LETTERS TO THE EDITOR

Electrocardiographic Criteria for Identifying False Positive Exercise Tests

The discussion of the identification of false positive exercise tests by Sapin et al. (1) is very timely because the surface auricular electrocardiogram (ECG) in health and disease and its effect on the ventricular complex has been largely ignored in recent times and is the most frequently misinterpreted by whoever wrote the program for computer readouts of ECG diagnoses. Yet the significance of the auricular ECG and its effect on the ventricular ST segment was known long before cardiology became an official subspecialty of medicine.

Thus, Ashman and Hull (2) in their 1937 elementary textbook on electrocardiography clearly pointed out that the P wave was diphasic (of right and left atrial origin) and that this could be clearly demonstrated by doubling the standardization and increasing the speed of the film. They gave the normal variations for all aspects of the P wave. They also pointed out that the P wave voltage tends to increase with increasing heart rate and that the PR interval tends to shorten with increasing heart rate until it disappears when the descending limb P wave reaches the QRS complex. The auricular T wave may then appear as a depression of the ventricular ST segment. They demonstrated the auricular T wave in a tracing showing sinus rhythm and complete atrioventricular block. One was taught years ago to attempt to visualize the auricular T wave by extrapolating the descending limb of the P wave to where it intersects the ventricular ST segment, as illustrated by Ellestad (3) in his editorial comment.

Bayley (4) emphasized that the P vector in the normal subject was written from left to right and inferiorly so that its highest voltage occurs in the inferior leads and falls within the sixth sextant of the triaxial reference system. Based on Wilson's concept of the ventricular gradient and the fact that the atrial wall is thin, Bayley predicted that the auricular T wave was the inverse of the P wave and that the areas of both were virtually identical. Changes in the one produced identical changes in the other but in opposite directions. Therefore, the predominant changes in the auricular T wave were also present in the inferior leads and changed proportionately but in opposite directions. The taller the P wave, the steeper the descent of the P wave that merged with the QRS complex and the greater the depression of the onset of the ventricular ST segment. Evans (5) pointed out that the nadir of the auricular T wave tends to occur early in the corrected QT segment. A careful inspection of the P wave and the presence or absence of the PR interval in Figure 5 will readily distinguish false positive from true positive exercise ECGs.

What was not mentioned by Sapin et al. is that there may be no electrical diastole when the P wave originates high on the descending limb of the T wave. This will produce the most marked ST segment depressions but this false positive result can be readily recognized because it occurs primarily in very healthy young persons who can exercise for much longer than 6 min and reach heart rates close to or even faster than the maximal predicted value.

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References

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2. Ashman R, Hull E. Essentials of Electrocardiography for Students and Practitioners of Medicine. New York: Macmillan, 1937.
3. Ellestad M. Role of atrial repolarization in false positive exercise tests. J Am Coll Cardiol 1992;18:434–5.
4. Bayley RH. Electrocardiographic diagnosis. In: Pullen RL, ed. Medical Diagnosis. Philadelphia and London: WB Saunders, 1944:423–77.
5. Evans W. Diseases of the Heart and Arteries. Baltimore: Williams & Wilkins, 1964.

Reply

Soloff has provided additional references to the normal atrial repolarization wave. Although a more recent investigation has provided data suggesting that some patients with cardiac disease have abnormal atrial repolarization waves (in the direction of, rather than opposite to, the P wave), it is reasonable to expect that in most patients atrial repolarization will occur as characterized by Soloff (1). The PR segment may become more downsloping in all individuals as the heart rate increases, and the patients with coronary artery disease, as well as normal individuals, may display the effect of atrial repolarization at high heart rates. The presence of a markedly downsloping PR segment may be a marker for the presence of exaggerated atrial repolarization waves, but it does not exclude the possibility that concomitant myocardial ischemia is influencing the ST segment.

The appearance of the PR segment provided independent predictive value for a false positive test in our retrospective study involving two highly selected groups of patients. Further work involving a larger number of patients studied prospectively is necessary to determine the clinical utility of the appearance of the PR segment as a marker for a false positive exercise test.

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Reference

1. Hayashi H, Okajima M, Yamada K. Atrial HTab wave and atrial gradient in patients with AV block. Am Heart J 1976;91:689–98.

Corrections

An error appeared in Table 4 of the article by Galloway et al. in the March 15 issue of the Journal (Galloway AC, Grossi EA

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