

ECG Quiz

JAY KAY, ALEX YIP, WING-HING CHOW

From Cardiac Medical Unit, Grantham Hospital, Hong Kong

The 12-lead ECG below belongs to a 66-year-old lady with a history of syncope. It was recorded prior to a follow-up clinic visit. She was taking sotalol for the paroxysmal fast palpitations (Figure 1).

Further 12-lead ECG was recorded in the presence of a standard magnet (Figure 2).

What is your diagnosis?

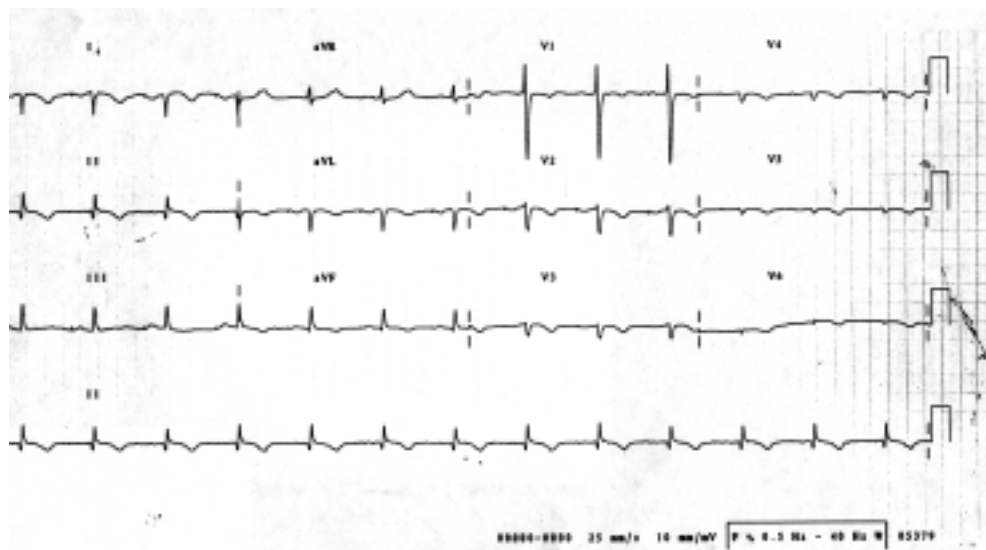


Figure 1.

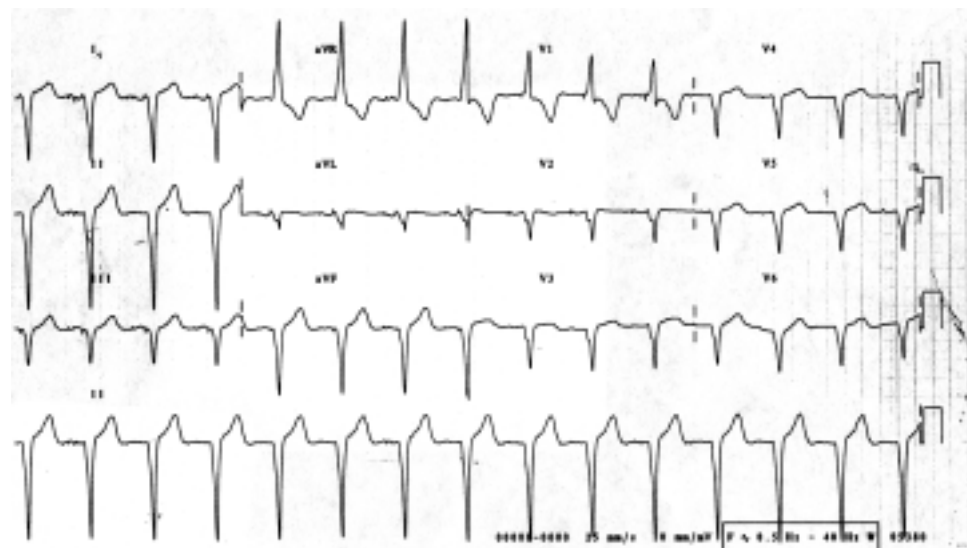


Figure 2.

Diagnosis

Dextrocardia: Sick Sinus Syndrome and atrial fibrillation with dual chamber permanent pacemaker

Figure 1 shows a regular rhythm at 75 times a minute. It is associated with irregular oscillations of the baseline and pacing stimuli preceding every P waves. On the other hand, pacing stimuli follows both atrial and ventricular complexes in Figure 2. These features suggest atrial demand pacing in the presence of atrial fibrillation, and asynchronous dual chamber pacing under the influence of magnetic field. Figure 1 also demonstrates normal QRS interval, inverted T waves and prolonged QT interval.

A number of more interesting features are found in Figure 1. Negative P waves and QRS complexes are evident in lead AVL and I. In these two leads, QRS morphologies are identical – a Qr pattern – and T waves are inverted. In AVR, P waves are positive and QRS complexes display an Rs pattern. The electrical axis in the frontal plane is deviated to the right. Last interesting finding is the lack of normal progression of R waves in the precordial leads. Instead, these leads start with an rS pattern, followed by progressive diminution of both the QRS and R-wave amplitudes across the precordium (V1-V5) and end in a QS pattern in V6.

These limb leads abnormalities should prompt the consideration of either erroneous limb leads misplacement or dextrocardia. Misplacements of the electrodes in the limbs are a recurrent technical error. The most frequent mistake is reversal of the right arm and left arm electrodes. This produces a characteristic pattern: lead I is upside down; lead II becomes lead III; and lead III becomes lead II. In the augmented leads, AVR becomes AVL; AVL becomes AVR; and AVF is unchanged. On the other hand, dextrocardia is a rare congenital abnormality with an incidence of 0.0125% from mass radiographic screening in adults. The heart is "flipped over" as it would be in a mirror image. There is a reversal of the right-to-left relationship while the anterior-posterior relations of the two ventricles remain normal. In the normally located heart, biatrial

depolarization by sinus impulses results in a mean P wave vector that is directed down and to the left of the patient, which is reflected by upright P waves in lead I. In contrast, the P-wave vector points down but to the right of the patient with dextrocardia, and a negative P wave is inscribed in lead I. Ventricular depolarization and repolarization are mirror images of the normal electrical sequences in uncomplicated dextrocardia. As a result, QRS complexes and T waves are upside down in leads I and AVL, and dominantly upright in leads III, AVF, and AVR.

Although erroneous reversal of the right arm and left arm electrodes and dextrocardia present with similar features in the limb leads, important differences exist between the two conditions in the precordial leads. As the heart is situated normally in the left chest, reversal of the right and left arm electrodes alone should show a normal R-wave progression from V1 to V6. In contrast, when dextrocardia is responsible for the limb leads abnormalities, a so-called "reverse R-wave progression" is found in the standard precordial leads. In other words, because the heart is in the right chest and the precordial leads are unipolar, recordings from the left chest will show the tallest QRS to be in V1 and, thereafter, its amplitude will diminish as the precordial electrodes are placed further and further away from the right-side heart. This pattern is evident in the Figure 1.

The patient has Sick Sinus Syndrome and slow atrial fibrillation with dual chambers pacing, in addition to the diagnosis of dextrocardia. Pacing from her right ventricular apical position therefore produces a wide right bundle branch block and superior axis pattern in Figure 2. The diffuse T wave inversion and prolonged QT interval were ascribed to the sotalol.

References

1. Braunwald E. Heart Disease: A Textbook of Cardiovascular Medicine. 5th ed. Philadelphia, WB Saunder Company, 1997, pp. 108-23.
2. Weatherall D, Ledingham J, Warrell D. Oxford Textbook of Medicine. 3th ed. New York, Oxford University Press, 1996, pp. 2182-200.