Level 7

ST depression and T negativity—a simple approach

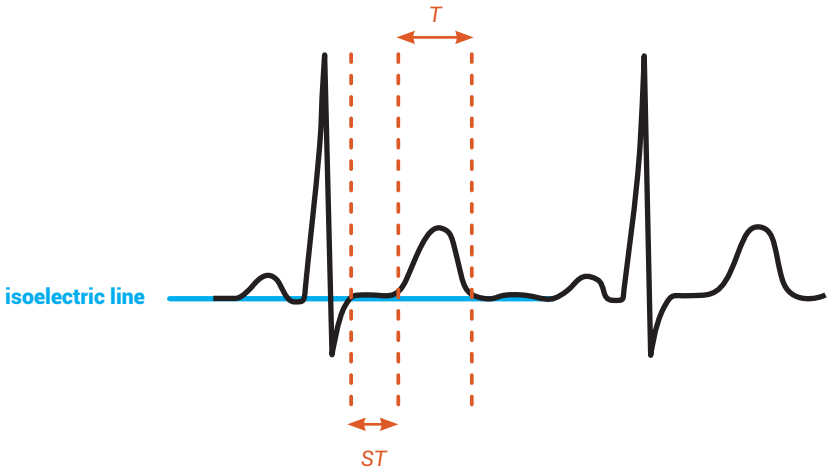
ST depression and T-wave negativity are commonly associated with debilitating and potentially life-threatening diseases. Every ECG student should be able to recognize and interpret them. So pay close attention.

Key concepts

Let's start off with two simple principles:

Principle #1:
The ST segment is normally located at the level of the isoelectric line.

By definition, the isoelectric line is located at the level of the ECG curve that comes after the T wave, before the next P wave.



Principle #2:
Except for V1, the T wave is normally positive.

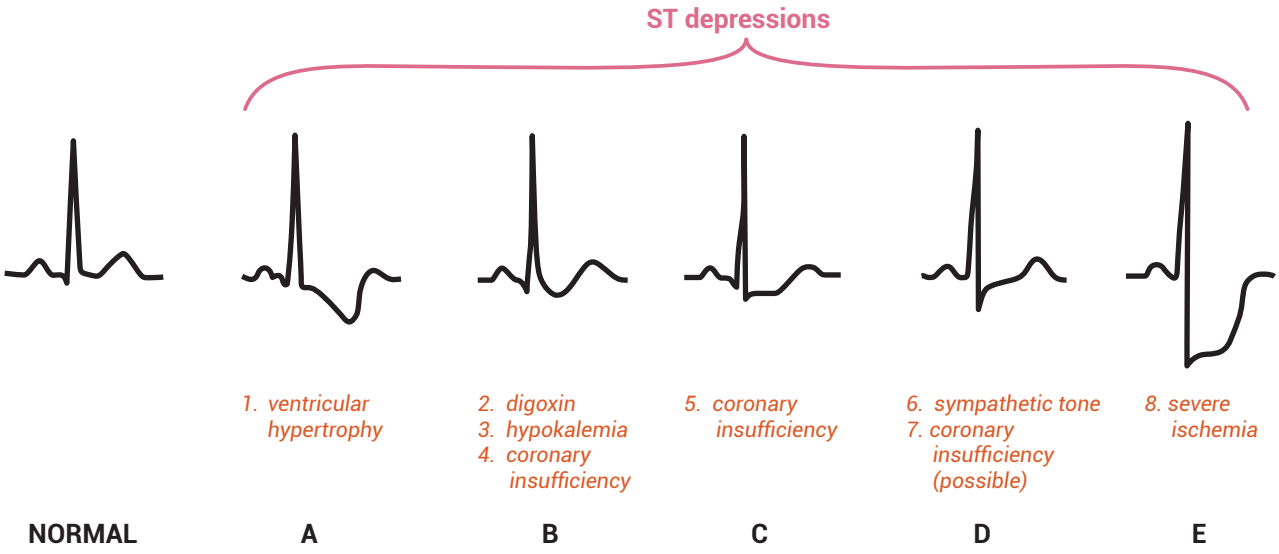
Once you recognize the presence of ST depressions or T-wave inversions, you should look at two things:

1. Their location (which leads are affected).
2. Their shape.

In Level 4, you learned what leads depict which parts of the ventricle. So if ST depression is present in V5 and V6, for example, you know that the lateral wall is the problem.

The different forms of ST depressions

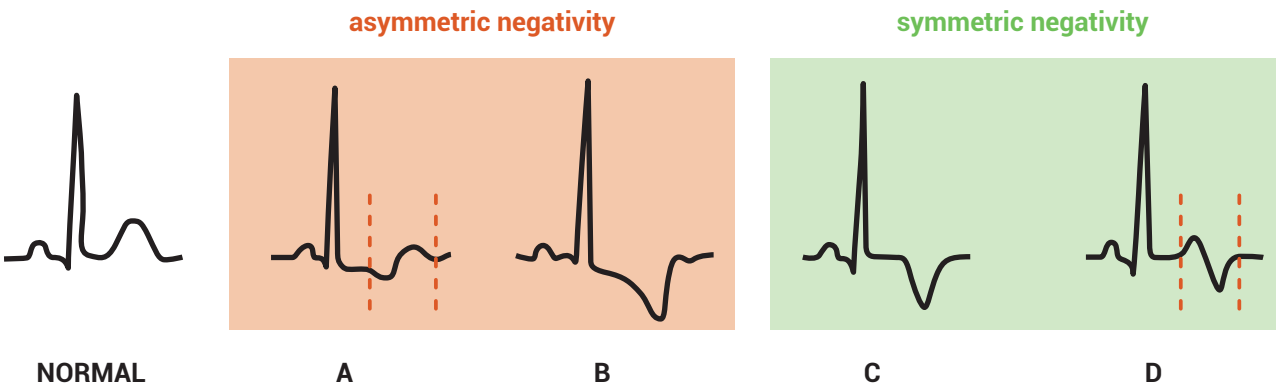
In our experience, you can tell a lot about the underlying diseases if you know how they change the appearance of the ST segment. Here are some examples:



- **Example A:** A descending ST depression is usually associated with ventricular hypertrophy.
- **Examples B, C and D:** These are only relevant over the left ventricle. (One exception to this rule is mirror images of a posterior wall ST elevation myocardial infarction, which will also produce similar ST depressions in V1, V2, and V3. More about that in Level 9.)
- **Example B:** ST depression with a sagging shape—this may be caused by coronary insufficiency (angina), digoxin, or hypokalemia.
- **Example C:** Horizontal ST depression, typically seen in patients with coronary insufficiency (i.e., symptomatic coronary heart disease).
- **Examples B and C:** Commonly seen in patients with exercise-induced angina undergoing stress test.
- **Example D:** Ascending ST depression may be caused by high sympathetic tone, but also by physical activity. During physical activity, ascending ST depressions do not necessarily mean that ischemia is present.
- **Example E:** Deep horizontal ST depressions are often seen in several corresponding leads in the setting of severe ischemia.

Patterns of negative T waves (also known as T-wave inversions)

Here are the most important patterns of inverted T waves:



Different patterns of T-wave inversions.

On the far left side, you can see a normal T wave for comparison. The other four patterns are negative and therefore abnormal. There's an important distinction that you need to make here:

- The T waves in examples A and B are **asymmetric**. They are slowly downward sloping with an abrupt return to the isoelectric line.
- The negative T waves in examples C and D, on the other hand, are **symmetric**.

This distinction is important because these changes frequently occur in two distinct settings with very different implications:

- **Asymmetric T-wave inversion** usually occurs in the setting of ventricular hypertrophy. When the left ventricle is hypertrophic, the inversions are located somewhere between V4 and V6. When the right ventricle is affected, they can be seen somewhere between V1 and V3.
- **Symmetric T-wave inversion** occurs in a setting in which myocardial cells are dying off—usually in the setting of myocardial ischemia or myocarditis.

T-wave inversion can also be **biphasic**, as in example A, in which we see a negative–positive pattern, whereas in example D we see a positive–negative pattern (terminally negative). Terminal negativity of the T wave has a high specificity for coronary artery disease, especially when the terminal part is symmetric. T waves are also abnormal if they are not positive enough. With predominant R waves, T waves should be at least 1/8 the size of the R wave. T waves may also be abnormal if they are flat or even horizontal.

*In right and left **bundle branch block**, repolarization is also impaired. Therefore, we can see negative T waves and ST depressions in leads V1 to V3 in right bundle branch block and in V4 to V6 in left bundle branch block. Two other common problems associated with negative T waves and ST depressions are **premature ventricular beats** and **Wolff-Parkinson-White syndrome.***