T-WAVE ABNORMALITIES IN BUNDLE BRANCH BLOCK

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The purpose of this review is to familiarize the medical underwriter with primary and secondary T-wave configurations in right and left bundle branch block (RBBB, LBBB).

Whether the T-wave in bundle branch block is primary or secondary can have a major impact on the correct risk classification.

Following depolarization, the rate of repolarization throughout the myocardium should be uniform. Normally, this produces QRS complexes and T-waves that are of equal area but opposite axial orientation. However, for physiologic reasons beyond the scope of this review, the heart has a ventricular gradient which causes the electrocardiogram to record positive wave forms for both QRS and T.

Repolarization alternatives depend upon two factors:

1. The direction of depolarization.
2. Anatomic and physiologic variations in the myocardium.

There are two forms of T-wave repolarization - primary and secondary.

- **Primary** T-waves are associated with abnormalities in the myocardium and are independent of the order of depolarization. Therefore, primary T-waves imply a fundamental change in the myocardium.

- **Secondary** forms are dependent on the altered course of depolarization and independent of the state of the myocardium; they are intrinsic to the block itself.

Primary T-waves may be produced by diminished blood supply to the myocardium, metabolic abnormalities, tachycardia and drugs such as digitalis. In addition to BBB, secondary T-waves are commonly seen in premature ventricular contractions.

Normally in BBB, T-waves are oriented in the opposite direction of the **terminal** portion of the widened QRS complex (secondary changes).

When in BBB the T-wave is the same direction as the **terminal** portion of the QRS complex, it is a primary configuration.

If pre-BBB T-wave negativity exists, when BBB develops, the T-waves will not become secondary and revert to upright; they will remain primary and negative.

In RBBB, secondary or normal T-waves in leads I, aVL, V4-5-6 are upright; in V1-2 they are usually inverted. A reverse of the T-wave axis in these or other leads where T is in the same direction as the terminal QRS complex is a primary abnormality. (Figure 1)

Primary and secondary changes are also seen in LBBB. As in RBBB, the T-wave is normally oriented opposite to the direction of the terminal portion of the QRS complex. Primary changes in LBBB most commonly include upright T-waves in leads I, aVL, V5-6. (Figure 2)

In both BBB, the magnitude of the T-wave (depth and width) is proportional to the area of the widened QRS. Therefore, with a primary abnormality, the area of the T-wave has a greater relationship to the QRS duration than to the underlying causative etiology.

ST orientations can also be primary and secondary though less dramatic than T-wave changes. As with T-waves, the ST segments are also expected to be oriented in the opposite direction as the terminal portion of the QRS. Often these are subtle and comparisons with old ECGs are needed.

RBBB is commonly a benign electrocardiographic finding not associated with underlying cardiac disease. However, primary T-waves with RBBB must alert the underwriter to the possibility of coexistent heart disease. With LBBB, primary T-waves may have less significance since the conduction abnormality itself is usually a marker of underlying heart disease. However, the risk may be compounded by the combination of a conduction system plus myocardial disease. Primary T-waves in LBBB may represent myocardial infarction.

**References**

Figure 1

Right Bundle Branch Block Showing Primary T-Wave Changes in Leads V1, V2, and V3.
Additionally, the applicant had an anterior myocardial infarct.
Figure 2
Left Bundle Branch Block Showing Primary T-Wave Changes Leads I, aVL, and V5-V6.