mrs RW?***

Potential causes for Mrs RW's re-presentation with presyncope include pacemaker malfunction, tachyarrhythmia and non-heart rhythm-related issues. The first two possibilities

### 2. Common indications for permanent cardiac pacing

**Sinus node dysfunction**

- Scenario: Sinus bradycardia or pauses, in the absence of rate-limiting medications; the exception is in patients with tachy-brady syndrome, who require both pacemaker insertion and rate-limiting medications
- Outcome: Either a single-chamber (AAI) or dual-chamber (DDD) pacemaker is recommended, depending on whether AV nodal function is preserved

**Atrioventricular block**

- Scenario: Symptomatic second- or third-degree heart block
- Outcome: Dual-chamber pacemaker is recommended. Common mode is DDD, except in patients with atrial fibrillation (in whom a single-chamber VVI pacemaker is used)

**Neurally mediated syncope (including carotid sinus hypersensitivity)**

- Scenario: Syncope due to abnormal increase in vagal tone
- Outcome: A single-chamber (AAI) or dual-chamber (DDD) pacemaker is inserted depending on whether AV nodal function is preserved

**Heart failure**

- Scenario: Symptomatic heart failure in sinus rhythm with left bundle branch block and left ventricular ejection fraction of 35% or less
- Outcome: Patients may be eligible for biventricular pacing, which has been shown to improve their survival and symptoms[4]

Abbreviations: AV = atrioventricular; AAI, DDD, VVI – see Box 1.

**Figures 2a and b. Electrograms from a permanent pacemaker showing atrial (upper) and ventricular (lower) traces. a (left). Normal atrial and ventricular sensing. b (right). Atrial fibrillation with rapid ventricular conduction.**

### 3. Pacemaker complications

**Procedure-related complications**

- Anatomical complications (e.g. pneumothorax during cannulation of the subclavian vein, ventricular perforation during lead placement)
- Postoperative haematoma at the pacemaker site
- Infection

**Pacemaker malfunction**

- Mechanical lead failure (e.g. conductor fracture or insulation damage)
- Battery failure
- Lead displacement
- Exit block (leading to elevated pacing threshold and possible loss of atrial or ventricular capture)
- Sensing problems

**Pacemaker syndrome**

- Involves suboptimal atrioventricular synchrony; contraction of atria against closed atrioventricular valves during ventricular systole may cause cannon pulse, headache, dyspnoea and presyncope
- Common with single-chamber ventricular pacemakers in presence of sinus rhythm

**External pacemaker interference**

- Magnetic fields around magnets or high voltage electricity (e.g. welding, alternators and high voltage electricity towers)
- Lower voltage electric currents (e.g. radiotherapy, domestic electric equipments, keyless car and security systems); these carry much lower risk than high voltage currents
- Direct introduction of electric currents (e.g. electrocautery and circulation boosters)

can be addressed through careful device interrogation.

***You refer Mrs RW to the pacemaker clinic and organise an appointment for her within the week. Interrogation of the pacemaker reveals intrinsic sinus rhythm with atrial sensing and ventricular pacing (DDD). There are five recorded episodes of ventricular tachycardia, the timing of which corresponds to Mrs RW's symptoms. When these episodes are examined individually, the electrogram shows a disorganised fast atrial rhythm with a fast irregular ventricular rhythm of approximately 250 beats per minute (Figures 2a and b). Rather than ventricular tachycardia, this is more consistent with atrial fibrillation driving rapid ventricular pacing. This results from atrial undersensing, with failure of the automatic mode switch to the VVI mode. These findings explain Mrs RW's symptoms of presyncope and palpitations.***

### *What additional therapy is required?*

Mrs RW's management should initially focus on achieving pharmacological rhythm control and reprogramming the pacemaker's atrial sensitivity to allow for automatic mode switch if required in the future. Her thromboembolic risk will also need to be assessed and managed.

***Review of Mrs RW's echocardiogram findings indicates that the atrial fibrillation is nonvalvular, and this allows calculation of her CHADS-VASc score for stroke risk (score of 2). Her creatinine clearance is normal.***

***Outcome: Mrs RW is educated about atrial fibrillation. She is commenced on sotalol 40 mg twice daily, and rivaroxaban 20 mg daily, and the pacemaker is reprogrammed to a higher atrial sensitivity. She does not experience any further palpitations. At six-month follow up, pacemaker interrogation shows a minimal atrial fibrillation burden of 2%.***

***As atrial fibrillation is a recognised marker of cardiovascular risk, Mrs RW is encouraged to take extra steps to reduce her overall cardiovascular risk, including achieving optimal glycaemic control and weight loss. These measures have also recently been shown to reduce the burden of atrial fibrillation.[5]*** **CT**

## References

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COMPETING INTERESTS: None.