Case 2: the interpretation of ST segment changes in the presence of bundle–branch block

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CASE 2

A 63-year-old man presented to casualty with a 1-hour history of crushing retrosternal chest pain associated with nausea and sweating. An electrocardiogram (ECG) was recorded (*Figure 1*). What was the diagnosis?

DISCUSSION

The ECG showed ST segment elevation in the anteroseptal leads V1 to V4. Small Q waves were present in leads V2 to V4. The diagnosis was acute anterior myocardial infarction. Sinus tachycardia and right bundle–branch block were present. An ECG recorded 2 hours later during thrombolysis showed persistent ST segment elevation and deepening of the Q waves (*Figure 2*). The right bundle–branch block had resolved.

A further ECG recorded 1 week later showed isoelectric ST segments, patho-

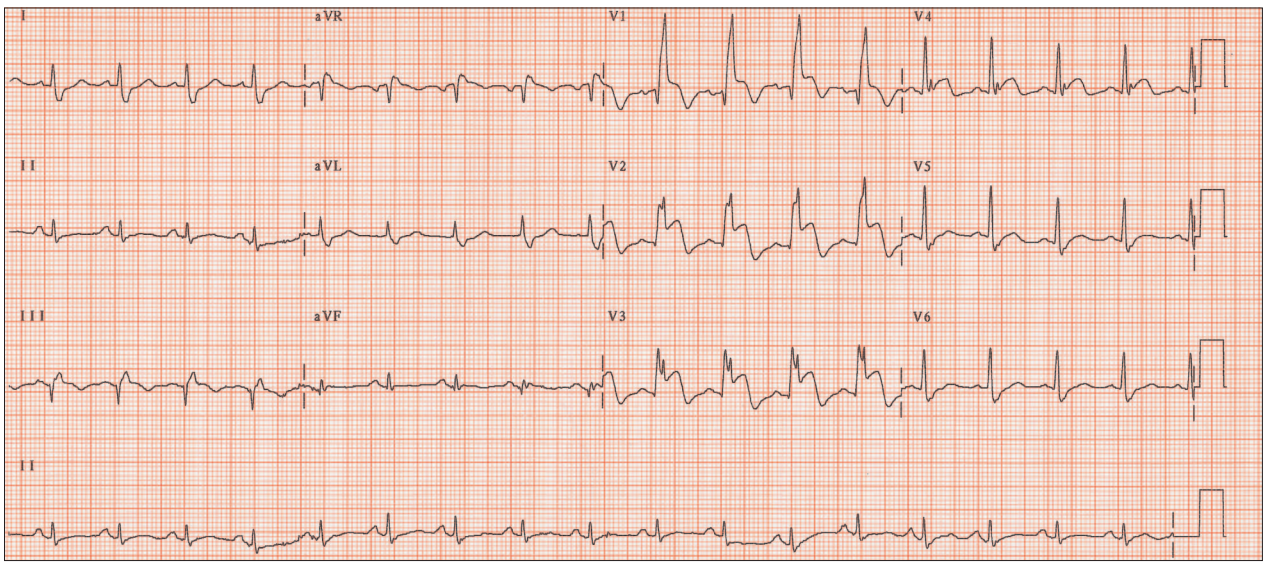

Figure 1. The electrocardiogram at presentation.

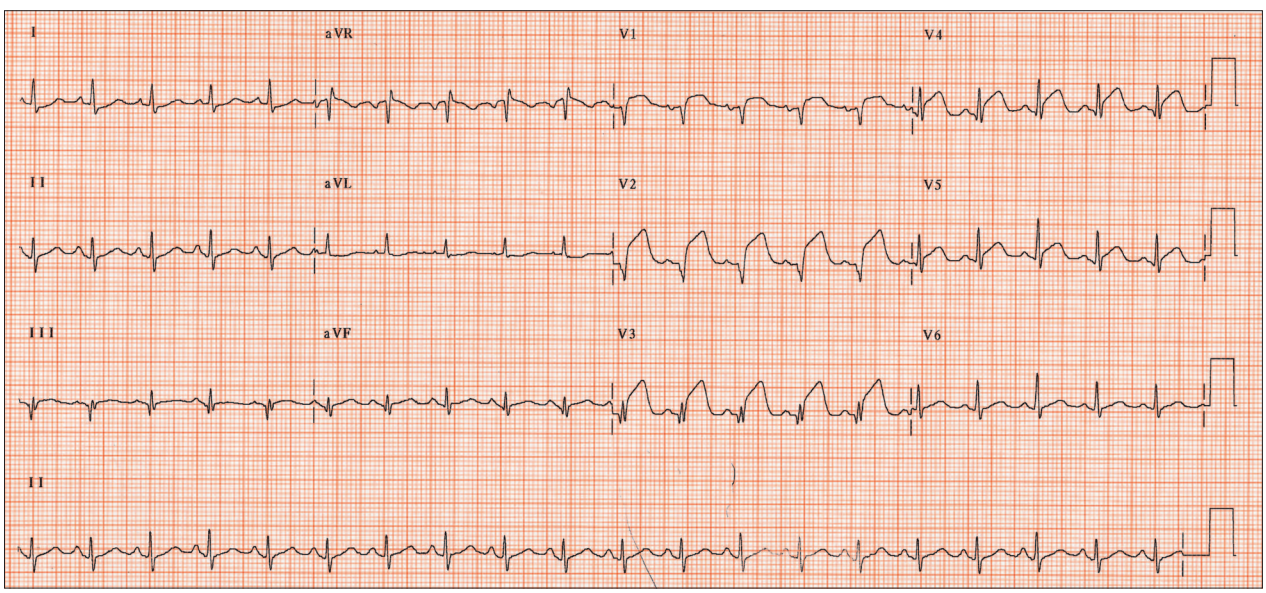

Figure 2. The electrocardiogram during thrombolysis.

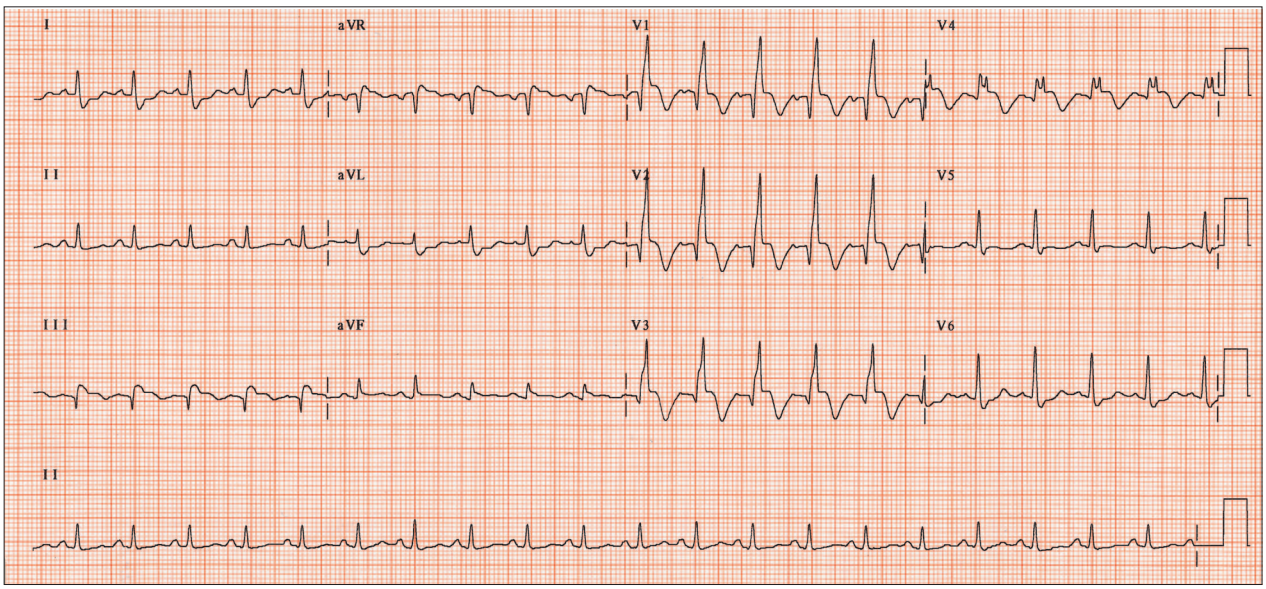

Figure 3. The electrocardiogram 1 week after presentation.

logical Q waves and inverted T waves in the anteroseptal leads (*Figure 3*). Right bundle–branch block was present once more. These ECGs demonstrate that it is possible to interpret ST segment changes resulting from acute ischaemia in the presence of right bundle–branch block.

Origin of the ST segment and T wave

The ST segment and T wave of the surface electrocardiogram correspond to the repolarization phase of the cardiac action potential — the plateau and downstroke respectively. During the plateau phase in a normal heart myocytes throughout the ventricular myocardium are depolarized to similar degrees and there is little or no current flow. The ST segments are therefore isoelectric. During the latter phase of the cardiac action potential, potential gradients develop between different areas of the ventricle resulting in the T wave. The polarity of the T wave is determined by the sequence in which ventricular repolarization occurs. The sequence of repolarization is in turn critically dependent upon the activation pattern.

Normal activation

In a normal heart both ventricles are activated rapidly and virtually simultaneously via the His–Purkinje system resulting in a narrow QRS complex. Following an isoelectric ST segment the T wave polarity is the same as that of the QRS complex because ventricular repolarization proceeds in roughly the reverse sequence to depolarization.

Right bundle–branch block

In the presence of right bundle–branch block the left ventricle is activated normally, via the His–Purkinje system. The repolarization sequence and hence the ST segment and T wave are therefore normal and the changes in these components of the ECG as a result of acute ischaemia are similar to those seen in the absence of right bundle–branch block.

Left bundle–branch block

In the presence of left bundle–branch block, activation of the left ventricle proceeds slowly and in an abnormal sequence as the activation wavefront is conducted slowly through the myocardium. As a consequence the repolarization sequence is altered markedly, reflected by the ST and T wave changes characteristic of left bundle–branch block: the ST segment is virtually non-existent while the polarity of the T wave is opposite to that of the QRS complex. Recognition of repolarization changes resulting from acute ischaemia in the presence of left bundle–branch block is therefore unreliable. HM

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Future electrocardiogram interpretations

- Progressive conduction block
- Collapse as a result of bradycardia
- Cardiac memory
- Transient ST elevation