



# The electrocardiogram in remote myocardial infarction: reassessment of criteria

**F**RANK N. WILSON defined the modern electrocardiographic criteria for myocardial infarction in two monumental papers in 1944 and 1946.<sup>1,2</sup> Gordon B. Myers and co-workers used Wilson's criteria in an exhaustive analysis of electrocardiograms (ECGs) in a large series of postmortem-confirmed cases of myocardial infarction. Myers and colleagues reported their correlations in a sequence of papers starting in 1948.<sup>3</sup>

The Myers group did injection studies of the coronary arteries and outlined the infarcted areas on the radiograms, which allowed the reader to document Myers' correlations and conclusions. Even today, this series of papers makes fascinating reading for the electrocardiographer.

## SENSITIVITY AND SPECIFICITY

In this issue of the *Cleveland Clinic Journal of Medicine*, James and associates correlate electrocardiographic criteria of anterior myocardial infarction with ventriculographic abnormalities. The criteria were based on electrocardiographic abnormalities found in a series of patients who had moderate or severe localized impairment of left ventricular contractility. These criteria then were applied to a large series of electrocardiograms of patients who had coronary arteriography and ventriculography and the predicted presence or absence of ventriculographic abnormalities were coded without knowledge of the actual findings at cardiac catheterization. The specificity of each of five criteria was high (99% to 100%) and the positive predictive accuracies were 85% to 88% for four of the five. The findings in aVL had a low positive predictive accuracy (50%). The five criteria may be used clinically with ease. Inclusion of patients with mild hypokinesia would probably have increased sensitivity, but specificity would have been impaired and mild hypokinesia is difficult to evaluate.

Warner and colleagues studied the ECGs of 36 patients who had akinesia or dyskinesia of the anterior wall of the left ventricle and compared the findings with those of 80 patients who had no abnormality of left ventricular wall motion.<sup>4</sup> Exclusion of all cases of hypokinesia is not clinically realistic. A combination criterion (Q in  $V_2$  or duration of R in  $V_2 < 20$  ms) had a sensitivity of 83% and specificity of 99%. A Q in  $V_2$  as the sole criterion, as recommended by Warner and associates, had a sensitivity of 64% and the specificity was 100%. It is unclear whether a QS in  $V_2$  was considered to be a Q wave. A QS deflection in  $V_2$  may be a normal variation if QS deflections are found also in  $V_1$  (and  $V_{3R}$  if recorded). The numbers of patients in the report of

■ See James and associates (pp 618–621).

Selective coronary arteriography and ventriculography findings can now be correlated with the findings of the electrocardiogram. Ideally, both left and right anterior oblique ventriculograms should be done, with the left view showing the ventricular septum and posterior portion of the ventricle. However, most routine studies include only the right anterior oblique view which, fortunately, provides most of the useful information concerning ventricular contractility. Because of the dual blood supply to the ventricular septum, extensive infarction is rare. Furthermore, septal infarction usually involves the inferior or anteroseptal regions as well. Strict posterior infarction without any electrocardiographic evidence of inferior or lateral involvement is also rare. If the clinical evidence suggests acute infarction, special back leads may reveal posterior infarction, and Q waves in these leads may remain permanently, giving evidence of previous myocardial infarction.

Warner and co-workers were small, and there was no testing of their criteria on an independent group of patients. A small Q wave before a small R in right precordial leads suggests myocardial infarction, but this is not an unusual finding in left ventricular hypertrophy and it occurs relatively rarely in individuals without cardiac disease demonstrable by cardiac catheterization.<sup>5</sup>

#### LOCATION OF INFARCTION

James and colleagues observed electrocardiographic evidence of only inferior infarction in nine patients who had anterior ventricular impairment. There may be anterior infarction in addition to inferior infarction electrocardiographically even though the ventriculogram shows only inferior infarction, and anterior infarction may be the sole electrocardiographic evidence of inferior infarction occasionally.<sup>6</sup> Precise localization of myocardial infarction is less important than the positive predictive accuracy of the diagnosis.

The influence of exact placement of precordial electrodes has not been explored adequately with respect to the diagnosis of myocardial infarction. For example, wide variations in placement may be encountered in female patients despite training of technicians to elevate pendulous breasts during recording.

#### LIMITATIONS OF DIAGNOSIS

One of the problems in clinical studies is the extent to which the patient population represents the general population or any of its subsets. Certainly, patients who undergo cardiac catheterization are not typical of all patients who have ECGs, to say nothing of the larger

subset of all patients referred to a clinic or of the general population. The more inclusive the population base, the more frequent the false-positive reports. Complete resolution of the influence of selection bias is not possible.

The importance of small Q waves in right precordial leads means that the electrocardiograph should be capable of recording these often narrow waves, but this capability is not universal. It has been shown that the sampling rate of 250 per second ordinarily used in computerized digital ECG systems is too low for satisfactory registration of small Q waves, as well as for certain other complexes.<sup>7</sup> James and colleagues have presented their data clearly and simply and tested the ECG criteria for anterior myocardial infarction in an independent group of patients. Their findings should serve as a guide to the diagnosis of anterior myocardial infarction. The electrocardiographic diagnosis of inferior myocardial infarction is more difficult than that of anterior, as Myers pointed out long ago.<sup>8</sup> Despite ventriculographic correlative studies of inferior infarction, much confusion remains because of incomplete investigations, the limitations imposed by the absence of semi-direct electrocardiographic leads, and poor understanding of the diagnostic criteria. Some computer programs are grossly oversensitive to the diagnosis of inferior infarction. Specificity and positive predictive accuracy are much more important than sensitivity in clinical electrocardiographic diagnosis.

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