The WPW pattern of a shortened PR interval and wide QRS is a result of the fusion of 2 wave fronts depolarising the ventricles (Figure 1).

The electrical characteristics of the accessory pathway (AP) differ from those of the AV node. The AP conducts faster than the AV node, but its refractory period may be shorter, the same, or longer. In addition, the antegrade and retrograde refractory periods may differ. About 40% of APs are concealed, in that there is no delta wave visible in sinus rhythm, but the pathway may be able to conduct retrogradely and result in orthodromic atrioventricular re-entry tachycardias.

This patient’s AP has a long antegrade refractory period, in the region of 1 200ms, such that it only conducts intermittently at slower heart rates and not at all at faster heart rates. On another ECG at a similar heart rate (54bpm) to the one shown, all the QRS complexes were pre-excited, whereas another with a heart rate of 60 was normal.

The correct answer is therefore (b): Sinus rhythm with intermittent pre-excitation (WPW).

(2) MANAGEMENT

The management of a patient with the Wolff-Parkinson-White pattern on the ECG depends on:

- The presence of symptoms (WPW syndrome)
- The potential risk of sudden death

Symptoms from pre-excitation are due to paroxysmal tachycardias (Figure 2). Most commonly, these are orthodromic atrioventricular tachycardias (AVRT) – narrow QRS, regular tachycardias with retrograde P waves, usually visible in the ST segment, just after the QRS complex. The mechanism is macro re-entry, with the AP forming the retrograde limb of the circuit and the AV node the antegrade limb. Rarely, the circuit operates in the opposite direction – antidromic AVRT. In this case, there is a regular wide QRS tachycardia which may be indistinguishable from ventricular tachycardia, because the ventricles are activated exclusively via the AP with slow, cell to cell conduction.
AVRT is the most common mechanism of tachycardia in neonates and infants up to the age of one year, but symptoms usually start in late childhood or adolescence. They may, however, start at any age.

The risk of sudden death in WPW syndrome is real but low – 0.25% per year or 3 - 4% over a lifetime. The mechanism is atrial fibrillation (AF) conducting sufficiently rapidly to the ventricles to induce ventricular fibrillation. AF is surprisingly common in patients with WPW syndrome. Around 20% will experience it at some time or another, even children as young as 10 years. It is usually triggered by an episode of AVRT. It is characterised by a very rapid, irregular wide QRS rhythm in which the QRS morphology is not compatible with right or left bundle branch block. The QRS morphology often varies from beat to beat, with occasional narrower complexes when an impulse happens to traverse the AV node ahead of that via the AP.

This patient has no symptoms of palpitations and therefore does not warrant treatment on that score. Is he at risk of sudden death should he develop AF? For the AP to conduct
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Further risk stratification. An exercise stress test is useful if the delta wave disappears at higher heart rates. This, however, is not always easy to determine if there is artefact in the exercise tracing. The ECG should be evaluated carefully to ensure that the delta wave is truly absent as left sided accessory pathways may have subtle and varying degrees of pre-excitation.

Both strategies are reasonable and management will depend on the patient’s wishes after balancing a very small lifetime risk of sudden death and a very small immediate ablation risk, the availability of EPS studies and the age of the patient (further risk stratification is preferred in the younger patient).

If his ECG had shown consistent pre-excitation and the patient is asymptomatic, there are 2 possible management strategies:\(^3\)

- Observation, without further evaluation or treatment, is reasonable in asymptomatic patients, provided the patient is informed of the small risk of life-threatening arrhythmias.

- Further risk stratification. An exercise stress test is useful if the delta wave disappears at higher heart rates. This, however, is not always easy to determine if there is artefact in the exercise tracing. The ECG should be evaluated carefully to ensure that the delta wave is truly absent as left sided accessory pathways may have subtle and varying degrees of pre-excitation.

The answer to (2) is: (a). Tell him that the ECG is benign and no further action is necessary, unless he develops symptoms.

![FIGURE 2: Arrhythmias in WPW syndrome (ECGs from different patients).](image)

A. Orthodromic atrioventricular re-entry tachycardia (AVRT), in which the AP forms the retrograde limb of the circuit and the AV node the antegrade limb. A regular, narrow QRS tachycardia. Note the retrograde P waves distorting the ST segments, best seen in II, about 90ms after the QRS. This is the most common arrhythmia in WPW.

B. Antidromic AVRT, in which the AP forms the antegrade limb, with retrograde activation via the AV node. A regular wide QRS tachycardia with QRS morphology that is not compatible with bundle branch block. Ventricular activation is slow and resembles ventricular tachycardia.

C. Pre-excited atrial fibrillation, in which the ventricles are activated rapidly through an AP with a short refractory period. Note the irregular wide QRS with bizarre morphology. Occasional capture via the AV node results in narrower complexes.

D. Orthodromic AVRT triggers AF with a rapid ventricular response which degenerates after a few seconds into ventricular fibrillation. This is the mechanism of sudden arrhythmic death in WPW syndrome.
Should an exercise test be inconclusive or the delta wave persists to maximum heart rate, an invasive electrophysiological study (EPS) should be considered to measure the refractory period of the AP. This should be done with the clear understanding by the patient that it will progress to radiofrequency catheter ablation of the AP, should its refractory period be less than 240ms.

There is now no place for the use of toxic antiarrhythmic drugs in WPW, except in rare instances when catheter ablation fails or is contra-indicated.

**LESSONS AND CONCLUSIONS**

- The WPW pattern on the ECG is due to fusion of impulses activating the ventricles prematurely via the accessory pathway (delta wave) with that via the AV node.
- Delta waves may be consistent, intermittent or absent (concealed pre-excitation).
- Intermittent delta waves indicate a long refractory period of the AP and therefore very low risk of atrial fibrillation triggering VF.
- In the absence of symptoms, intermittent pre-excitation does not need treatment.

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**REFERENCES**