Case Reports

The Common, Less Common and Uncommon Examples of Exercise ECG

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Abstract
We present three interesting and representative cases of exercise ECGs which were done as part of Stress Myocardial Perfusion study. Aim is to emphasize the point that the stress part of the test should be conducted by an expert in the field and recovery phase ECG records should be analyzed carefully for maximum benefit from this test.

Introduction
Exercise ECG (TMT) is a commonly used investigation in the diagnosis and follow up of ischemic heart disease (IHD). There are various patterns of positive TMTs. Majority of positive ECGs show a common pattern in the form of ST-T changes in inferolateral leads while some other patterns are not common. We present here examples of common pattern as well as uncommon forms of TMT. Exercise was done as per Bruce protocol. Recovery phase was monitored with person in sitting position and blood pressure recordings were done at 2 minutes intervals.

Case 1
Fifty three years old male had a single episode of vague chest discomfort. His resting ECG was normal but the hemodynamic response during exercise. He achieved a heart rate of 153/min (86% of THR) as shown in Fig. 3. Exercise ECG shows less than 0.10 mV upsloping ST depression in inferolateral leads which is normal variant. At this point we may think that it is a normal study. But, ST becomes horizontal in V1 to V4 with ST depression in V2 to V4 in second phase of recovery period. By the 4th stage of recovery (by 8 minutes), these changes almost return to normal (Figure 3). The systolic blood pressure showed a rise of only 10 mm of Hg (150 to 160) during the exercise probably indicating inadequate LV systolic function response to exercise. The myocardial perfusion images shows large perfusion defect in lateral wall and small perfusion defect in distal anteroseptal region in stress which reversed completely in rest perfusion image indicating significant lesions in proximal LCx and mid LAD with perfused but at risk myocardium in its territory (Figure 3).

Case 2
Sixty seven years old male had a single episode of mild and brief chest discomfort in May 2007. His coronary angiogram at that time showed 70% block in LAD and 90 to 100% block in OM1. PCI with stent to LAD was done in May 2007 and was advised regular follow up. He has remained asymptomatic on normal activities and reported for his periodic medical check up and underwent stress myocardial perfusion study. He exercised for 10 min 02 sec, up to a workload of 13.50 METS, achieved heart rate of 148/ min (90% of THR) and remained asymptomatic during exercise with normal BP response. Exercise ECG showed ST depression in II, III, aVF, V4, V5, V6 which persisted during recovery period also (Figure 1). Stress myocardial perfusion study shows normal perfusion in all regions of LV at peak exercise (Figure 1). Normal stress myocardial perfusion study in this case helped the person who had an episode of chest discomfort with doubtful resting ECG abnormality and positive TMT in clearing the doubt about possible IHD without undergoing invasive procedures like coronary angiography.

Discussion
As per the current teaching and practice, “development of 0.10 mV (1 mm) or more of J point depression measured from the PQ junction, with a relatively flat ST segment slope (e.g., less than 0.7 to 1 mV/sec), depressed 0.10 mV or more 80 milliseconds after the J point (ST 80) in three consecutive beats, with a stable baseline” is considered to be an abnormal response. Based on these criteria’s, we diagnose persons into likely patients of IHD without analyzing their symptom profile at rest as well as during exercise, effort tolerance of the person and the hemodynamic response during exercise. Commonest pattern of positive TMT is in the form of ST depression in leads II, III, aVF, V4, V5, and V6. The actual reason and relevance of these changes have been a matter of discussion and doubt. Unlike ECG changes of ischemia in resting ECG which shows changes in leads representing the ischemic area, exercise ECG changes do not represent the affected area. Exercise induced ST segment changes is a weak marker for prevalent and incident IHD compared to effort tolerance and hemodynamic response during exercise and American College of Cardiology

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has cautioned against using the ECG changes in TMT as sole criteria for disease prediction in asymptomatic individuals. ECG monitoring during exercise is required to look for any arrhythmia during exercise. If ST-T changes in inferolateral leads are seen in asymptomatic persons who can achieve more than 10 METS of exercise without symptoms and have normal hemodynamic response during exercise, this pattern is likely to be false positive. Exercise ECG changes in leads I, aVL, V1, V2, V3 are not common but they are more specific indicating exercise induced myocardial ischemia. Since this is not seen in majority of cases of TMT, it is not a sensitive marker of inducible myocardial ischemia. The first case discussed is showing the common pattern which is non specific and likely to be false positive in a person with normal effort tolerance and normal hemodynamic response.
Fig. 2: Resting, peak exercise and recovery phase ECGs as well as stress myocardial perfusion image showing ST-T changes in all leads of ECG during exercise and recovery and reversible perfusion defect in LCx and distal LAD territory.

During exercise. The uncommon pattern seen in second and third cases are more specific.

In 10% cases of TMT, changes occur only during recovery period of exercise ECG. Relevance of this is another area of discussion—whether it is equally relevant as those changes occurring during exercise. In these three sample cases which we have seen, it is found that recovery phase ECG changes are equally or more relevant than those occurring during exercise. Probably, ECG changes seen during recovery phase is likely of more value as it reflects the ischemia related abnormal electrical activity of myocardium with no interference from the accentuated chest wall and diaphragmatic movement. The second case shows less common pattern of TMT showing changes in all leads during exercise which continues into recovery period and is proved to be true positive by positive stress myocardial perfusion study. The third case is more interesting in that it shows no significant ECG abnormality during exercise and significant ST-T changes in V1 to V4 during recovery period. This is proved true positive by
the positive stress myocardial perfusion study. These cases show the importance of careful analysis of recovery phase of TMT. Since TMT can be misleading in a large number of cases, more and more patients are undergoing stress myocardial perfusion study to clear doubt about IHD and it has proved to be a very reliable and robust test provided the nuclear medicine physician knows how to conduct stress test properly and the correct timing of tracer injection during exercise. Stress test should always be done by a well trained doctor and not by technologist if we want correct information which will give maximum benefit to the patient from this test as we have to monitor the symptom profile and hemodynamic response during exercise for correct interpretation of the test. Due to restrictions on the use of radioactive material and high cost involved, stress myocardial perfusion study facility is not available to majority of population. If biomedical engineers can develop exercise echocardiography which will give real time LV function data during exercise, it will be a much more credible tool compared to TMT and will
benefit in better evaluation of persons with known or doubted cardiac disease.

References