AMERICAN HEALTH CONSULTANTS®

Emergency Medicine Reports

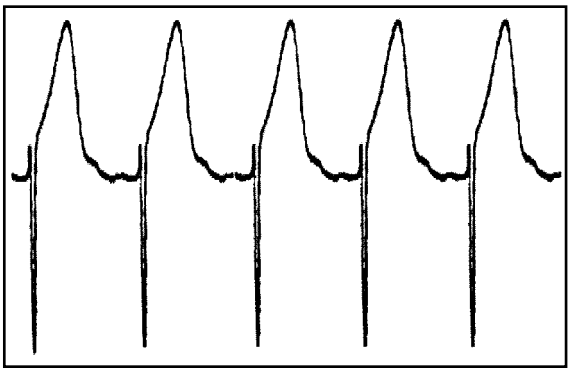
The Practical Journal for Emergency Physicians

Visual Glossary: Figures 1-36

Electrocardiographic Diagnosis of Acute Coronary Syndromes

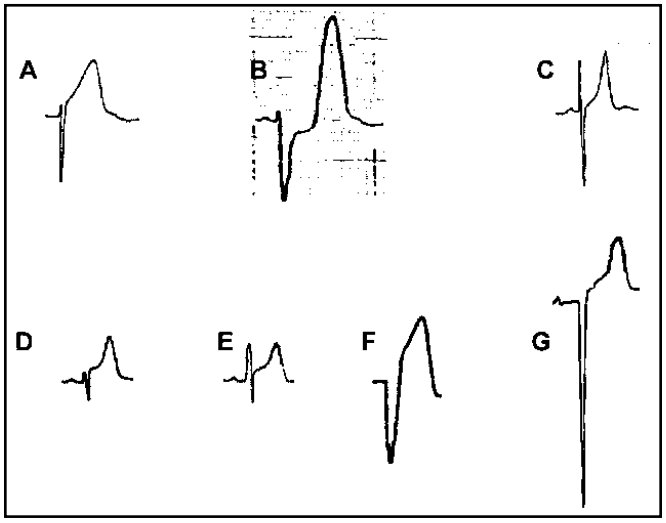
(Enclosed for use with the April 23, 2001, issue)

Figure 1



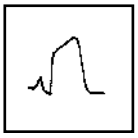
Hyperacute T wave: The hyperacute T wave is the earliest electrocardiographic finding encountered in the STE-AMI patient. These T waves are broad-based, asymmetric structures that rapidly evolve to more typical STE.

Figure 2



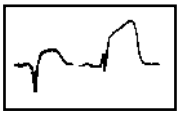
Electrocardiographic differential diagnosis of the hyperacute T wave: A, AMI. B, AMI. C, Hyperkalemia. D, Benign early repolarization (BER). E, Acute pericarditis. F, Left bundle-branch block (LBBB). G, Left ventricular hypertrophy (LVH).

Figure 3



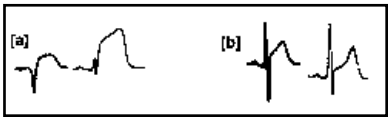
Giant R wave: The Giant R wave is an intermediate structure between the hyperacute T wave and the typical ST segment elevation.

Figure 4



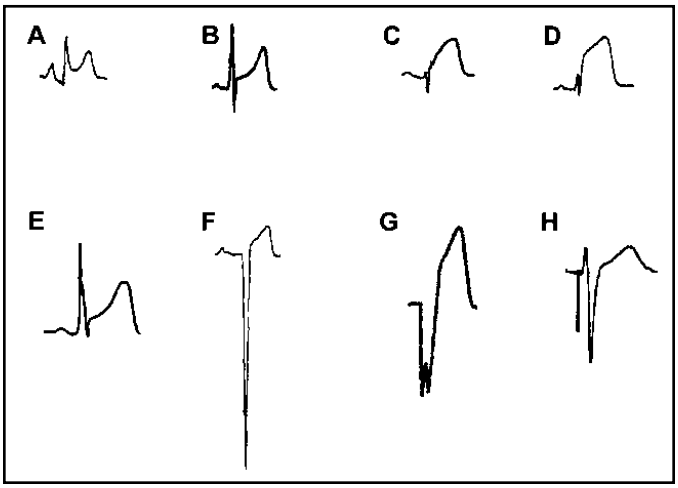
ST segment elevation: The morphology of the ST segment, when it is elevated in the setting of AMI, most often involves either an obliquely flat or a convex configuration.

Figure 5



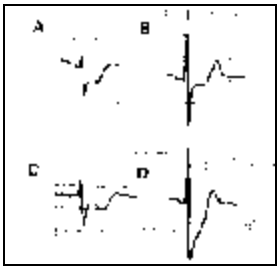
Morphology of ST segment elevation: The initial, upsloping portion of the ST segment usually is either flat or convex in the AMI patient (see A). This morphologic observation, however, should only be used as a guideline—it is not infallible. Patients with ST segment elevation due to non-AMI syndromes may demonstrate concavity of this portion of the waveform (see B)—pericarditis and benign early repolarization, respectively.

Figure 6



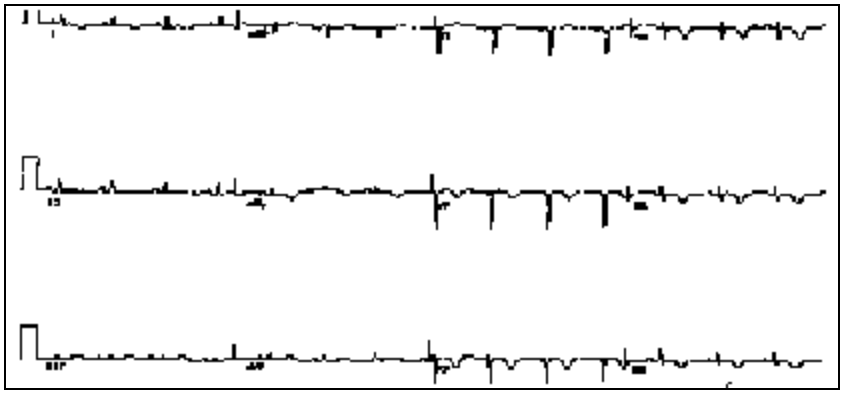
Electrocardiographic differential diagnosis of ST segment elevation: A, Acute pericarditis. B, Benign early repolarization (BER). C, AMI. D, AMI. E, Atypical morphology of AMI. F, Left ventricular hypertrophy (LVH). G, Left bundle-branch block (LBBB). H, Ventricular paced rhythm (VPR).

Figure 7



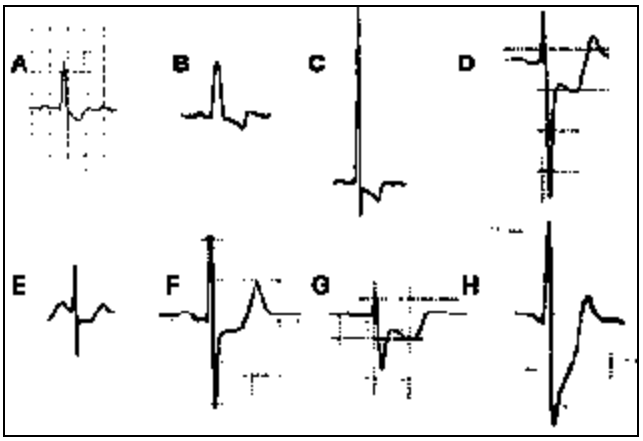
ST segment depression as seen in acute coronary syndromes (ACS) of varying morphologies: A, Horizontal. B, Horizontal. C, Downsloping. D, Upsloping.

Figure 10



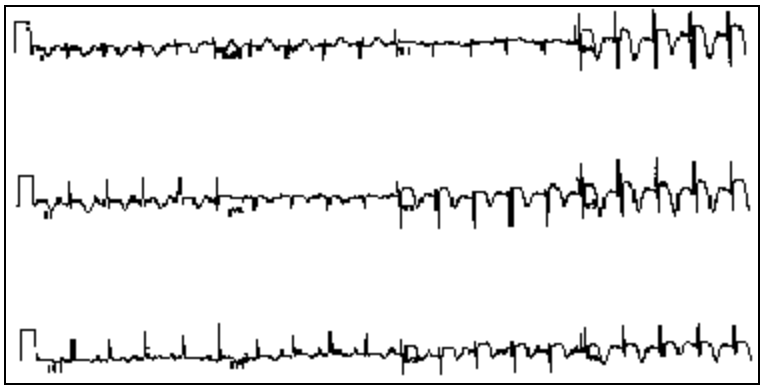
T wave inversion associated with acute coronary syndrome (ACS) in a chest pain patient.

Figure 8



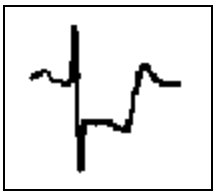
Electrocardiographic differential diagnosis of ST segment depression: A, Digoxin effect. B, Left bundle-branch block (LBBB). C, Left ventricular hypertrophy (LVH). D, AMI of the posterior wall (as seen in lead V_2). E, ST segment depression of acute coronary syndrome. F, ST segment depression of acute coronary syndrome. G, ST segment depression of acute coronary syndrome. H, ST segment depression of acute coronary syndrome.

Figure 11



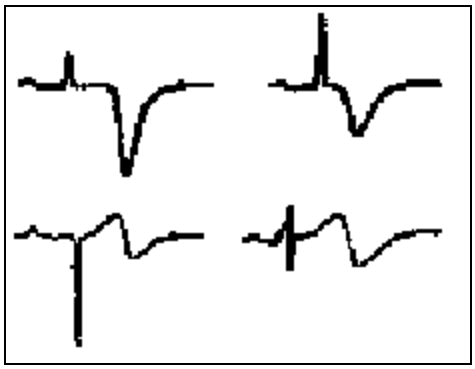
CNS T wave inversions seen in the anterolateral area. This patient presented with severe headache and was found to have extensive subarachnoid hemorrhage by CT scan.

Figure 9



Reciprocal ST segment depression: In the setting of STE AMI, ST segment depression located in leads distant from the infarction is termed reciprocal change or reciprocal ST segment depression. Reciprocal change is useful diagnostically—its presence strongly suggests AMI—and prognostically—patients with such a finding have larger infarcts, lower resultant ejection fractions, and higher rates of death.

Figure 12

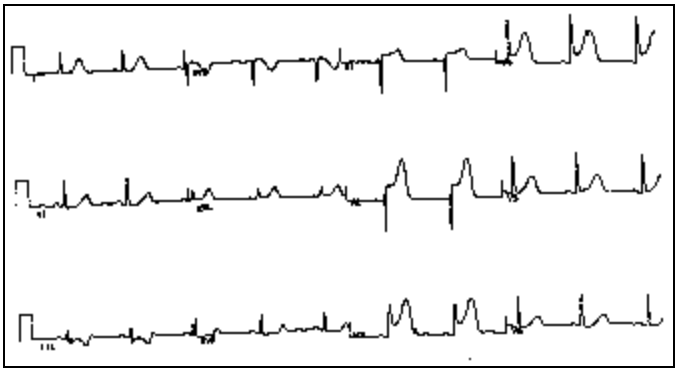


Wellen's T waves: Wellen's T waves occur in two basic forms. The upper examples depict the more common pattern—deeply inverted T waves. The less commonly encountered morphology, biphasic T wave, is shown in the lower panel.

Figure 13

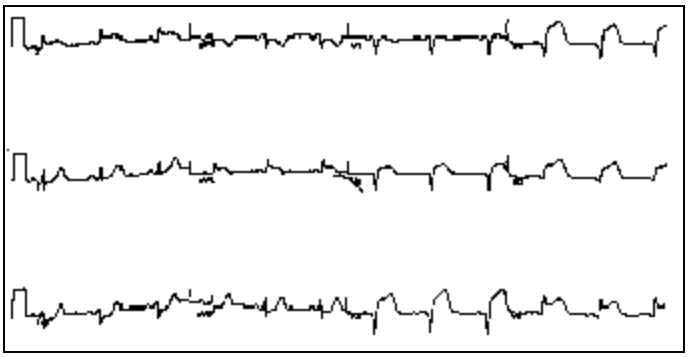
Q wave with ST segment elevation: Q waves most often indicate completed infarction and usually appear 9-12 hours after AMI that is not aborted. Q waves may appear as early as 1-2 hours after the onset of AMI. Such patients will present with ST segment elevation and pathologic Q waves.

Figure 14



Anterior AMI: STE is seen in the leads V_1 to V_4, consistent with anterior wall AMI. This pattern may be described as either anterior or anteroseptal.

Figure 15



Anterolateral AMI: Extensive infarction is seen here with STE in leads V_2 to V_4 (anterior) and leads I, aVL, V_5, and V_6 (lateral), consistent with an anterolateral AMI.

Figure 16

Lateral AMI: Isolated lateral wall AMI is seen with STE in leads I and aVL. Note the STD seen in the inferior and right precordial leads, consistent with reciprocal change. The STD in leads V_1 to V_3 also may represent posterior wall AMI.

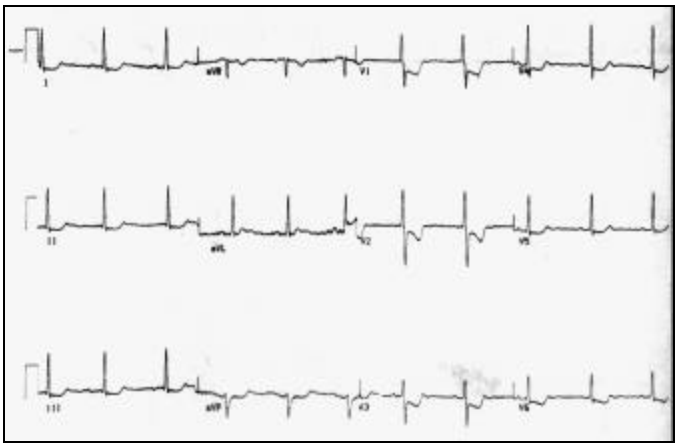
Figure 17

Inferior AMI: Inferior wall AMI is seen with STE in leads II, III, and aVF. Note the STD seen in the lateral and right precordial leads, consistent with reciprocal change. The STD in leads V_1 to V_4 also may represent posterior wall AMI.

Figure 18

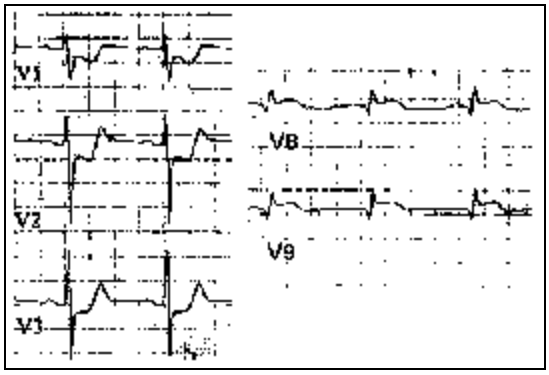
Inferoposterior AMI: 12-lead ECG of an acute myocardial infarction of the inferior and posterior walls of the left ventricle. In addition to the STE seen in the inferior leads, STD is encountered in the right precordial distribution. This STD is associated with a prominent R wave. These findings are suggestive of posterior wall AMI in addition to the inferior AMI. STD also is seen in leads I and aVL, consistent with reciprocal change.

Figure 19



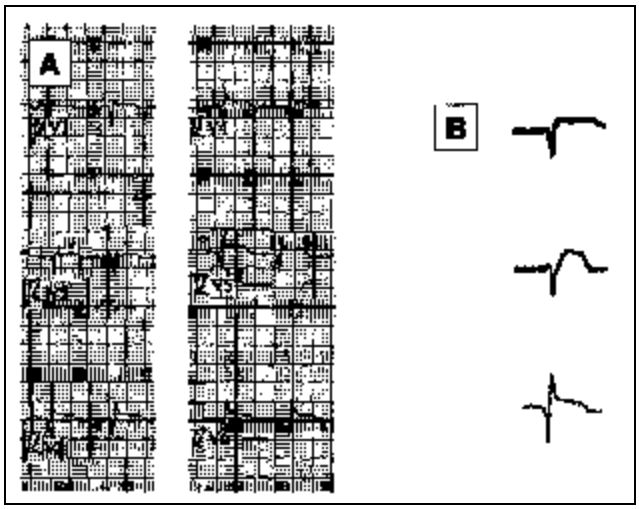
Isolated posterior AMI: As in Figure 18, STD is noted in the right precordial leads, consistent with an isolated posterior wall AMI.

Figure 20



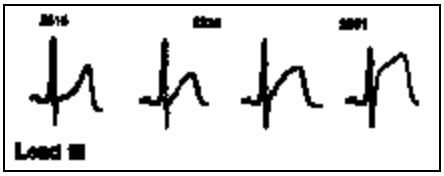
Posterior wall AMI: Right precordial (leads V_1 to V_3) ST segment depression and posterior thoracic leads with STE consistent with posterior wall AMI.

Figure 21



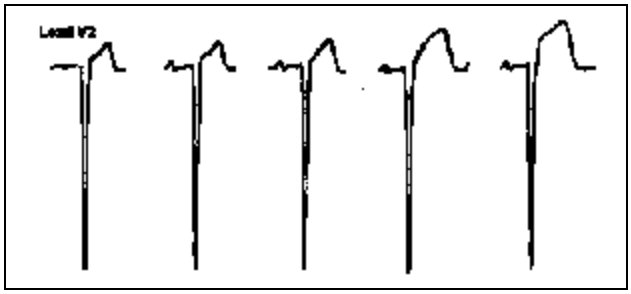
Right ventricular infarction: A, Right-sided anterior thoracic leads in right ventricular AMI. B, Right ventricular AMI: single lead RV_4.

Figure 22



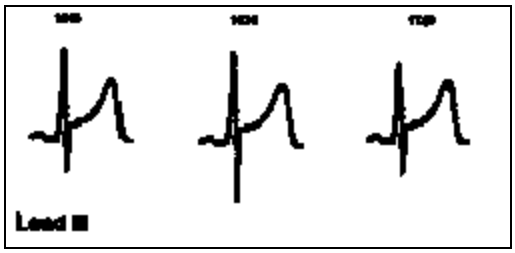
AMI noted with serial ECGs: Adult patient presents with chest pain and an initially normal ECG. With continued pain, serial ECGs are performed that quickly detect change, ultimately diagnostic of AMI.

Figure 23



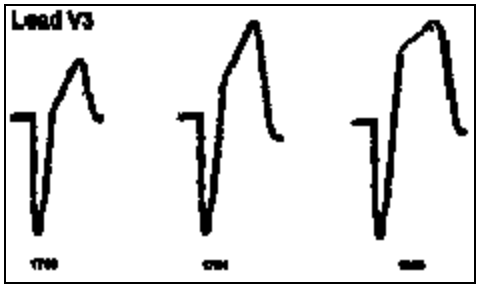
ECGs in the AMI LVH patient: Serial ECG demonstrating interval change consistent with AMI in the LVH pattern.

Figure 24



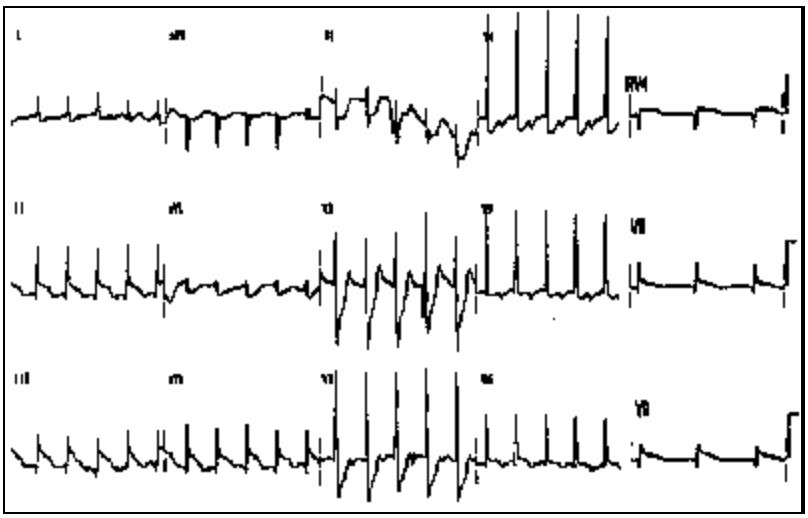
Benign early repolarization (BER): Serial ECG demonstrating lack of interval change in the BER pattern—confirming a non-infarction cause of the STE.

Figure 25



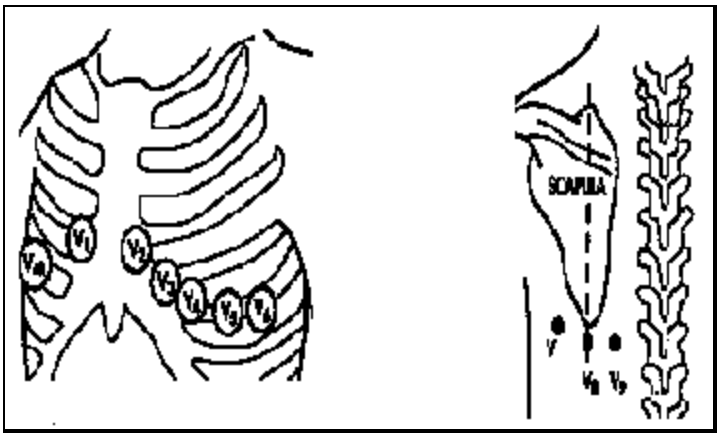
Left bundle-branch block with electrocardiographic AMI: Serial ECG demonstrating interval change in the LBBB pattern complicated by AMI.

Figure 26a



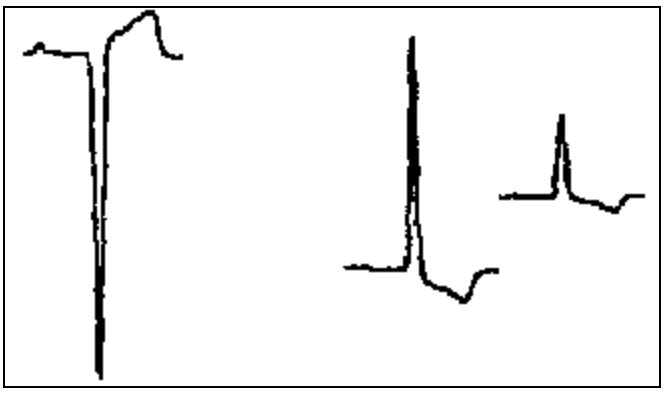
A 15-lead ECG with AMI of inferior, posterior, and right ventricular segments.

Figure 26b



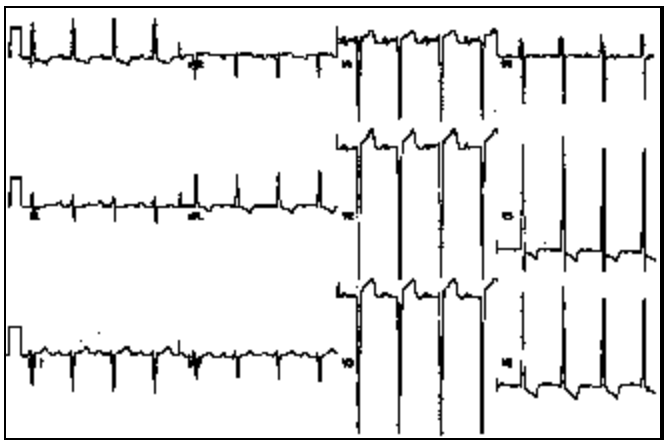
Placement of the additional electrocardiographic leads of the 15-lead ECG: Lead RV_4 is placed in a similar position to lead V_4 yet on the right thorax. The posterior leads V_8 and V_9 are placed on the patient's left back—V_8 at the tip of the scapula and V_9 in an intermediate position between lead V_8 and the left paraspinal muscles. The additional "V" notation located lateral to V_8 also may be used and is termed V_7.

Figure 27



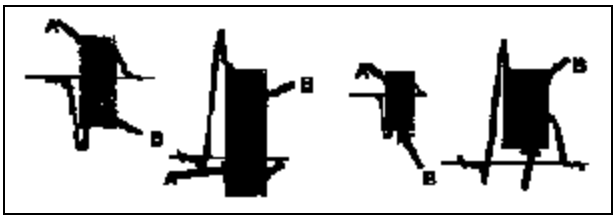
Left ventricular hypertrophy: Electrocardiographic changes associated with the LVH pattern.

Figure 28



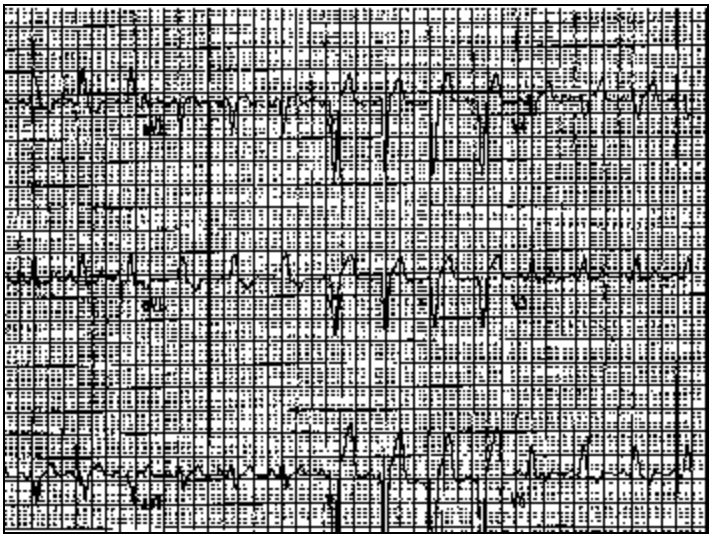
12-lead ECG with LVH: No AMI was found in this patient; the ST/T changes represent repolarization change associated with LVH.

Figure 29



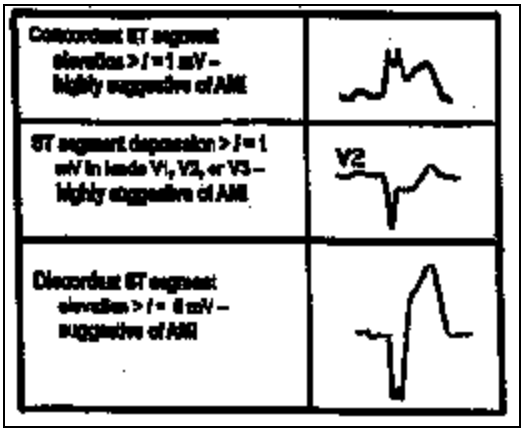
The concept of appropriate discordance in the LBBB pattern: The shaded areas note the portions of the waveform which must be evaluated in the LBBB pattern. In all examples listed, "A" depicts the initial portion of the ST segment/T wave complex while "B" refers to the major terminal segment of the QRS complex. The appropriate relationship of the ST segment to the T wave in the LBBB pattern is one of discordance (i.e., the major terminal portion of the QRS complex and the ST segment/T wave complex must be on opposite sides of the isoelectric baseline). This "normal" relationship is seen in the two examples on the left. Abnormal relationships are seen in the two examples on the right—near right, concordant ST segment depression and, far right, concordant ST segment elevation. In both of these cases, such findings suggest acute coronary ischemia.

Figure 30



LBBB pattern without electrocardiographic AMI: In the patient with LBBB, the anticipated or expected ST segment-T wave configurations are discordant, directed opposite from the terminal portion of the QRS complex, and called QRS complex-T wave axes discordance. As such, leads with either QS or rS complexes may have markedly elevated ST segments, mimicking AMI. Leads with a large monophasic R wave demonstrate ST segment depression. The T wave, especially in the right to mid precordial leads, has a convex upward shape or a tall, vaulting appearance, similar to the hyperacute T wave of early myocardial infarction. The T waves in leads with the monophasic R wave frequently are inverted.

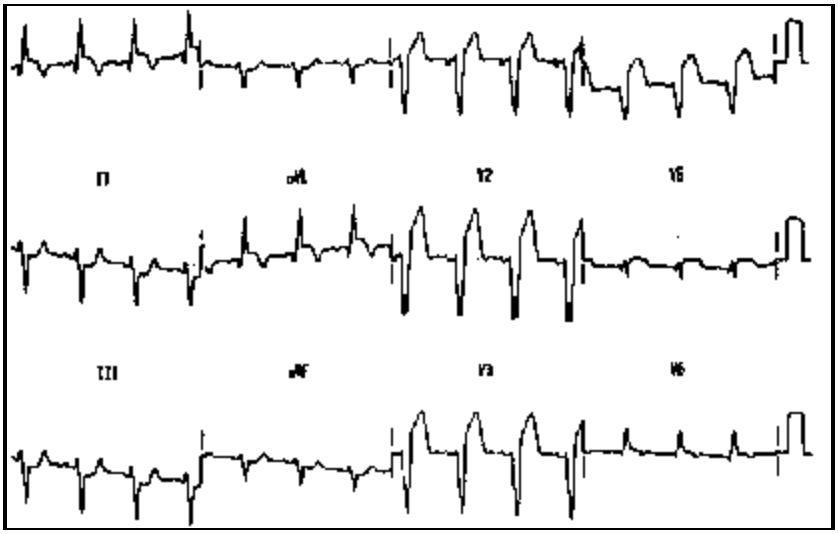
Figure 31a



Electrocardiographic criteria of the diagnosis of AMI in LBBB: The electrocardiographic criteria suggesting a diagnosis of AMI according to Sgarbossa et al[18] include on the left (1) ST segment elevation greater than one millimeter which is concordant with the QRS complex (score of 5); in the middle (2) ST segment depression greater than 1 mm in leads V_1, V_2, or V_3 (score of 3); and on the right (3) ST segment elevation greater than 5 mm that is discordant with the QRS complex (score of 2). A total score of 3 or more suggests that the patient is likely experiencing an acute infarction based on the electrocardiographic criteria. With a score of less than 3, the electrocardiographic diagnosis is less assured, requiring additional evaluation.

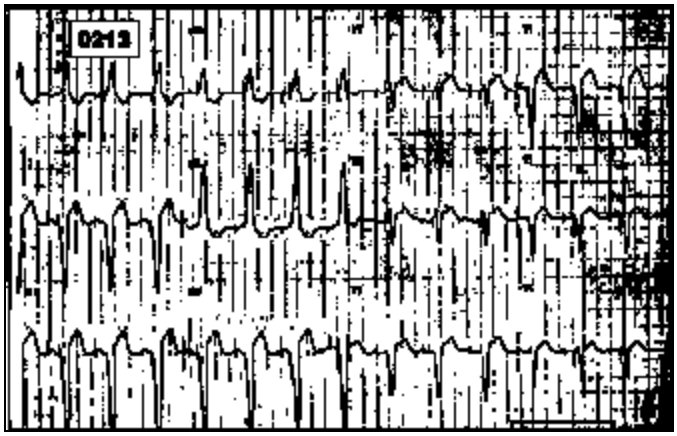
Source: Brady WJ. Mastering the Electrocardiogram: State-of-the-art techniques for evaluating ST segment elevation in acute myocardiol infarction and other clinicl syndromes. *Emergency Medicine Reports* 1998;19:78-85.

Figure 31b



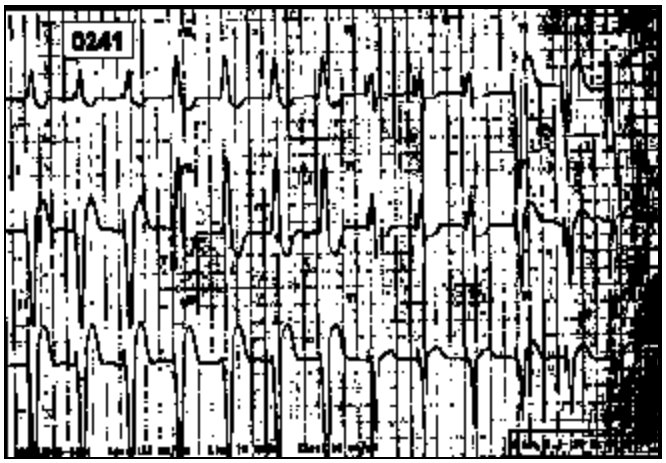
12-lead ECG with AMI in the setting of LBBB: Anterolateral AMI in a patient with preexisting LBBB. The rule of appropriate discordance is violated in a number of leads in this example. The lateral leads (I, aVl, V_5, and V_6) reveal concordant STE while the inferior leads (III and aVf) demonstrate concordant ST segment depression—both features that suggest acute coronary ischemia. Further, excessive discordant STE is seen in leads V_2 through V_4, another worrisome feature for AMI.

Figure 32



Ventricular paced rhythm with appropriate relationships: The concept of appropriate discordance also may be applied in this instance as it is in the LBBB patient.

Figure 33

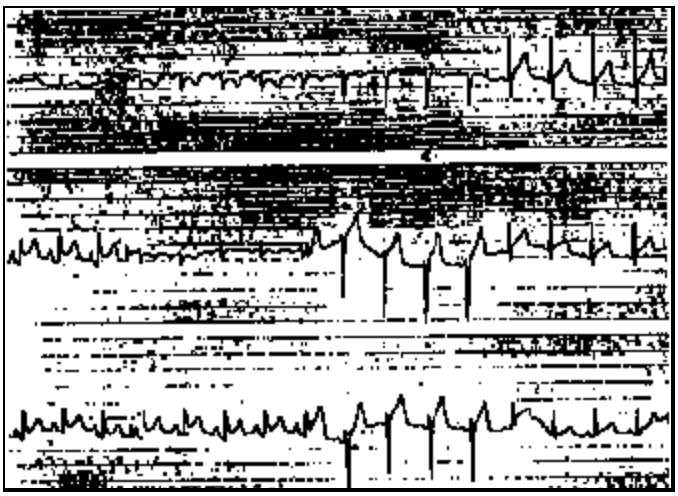


AMI in the setting of ventricular paced rhythm: This is a serial ECG performed in the patient seen in Figure 32. Note the progression of STE in the inferior leads and STD in the right precordial leads. While these changes are not diagnostic of AMI, the change noted over approximately 30 minutes in the appropriate patient (i.e., chest pain worrisome for ACS) is highly suggestive of AMI.

Figure 34

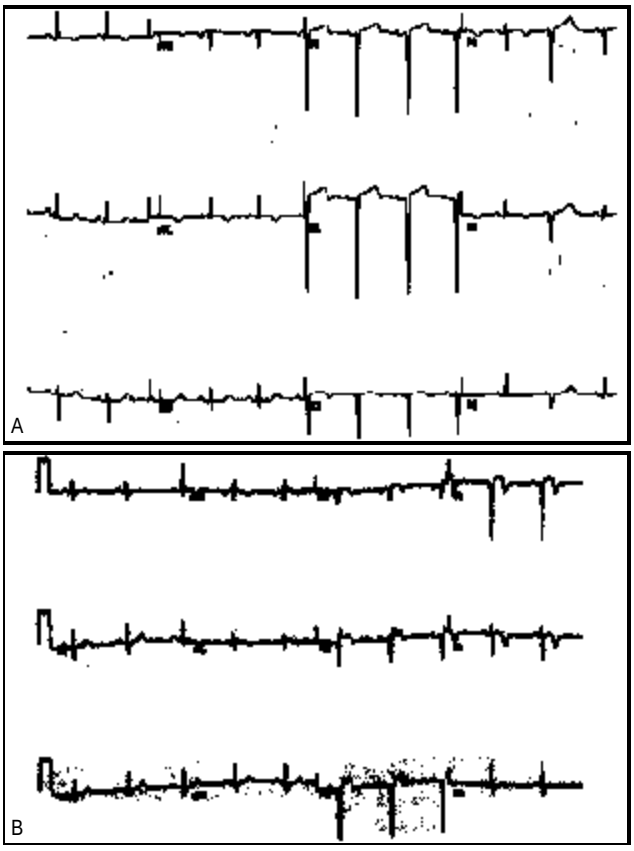
Benign early repolarization (BER): Note the STE in all leads except leads I, aVR, aVL, and V_1, as well as the prominent T waves in similar distribution.

Figure 35



Acute pericarditis: Diffuse STE is seen accompanied by PR segment depression in the inferior leads and PR segment elevation in lead aVR.

Figure 36a and 36b



Left ventricular aneurysm: A, Minimal ST segment elevation. B, More pronounced ST segment elevation.