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Recommendations for Optimizing Cardiac Ischemia Detection for Physical Therapy Practice: Research Review

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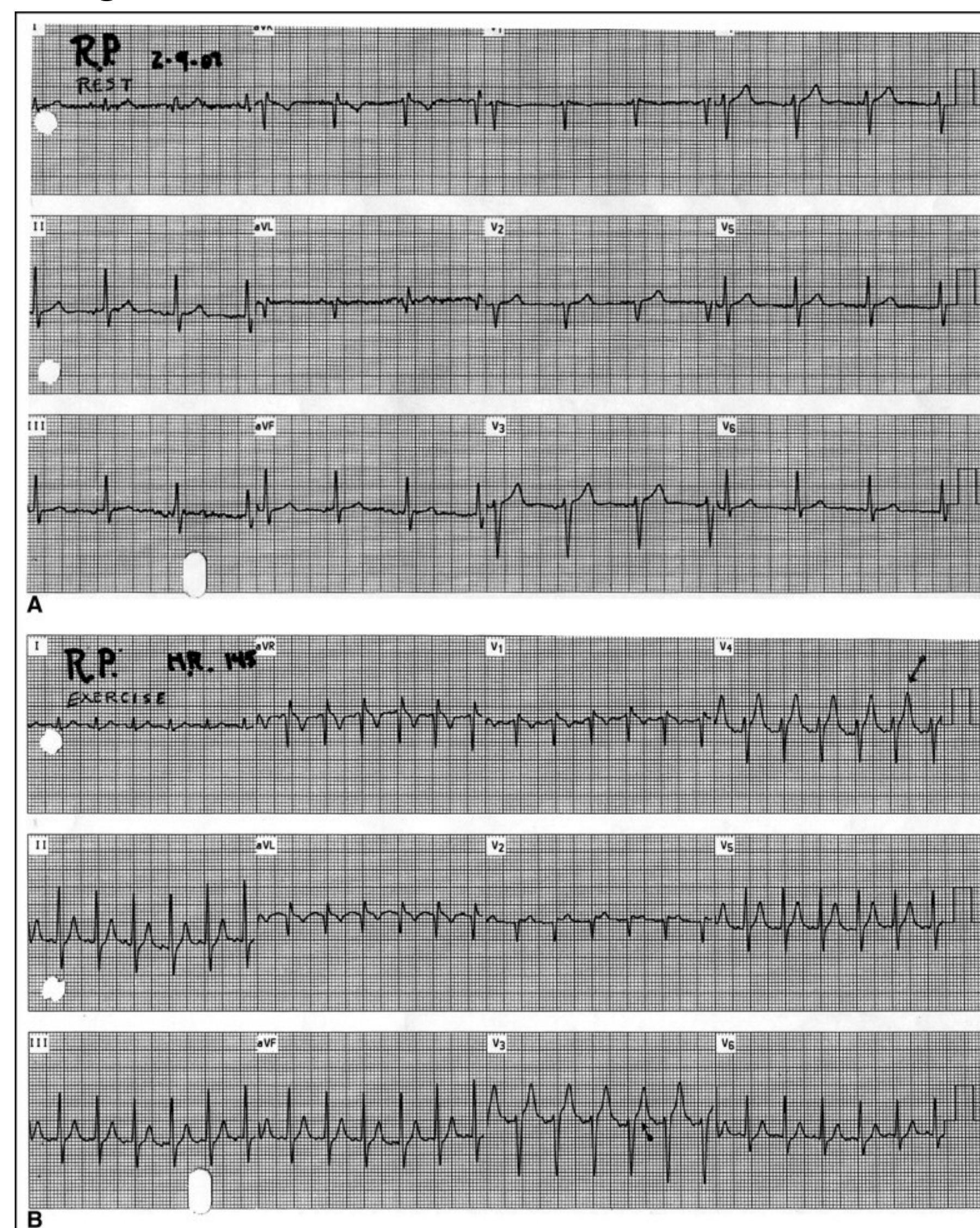
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Background

- ♥ Every 25 seconds, an individual experiences a vascular event, such as a myocardial infarction emphasizing the importance of early and accurate recognition of cardiac ischemia.¹⁰
- ♥ Initial 12-lead electrocardiogram (ECG) followed by a treadmill ECG graded exercise test (GXT) to detect cardiac ischemia through the interpretation of ST-segment deviation is not reliable as, ST-segment deviation may not be present or appear only after 70% of blockage.^{9,16,21}
- ♥ Using GXT with ECG monitoring to include P-wave duration and magnitude, R-wave amplitude and progression, peaked T-waves, and the presentation of U-waves may be more reliable, reduce healthcare costs, and improve the efforts of the physical therapists to recognize and detect cardiac ischemia before a major event occurs.^{6,10,27}

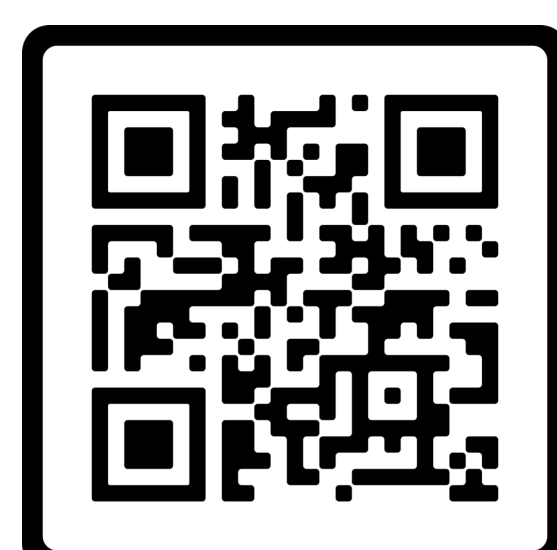
Purpose

The purpose of this study is to guide physical therapists in recognizing ischemia using electrocardiogram strips during graded exercise stress testing using methods other than relying on ST segment deviation for cardiac ischemia detection.



References

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Research Methods

- ♥ A literature review of the English-language literature published between 1975 to 2022 on the detection and prediction accuracy of ECG abnormalities on cardiac ischemia during GXT was conducted using PubMed and CINAHL.
- ♥ Inclusion criteria included studies utilizing 12-lead ECG monitoring while performing GXT for the detection of cardiac ischemia. Exclusion criteria included studies that did not utilize GXT or ECG for detection of cardiac ischemia.

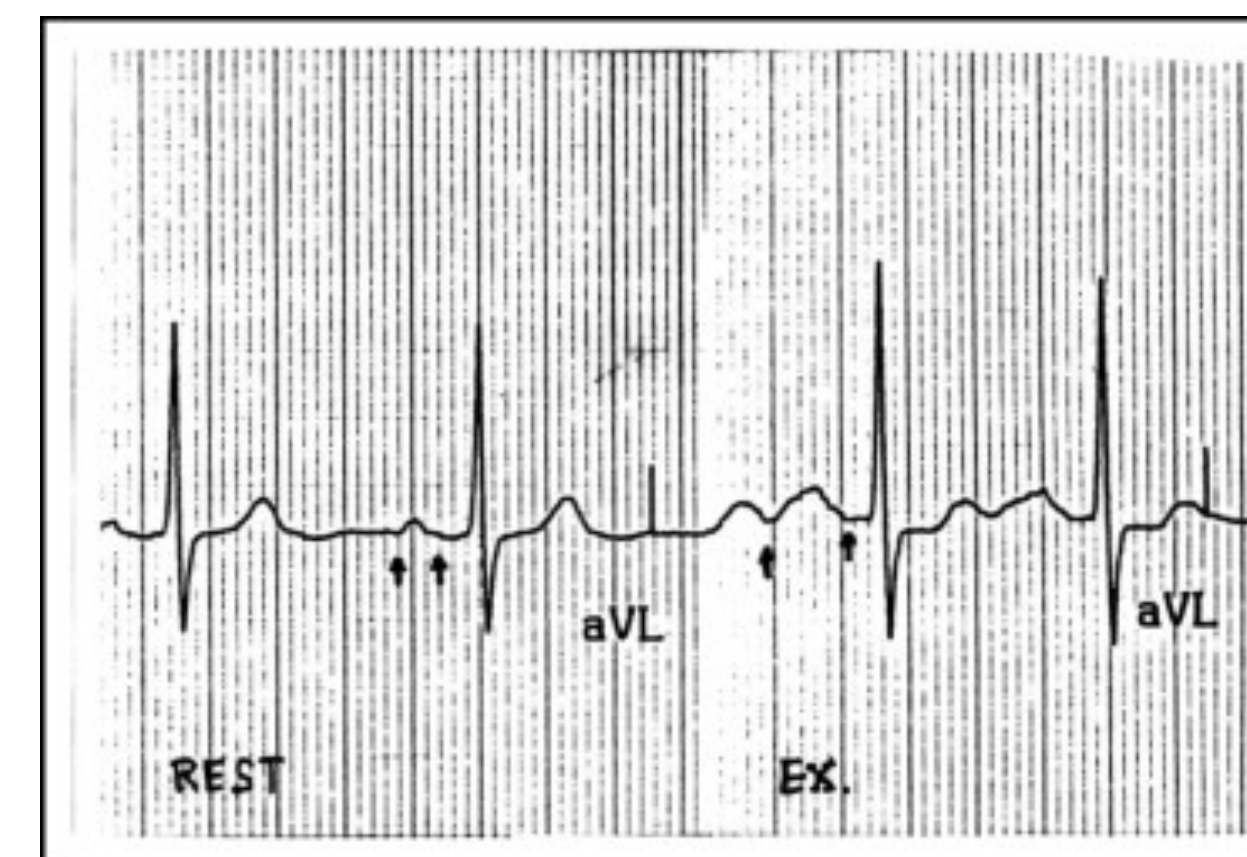


Figure 2. Enlarged ECG complexes illustrate a marked increase in P-wave duration from 120 ms at rest to 200 ms during exercise (EX.).¹¹

Figure 3. Demonstration different U-wave morphologies. (A) Normal U-wave (amplitude ≥ 0.05 mV), (B) negative U-wave (amplitude ≥ 0.05 mV), (C) minor negative U-wave (amplitude < 0.05 mV), (D) no U-wave.³⁵

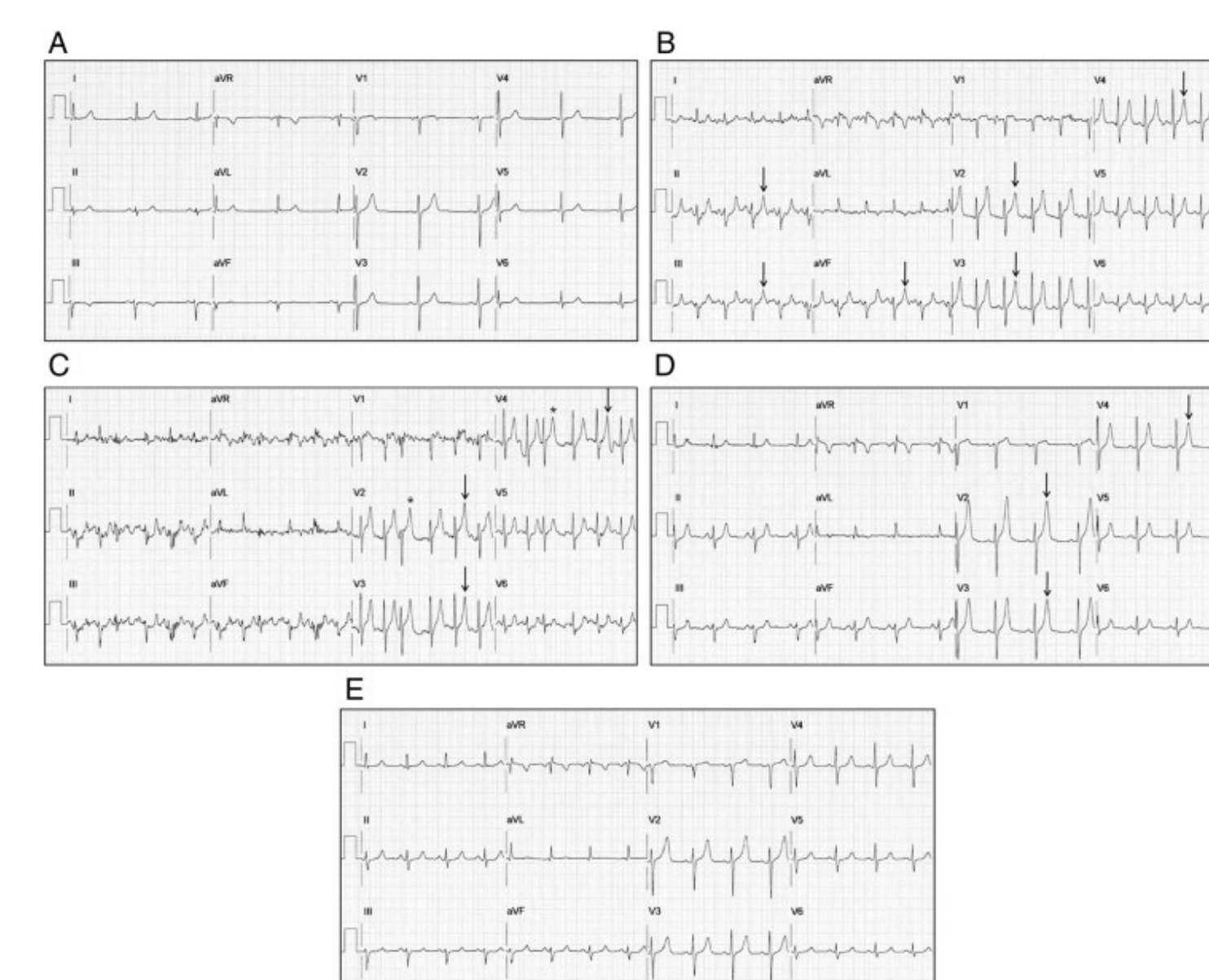


Fig. 1. Electrocardiograms during the stress testing showing peaked T waves (arrows). A, Normal baseline EKG. B, Electrocardiogram during stress testing at Bruce protocol stage 3 showing peaked T waves (arrows). There was also evidence of J-point elevation in V_1 through V_3 and aVR. C, Electrocardiogram at onset of recovery showing peaked T waves (arrows). There was also evidence of J-point elevation in V_1 through V_3 and aVR, as well as J-point depression in V_6 and III. An isolated premature atrial complex is seen in the third QRS (*). D, Electrocardiogram at 1 minute and 46 seconds in the recovery period showing peaked T waves (arrows). There was persistence of the J-point elevation in V_1 through V_3 and aVR, as well as J-point depression in V_6 and III. E, Electrocardiogram at the end of recovery period at 10 minutes showing decrease in the height of the T waves. Slight variation in the QRS amplitude is due to respiration.³³

Relevance to Physical Therapy

- ♥ This study can guide physical therapists to recognize the importance of additional ECG criteria for the detection of cardiac ischemia.
- ♥ Recognizing waves indicative of cardiac ischemia can aide the Physical Therapist in early detection and initiate prompt referral.

Discussion Points

- ♥ ECG Abnormalities
- ♥ ST-deviation
 - ♥ ST deviation detection provides sensitivity ranging from 44-71%.¹⁸
 - ♥ ST-segment deviation presentation has been shown to be a late sign of cardiac ischemia as most patients present with a main artery occlusion of 70% or higher after a positive stress test has been diagnosed.^{9,16,21}
- ♥ P-wave
 - ♥ P-wave duration showed detection improvement in women from 29% to 64%.¹⁶
 - ♥ Additionally, when P wave duration and ST-segment change were combined, sensitivity increased to 79%.¹⁶
 - ♥ P-wave amplitude measured at rest and at 50% of exercise intensity increased the detection of coronary artery disease to a sensitivity of 69% and a specificity of 78%.⁹
 - ♥ Combining P-wave amplitude and duration was shown to be statistically significant at 0.001 during every minute of recovery for the detection of CAD.²¹
 - ♥ Combining ST-segment deviation, angina, and P-wave duration change increased sensitivity to 100% compared to ST-segment and angina at 57% or P-wave duration at 69%.²¹
- ♥ R-wave
 - ♥ R wave amplitude correction further increased the detection of ST depression with a localization of 52%-86%.²⁷
 - ♥ Left main coronary artery disease localization was improved from 40% to 100% and left circumflex coronary artery disease localization was improved from 0% to 83% with the inclusion of R-wave amplitude correction.^{6,13,27}
- ♥ T-wave
 - ♥ T-wave changes combined with ST deviation increased specificity from 22% to 97% for CAD location.^{11,15,17,25,28,29}
- ♥ U-wave
 - ♥ exercise-induced U waves in precordial leads have been correlated with anterior myocardial ischemia as well as highly predictive for severe disease of the LAD artery.²⁰

Conclusion

- ♥ In combination with GXT and ST-segment deviation, P-wave duration and magnitude, R-wave amplitude and progression, peaked T-waves, and presentation of inverted U-waves have all shown promise to being effective additive or alternative methods for cardiac ischemia detection.