

# Electrocardiographic Case – “Abnormal Rhythm” in a Normal Heart

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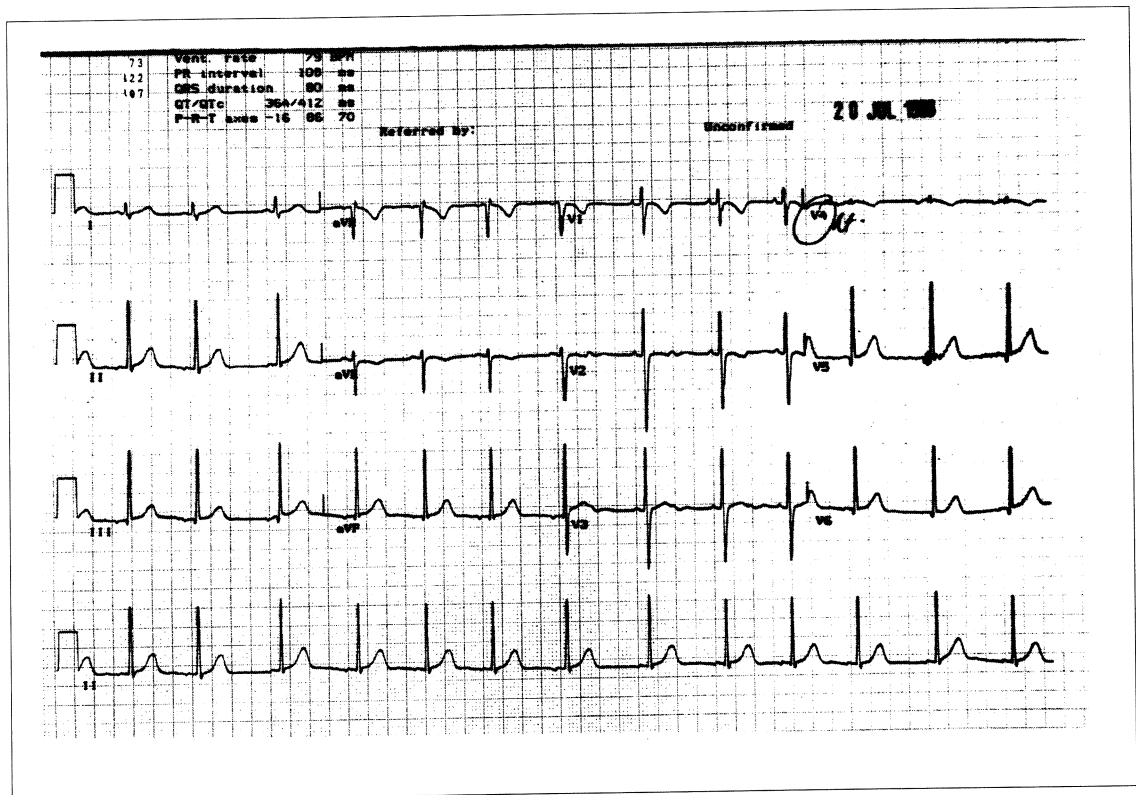


Fig 1

This is the ECG of a 7-year-old boy who was referred for evaluation of an asymptomatic cardiac murmur. Physical examination was within normal limits. The clinical diagnosis of an innocent murmur was made. What does the ECG show?

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**Answer**

Low ectopic atrial pacemaker (coronary sinus rhythm).

**DISCUSSION**

In this ECG tracing, each QRS complex is preceded by a p wave. However, the p wave axis is located in an upper quadrant (negative in limb lead II, III and aVF). This is in contrast to the normal p wave axis, which is usually located in the second quadrant. There is no other abnormality in the rest of the ECG.

The usual stimulus for cardiac activation arises from the sinoatrial node. The impulse then spreads along specialised conduction pathways to the atrioventricular node, and subsequently the His-Purkinje system to the rest of the myocardium. The p wave on the ECG represents atrial depolarisation.

Although this is conventional teaching, the pacemaker is not necessarily localised to the sinus node alone. Existence of extranodal pacemaker was demonstrated by Randall et al<sup>(1,2)</sup>. These were identified as coming from a region extending from the right atrium-superior vena cava junction anteriorly, to the right atrium-inferior vena cava junction posteroinferiorly, that paralleled the crista terminalis. This region was termed the 'pacemaker complex' by Boineau et al<sup>(3)</sup>.

In the low atrial rhythm (or "coronary sinus rhythm" as previously known), activation of the cardiac cycle begins in a pacemaker situated lower in the atrium<sup>(4)</sup>, and not from the SA node as is the usual case. This explains for the difference in p wave axis observed. It is similar in concept to the mechanism of the wandering pacemaker<sup>(5)</sup>, but different insofar as the number of pacemaker sites is concerned.

In itself, there is little clinical significance when there is no associated heart disease or other underlying conduction abnormality. However, it is important to appreciate this diagnosis so that the patient can be reassured that this is a variant, and no unnecessary alarm is caused.

**REFERENCES**

1. Randall WC, Talano J, Kaye MP, et al. Cardiac pacemakers in absence of the SA node: Responses to exercise and autonomic blockade. *Am J Physiol*, 1978; 234:A465.
2. Randell WC, Wehrmacker WH, Jones SB. Hierarchy of supraventricular pacemakers. *J Thorac Cardiovasc Surg*, 1981; 82:797.
3. Boineau JP, Schuessler RB, Mooney CR, et al. Multicentric origin of the atrial depolarisation wave. The pacemaker complex. *Circulation* 1978; 58:1036.
4. Park MK, Guntheroth WG. How to read pediatric ECGs (Chapter 7, p111), Mosby Year Book. Third edition. 1992.
5. Quek SC, KS Ng, PS Low. P waves on ECG - variations on a theme. *Singapore Med J*, 38, no.10 (1997):453-4.