Pause-dependent paroxysmal phase-4 atrioventricular block

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DESCRIPTION

An elderly man with hypertension and dyslipidaemia presented with an episode of syncope. Initial ECG showed normal sinus rhythm with ventricular rate of 47 bpm, PR interval of 184 ms, QRS duration of 96 ms, left anterior fascicular block and 2:1 atrioventricular (AV) block (figure 1), which subsequently reverted to 1:1 AV conduction. Cardiac monitoring during hospital stay revealed a period of prolonged ventricular asystole secondary to pause-dependent paroxysmal AV block (PAVB) (figure 2). The patient underwent dual chamber pacemaker implantation and was discharged without complications.

PAVB is an under-recognised entity, and is defined as the sudden and repetitive block of atrial impulses to the ventricles.^{1 2} This is characterised by a 'bradycardia-dependent' or 'pause-dependent' phase 4 AV block, occurring in the diseased conduction system (His-Purkinje fibres).² It is thought to occur due to spontaneous depolarisation within the diseased His-Purkinje fibres during a prolonged pause (eg, compensatory post-extrasystole pause or spontaneous slowing of sinus rate). Subsequently,

when an electrical impulse reaches this conduction tissue during phase 4 of the action potential (resting state), the conduction system is incapable of depolarisation due to very low resting membrane potentials (due to depleted sodium reserves).² Conduction may only recover with the delivery of a premature ventricular beat, as it resets the membrane potential to its baseline value. This mechanism of AV block is very uncommon as compared with acquired high-degree or complete heart block, vagally mediated AV block, congenital heart block or tachycardia-mediated phase 3 PAVB.^{2 3}

Learning points

- ▶ Common causes of atrioventricular (AV) block include acquired high-degree or complete heart block, vagally mediated AV block, congenital heart block or tachycardia-mediated phase 3 PAVB (due to atrial tachyarrhythmias).
- ▶ Bradycardia-dependent or pause-dependent paroxysmal AV block (PAVB) is an uncommon and under-recognised entity, and is defined as the sudden and repetitive block of atrial impulses to the ventricles.
- ▶ The mechanism of this AV block is inactivation of sodium channels due to spontaneous depolarisation within diseased His-Purkinje fibres during a post-extrasystole compensatory pause, followed by inability to conduct electrical impulses due to a very low resting membrane potential (phase 4 of action potential).
- ▶ PAVB indicates significant underlying conductive tissue abnormalities and pacemaker implantation is appropriate, particularly when associated with symptoms.

Figure 1 Twelve-lead ECG showing normal sinus rhythm with 2:1 atrioventricular (AV) block, ventricular rate of 47 bpm, PR interval of 184 ms, QRS duration of 96 ms and left anterior fascicular block.

Figure 2 Telemetry strip showing normal 1:1 atrioventricular (AV) conduction followed by pause-dependent paroxysmal atrioventricular block (PAVB), which is initiated by an atrial extrasystole (arrow) and followed by a compensatory pause (bracket). Subsequent sinus beats are unable to conduct to the ventricles due to complete AV block with ventricular asystole. There is also evidence of sinus acceleration (shortening of P-P interval) during ventricular asystole that does not affect the AV block (since sodium channels within the His-Purkinje fibres are inactivated). Finally, the PAVB appears to be terminated by a premature ventricular contraction.

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