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Grade 3 ischemia on the admission electrocardiogram predicts rapid progression of necrosis over time and less myocardial salvage by primary angioplasty

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Abstract

Backgroud: Among patients with ST-elevation acute myocardial infarction, those with terminal QRS distortion (grade 3 ischemia) have higher mortality and larger infarct size (IS) than patients without QRS distortion (grade 2 ischemia).

Methods: We assessed the relation of baseline electrocardiographic ischemia grades to area at risk (AR) and myocardial salvage [100 (AR − IS)/AR] in 79 patients who underwent primary angioplasty for first ST-elevation acute myocardial infarction and had technetium Tc 99m sestamibi single-photon emission computed tomography before angioplasty (AR) and at predischarge (IS). Patients were classified as having grade 2 ischemia (ST elevation without terminal QRS distortion in any of the leads, n = 48), grade 2.5 ischemia (ST elevation with terminal QRS distortion in 1 lead, n = 16), or grade 3 ischemia (ST elevation with terminal QRS distortion in >2 adjacent leads, n = 15).

Results: Time to treatment was comparable among groups. AR was comparable among groups (38% ± 20%, 33% ± 23%, and 34% ± 23%, respectively; $P = .70$). There were no differences among groups in residual myocardial perfusion (severity index 0.28 ± 0.12, 0.29 ± 0.16, and 0.30 ± 0.15 in grades 2, 2.5, and 3 ischemia, respectively; $P = .97$). In contrast, there was a trend toward lower myocardial salvage (45% ± 32%) in the grade 3 group than in the grade 2 (65% ± 33%) and grade 2.5 (65% ± 40%) groups ($P = .16$). Salvage was dependent on time only in the grade 3 group. Spearman rank correlation coefficients between time to treatment and percentage salvage were 0.003 ($P = .99$), −0.24 ($P = .38$), and −0.63 ($P = .022$) for grades 2, 2.5, and 3, respectively.

Conclusions: Patients with grade 3 ischemia have rapid progression of necrosis over time and less myocardial salvage. This admission pattern is a predictor of myocardial salvage by primary angioplasty.

Keywords: Acute myocardial infarction; Electrocardiography; Infarct size; Area at risk

1. Introduction

Prognosis after acute myocardial infarction (MI) is related to final infarct size (IS) [1-3]. Final IS is determined by the size of the initial ischemic myocardium at risk [4-8], the duration of coronary artery occlusion [4,6,9], and the rate of progression of the wave front of

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necrosis [5], or the "severity" of ischemia. The latter depends on at least 2 factors: (1) the presence of residual blood supply to the infarct zone, either by antegrade flow in the infarct-related artery (subtotal occlusion or intermittent reperfusion) or by collateral circulation [4,6-9]; and (2) metabolic factors such as the oxygen requirement of the myocardium [4] and presence of metabolic protective mechanisms (ie, "ischemic preconditioning") [10-13]. The ability to estimate immediately upon admission the expected rate of progression of necrosis may enable physicians to identify patients in whom reperfusion would not be expected to salvage myocardium and conversely those who might benefit from reperfusion even if the time elapsed from symptom onset is prolonged.

The extent of myocardial involvement (ischemic area at risk [AR]) can be estimated by searching for symptoms and signs of heart failure and using echocardiography, radionuclide techniques, ventriculography, or magnetic resonance imaging. However, imaging methods increase delays in treatment and can neither measure the "severity" of ischemia nor differentiate between viable myocardium and already infarcted myocardium during the evolving phase of infarction. Although single-photon emission computed tomography (SPECT) with technetium Tc 99m sestamibi can quantify the AR and its residual flow and the final IS [6-9,14-18], this method likewise is relatively expensive, time consuming, and technically demanding; and yet does not give answers in real time when decisions concerning reperfusion therapy or transfer to other centers for primary transcutaneous coronary interventions (PCI) are being made.

Previous studies showed that patients with ST-elevation acute myocardial infarction who have terminal QRS distortion in 2 or more adjacent leads (grade 3 ischemia) on the admission electrocardiogram (Figs. 1-3) have worse prognoses [19-21], larger IS [20,22,23], and less benefit from thrombolysis [22,23]. We have also shown that even with primary angioplasty, patients with grade 3 ischemia have higher mortality than patients with grade 2 ischemia (ST elevation without terminal QRS distortion) [24]. Whether grade 3 ischemia at presentation reflects a larger myocardial AR, or more "severe" ischemia due to lack of the above mentioned protective mechanisms, remains unclear.

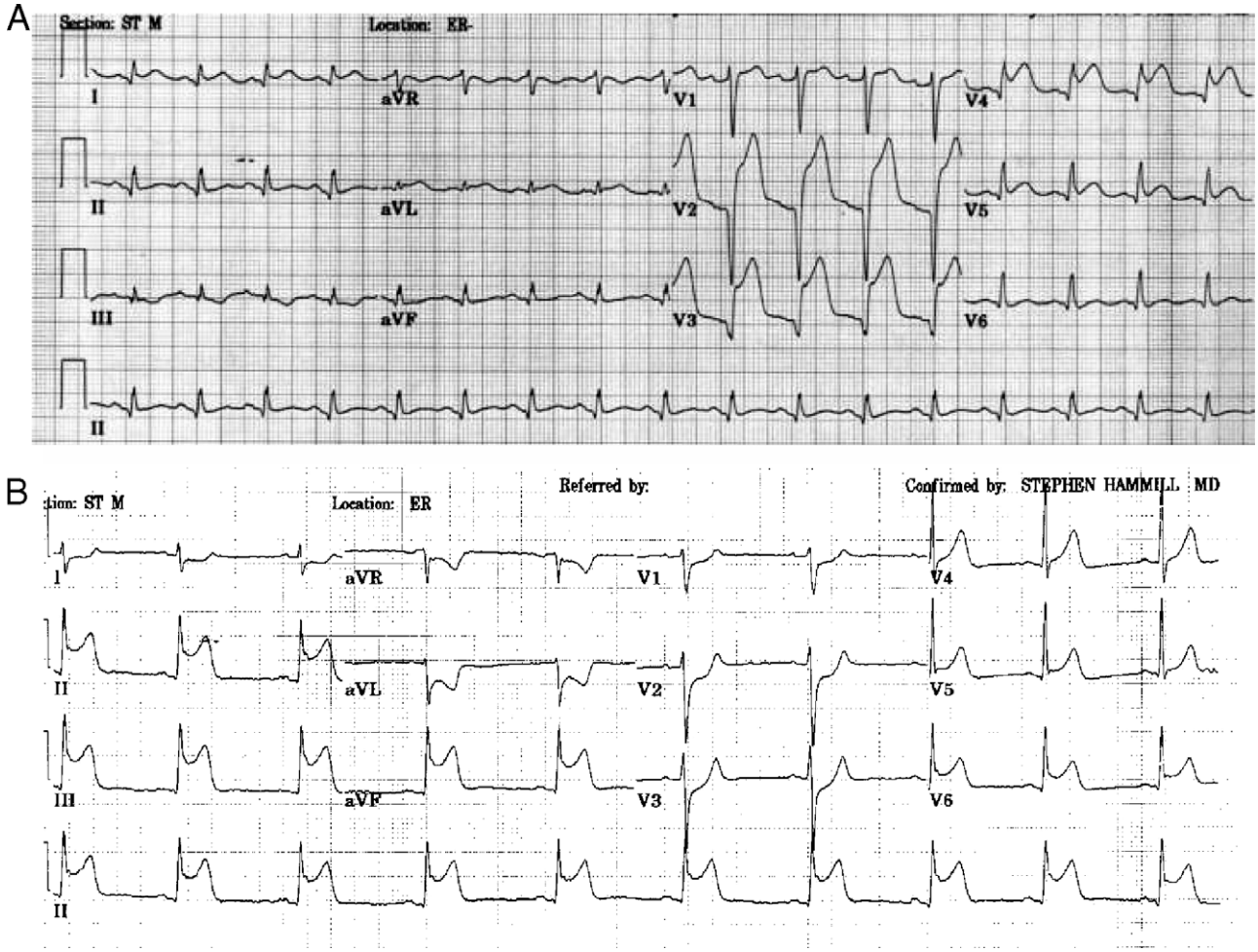

Fig. 1. Admission electrocardiograms of patients with anterior acute MI (A) and inferior acute MI (B) with grade 2 ischemia. A, There is ST-segment elevation in leads V_1 to V_5. However, S waves are preserved in V_1–V_3 and the J point/R wave ratio is <0.5 in V_4 and V_5. B, There is ST-segment elevation in leads II, III, and aVF and V_5 to V_6. The J point/R wave ratio is <0.5 in all.