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ECG Changes From Medications

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Published version. *Journal of the American Academy of Physician Assistants*, (March 2012), Permalink: www.jaapa.com/ecg-changes-from-medications/article/231597/. Reproduced with permission.

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INTERPRETING ECGS

ECG changes from medications

James F. Ginter, MPAS, PA-C, Patrick Loftis, PA-C, MPAS, RN March 12, 2012

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The use of various medications is associated with characteristic changes on ECG. These changes may occur with either therapeutic or toxic blood levels. Probably the most classic of these medications is digoxin, the use of which is known to cause different ECG changes with different blood levels.

With therapeutic blood levels of digoxin (usually 0.5-2.0 ng/mL$_1$), changes in the ST segment and T wave commonly known as *digitalis effect* are often observed. The ST segments arising immediately after the preceding R wave are gradually downsloping. The associated T waves are either depressed or inverted (**Figure 1**). Because they are similar, these changes may be confused with the changes that occur during left ventricular hypertrophy. There is no clinical consequence or intervention necessary in patients who manifest these ECG changes with therapeutic digoxin levels.

In patients with toxic levels of digoxin (>2.0 ng/mL), however, different characteristic changes tend to occur. These changes may include sinus bradycardia, block, or arrest. As opposed to the changes seen during therapeutic digoxin use, these changes sometimes require intervention. AV node interruption resulting in first-, second-, or third-degree heart block may also occur. As discussed in previous sections of this department (see Third-degree atrioventricular block), pacing may be required. Lastly, toxic levels of digoxin may also cause tachyarrhythmias. Symptoms of digoxin toxicity may include headache, nausea, vomiting, yellow or green vision, and death. An antidote called Digoxin Immune Fab may be used in severe cases to reverse the effect of the toxicity.

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Medications that cause changes in electrolyte levels, such as those that result in electrolyte loss, may also cause changes on ECG (see Electrolyte abnormalities on ECG). Many medications also cause changes to the QTc interval. A list of many of these medications can be found at QTdrugs.org. Patients with a history of long QT syndrome should avoid these medications. Many other medications can cause ECG changes, including tricyclic antidepressants, beta-blockers, and other antiarrhythmics.

ECG Challenge

A 64-year-old male with a history of congestive heart failure presented for a preoperative evaluation before knee surgery (**Figure 2**). He denied any current complaints. His current medications included digoxin, furosemide, lisinopril, and aspirin.

Stepwise approach:

1. Is the ECG **regular**? Yes, the QRS complexes do march out.

2. **Rate**? Find a QRS complex on or near a dark line. A) Counting the large boxes, we see that there are almost 5 large boxes before the next QRS complex. Five boxes would make the rate 60, so we will estimate it to be at 65 beats per minute (bpm). B) There are about 7 QRS complexes in 6 seconds (30 large boxes), which estimates the rate at 7 x 10 = 70 bpm. C) There are about 5 boxes in between the QRS complexes, making the rate 300/5 or about 60 bpm.

3. **There is a P wave** for every QRS, so this is sinus.

4. The **PR interval** is about 3 small boxes or 0.12 seconds. This is normal.

5. The **QRS complex** is about two small boxes, which is 0.08 seconds. This is normal.

6. There is **no ST segment elevation** here. There is a slight, downward sloping ST segment characteristic of digitalis effect or ventricular hypertrophy. As there are no criteria for left ventricular hypertrophy on this ECG and the patient is on digoxin, this is likely digitalis effect.

7. There are **no U waves**.

ECG Diagnosis

The patient had a digoxin level of 0.7 ng/mL, which is therapeutic. His ECG showed normal sinus rhythm with ST changes consistent with digitalis effect. As part of his evaluation, he also underwent a stress test which was negative for any acute ischemic changes or reversible wall motion abnormalities. No treatment is needed for this ECG finding. The patient was able to undergo his knee surgery without complication.

REFERENCE

1. Lab Tests Online. Digoxin. http://labtestsonline.org/understanding/analytes/digoxin/tab/test Accessed 2/12/2012. Updated April 28, 2011. Accessed March 5, 2012.

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