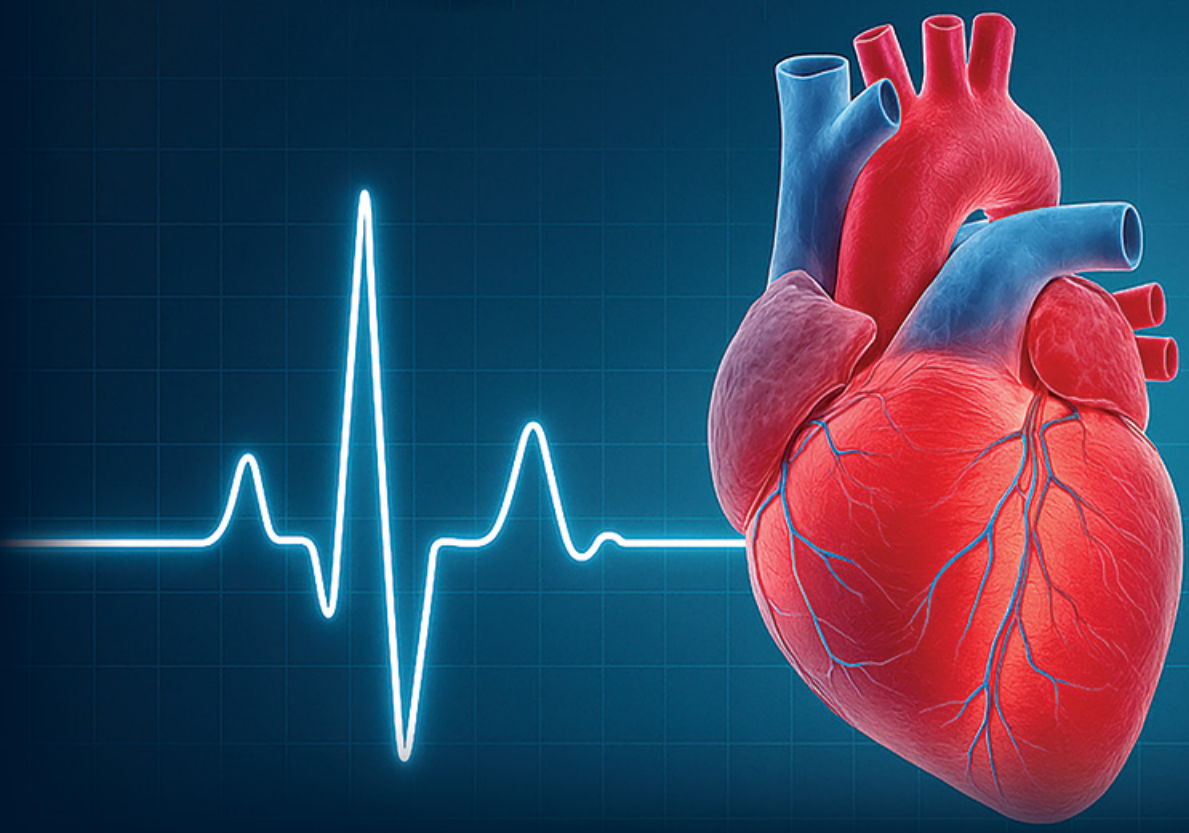
ECG

Self-Study Book



K. Wang

JAYPEE

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Chapter 4

Exercise Stress Testing

Sedigheh Saedi

Exercise stress testing (EST) is a simple and noninvasive method of evaluation of response to physiologic stress of exercise and increased myocardial demand.

ECG CHANGES INTERPRETATION

If myocardial ischemia exists, the ST segment becomes progressively more horizontal with exercise. The PQ segment is used for comparison and interpretation of ST segment depression.

ST segment depression of 1 mm or more as compared to PQ segment occurring 80 milliseconds (ms) after the J point (ST80) in three consecutive beats without baseline shifts, is an abnormal response hinting myocardial ischemia. In heart rates above 130, ST60 point (60 ms after J point) should used for the purpose of interpretation.

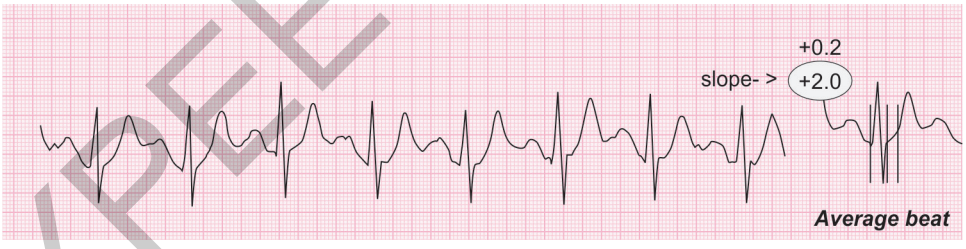

Figure 1 Normal findings

- *Normal response:* There is progressive shortening of PR, QRS, and QT. PR segment down sloping and J point depression are also normal findings **(Figure 1)**.
- *Rapid up sloping changes:* It is a normal exercise response and is more common in older patients. The ST60 or 80 depression is less than 1.5 mm and slope is sharply positive (>1 mV/sec) and upgoing **(Figure 2)**.

Figure 2 Rapid upsloping changes, The ST60 point depression is about 1 mm and slope is sharply positive

- *Slow upsloping ST depression:* The ST60 or 80 depression is equal to or more than 1.5 mm but slope is positive (>1 mV/sec) and upward going. It is an abnormal response especially if there is coronary risk factors or the patient has a high pretest probability of coronary artery disease (CAD) **(Figure 3)**.

Figure 3 Slow upsloping changes. The ST60 point depression is about 1.5 mm but slope is still upward

- *Horizontal ST depression:* This is the main abnormal response pointing to presence of CAD. There is a ST 60 or 80 depressions of 1mm or more with a slope near zero **(Figure 4)**.

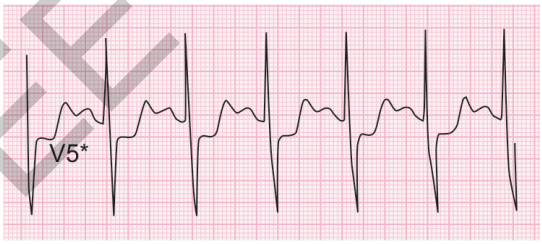

Figure 4 Horizontal changes. The ST60 point depression is about 2 mm and the slope is almost zero

- *Minor ST depression:* It is a the same response as horizontal ST depression but the depression is less than 1mm and should be considered when the exercise has been terminated in less than maximal workload (i.e. less than about 10 METs). For example, ST depression of 0.8 mm with a slope near zero in a patient who has exercised only up to 5 METs is an abnormal response **(Figure 5)**.

Figure 5 Minor ST depression less than1mm in a patient who exercise test was terminated after 4 minutes

- *Downsloping ST depression:* These changes are also indicator of myocardial ischemia. There is ST 60 or 80 depressions of 1mm or more with a negative, down going slope **(Figure 6)**.

Figure 6 Downsloping ST-depressions

- *ST elevation (in non-Q wave leads):* ST elevation during EST is a sign of severe ischemia and high risk patient. Exercise should be terminated immediately. ECG shows J point and ST 60 or 80 elevations of 1mm or more **(Figure 7)**.

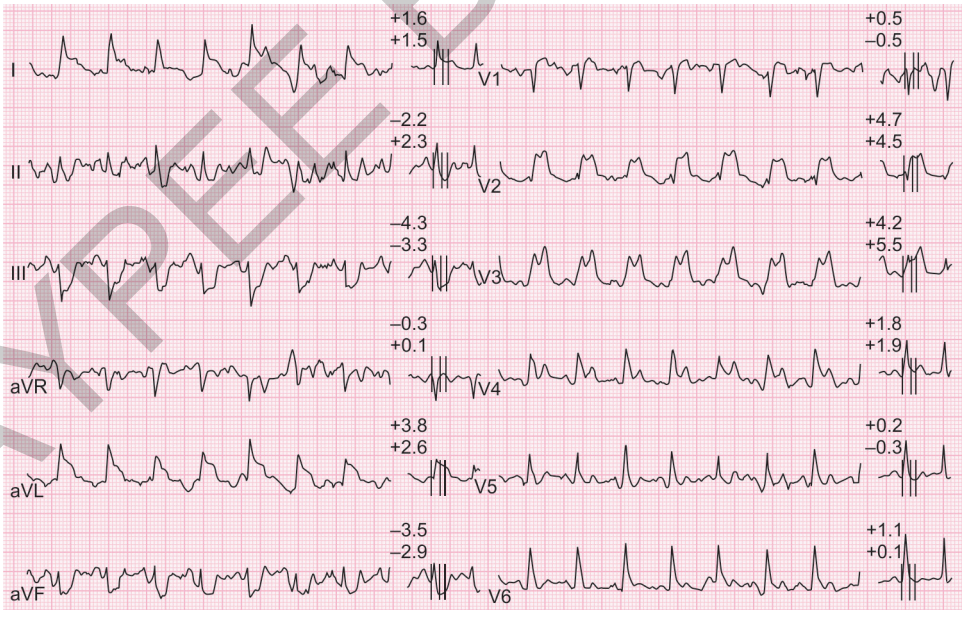

Figure 7 ST-elevation during exercise in inferior, lateral and precordial leads

- *ST elevation (in Q wave leads):* These changes are usually an indicator of severe regional wall motion abnormality in patients with previous myocardial infarction.[1-3,5]

INDICATIONS FOR TERMINATION OF EST[4]

Absolute

- Significant ST-segment elevation in leads without Q waves (except aVR, aVL, and V1)
- Significant drop in systolic blood pressure
- Development of considerable angina, dizziness, presyncope
- Sustained ventricular tachycardia or heart block
- Inability to monitor the ECG and blood pressure
- Patient's request

Relative

- Significant ST depression (>2 mm)
- Other arrhythmias (except sustained ventricular tachycardia or heart block) that might progress to make the patient unstable
- Severe hypertensive response (systolic blood pressure >250 mm Hg or diastolic blood pressure >115 mm Hg)

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ECG

Self-Study Book

In this ECG self-study book, over 400 practice tracings are compiled representing nearly all clinical entities we commonly encounter. Each page has an ECG tracing for you to analyze. Some have multiple choice questions and some require drawing a ladder diagram. Answers or diagnoses and discussions are in the bottom of the tracing for you to compare with yours. Salient features of the tracing, the logic behind the ECG findings, and the clinical relevance of the findings are emphasized.

K. Wang is Clinical Professor of Medicine in the Cardiovascular Division of the University of Minnesota, USA. He has been interested in ECG throughout his career of 50 years. He has given many ECG lectures or courses to various levels including medical students, trainees, and practicing physicians. He also published many articles related to ECG. Earlier this year, he published Atlas of Electrocardiography. He earned the reputation of detecting subtle ECG findings and making complicated matters simple, logical, and easy to understand, and make the ECG findings clinically relevant. No wonder he has earned "Teacher of the Year" awards 15 times in his career from medical students, residents and fellows. He also runs the "ECG of the Week" program at Med Scape (WebMD) and the "ECG of the Month" at "theheart.org". He also runs video sessions on various ECG topics on "hqmeded.com".

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