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Diagnosing right ventricular hypertrophy

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Right ventricular hypertrophy (RVH) is the abnormal enlargement of the right ventricle in response to pressure overload, most commonly due to severe lung disease. The right ventricle is considerably smaller than the left ventricle and produces electrical forces that are largely obscured by those generated by the larger left ventricle.

Symptoms RVH by itself has no individual symptoms.

Etiology The most common etiology of RVH is most commonly due to severe lung disease. Other less common causes include pulmonary embolism, atrial septal defect, pulmonic stenosis, and congenital heart disease.

Treatment The treatment and prognosis of RVH depend on the etiology of the enlargement.

ECG findings In order for RVH to be manifested on the ECG, it must be severe enough to overcome the concealing effects of the left ventricle. As discussed in a [previous installment](#) of this department on left ventricular hypertrophy, the ventricle is forced to work against this increased pressure, causing the muscle to hypertrophy in an effort to keep up with the demand.

Diagnosing RVH The diagnosis of RVH requires careful scrutiny of the QRS complex. The most common ECG finding is right axis deviation of greater than 100. Like LVH, the reason for this is that all cells in the heart muscle depolarize, generating electrical activity. More cells (eg, hypertrophy) create more electricity. This can cause a shift in the axis toward the hypertrophied chamber—in this case, the right ventricle. This finding should always be present before RVH is considered.

RVH is better appreciated in the precordial leads because they overlie the ventricles directly. Besides axis shift, other changes may also be used to determine the presence of RVH including abnormalities of the QRS segment (increase in voltage in V1 V5 and V6); P wave abnormalities (P pulmonale, Peaked T waves inferiorly); and ST segment depression and T wave inversion (V2 through V6). RVH is recognized by the following findings on an ECG. At least one of the following findings must be present with RVH (the more findings, the higher the sensitivity), including:

Right axis deviation greater than 100

R wave taller than S wave in V1 (R/S ratio greater than 1), or R wave smaller than S wave in V5 or V6 (R/S less than 1).

- R wave in V1 greater than 7mm
- R in V1 + S in V5 or V6 greater than 10.5 mm
- rSR' V1 with R' greater than 10 mm
- qR complex in V1
- Secondary ST-T wave abnormalities due to hypertrophy
 - Down-sloping ST depression & T-wave inversion in R precordial leads
 - R atrial abnormality.

EKG challenge

Figure 1 is an ECG of a 50-year-old male who presented to his PA's office for follow-up after a pulmonary embolism. (You may click on Figure 1 to enlarge the image.) His BP on today's visit is 124/78 mm Hg. He takes warfarin 5 mg daily.

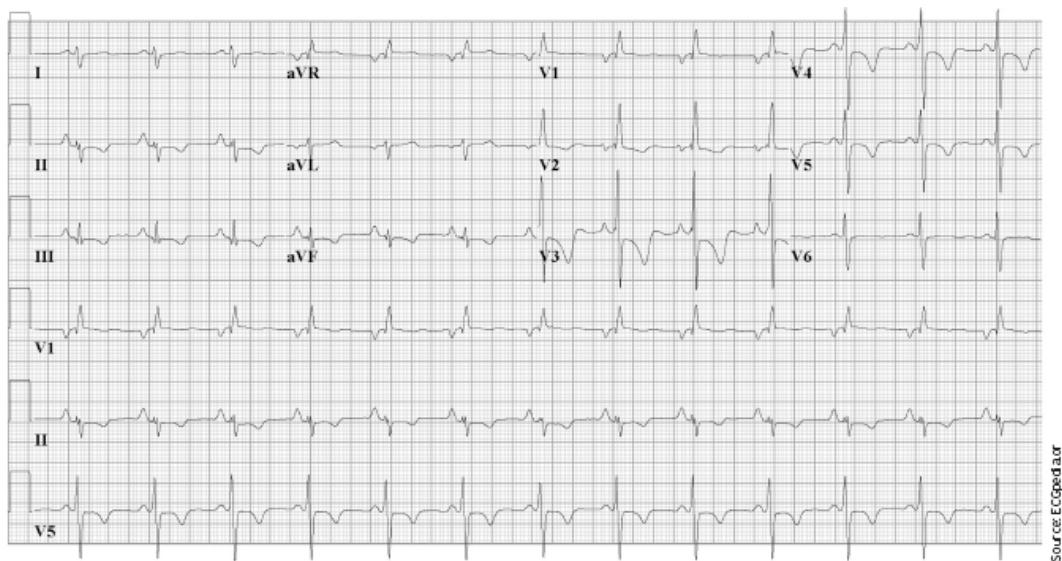


FIGURE 1. Preoperative ECG of a man with hypertension.

Using the stepwise approach to analyze the patient's ECG (Figure 1), consider the following:

1. Is the ECG regular? Yes. The QRS complexes march out.
2. What is the heart rate? Find a QRS complex on or near a dark line.
 - Method A: Counting the large boxes, we see that there are just under 4 large boxes before the next QRS complex. Four boxes would put the rate at 75 beats per minute, or we could estimate a little more at 80 beats per minute.
 - Method B: There are about 8 QRS complexes in 6 seconds (30 large boxes), which estimates the rate at $8 \times 10 = 80$ beats per minute.
 - Method C: There are 4 large boxes between the QRS complexes, which gives us $300 / 3.5 = 85$ beats per minute.
3. There is a P wave for every QRS and they all look the same.
4. The PR interval is about 4 small boxes, which is 160 milliseconds. The QRS complex is less than 2 small boxes, making it normal.
5. The ST segments in leads V2 through V4 are depressed, which could suggest injury or ischemia to the lateral wall (more on this in a future segment).
6. The T waves in leads V3 to V5 are inverted. This is a nonspecific finding which could suggest underlying ischemia and should be investigated if it was not done previously.
7. There are no U waves.

In order to determine whether criteria for RVH are present in this ECG, we need to evaluate for right axis deviation (click [here](#) for a previous installment from this department on axis deviation) and look at leads V1, V5, and V6. Let's go through each criteria separately.

1. There is right axis deviation.
2. The R wave in lead V1 is taller than S wave.
3. The R in V1 + S in V5 is greater than 10.5 mm.
4. There is qR complex in V1.
5. There is secondary ST-T wave abnormalities due to hypertrophy: planar ST depression and T-wave inversion in right precordial leads.

This ECG meets 5 of the criteria for RVH, which is highly sensitive for this patient actually having RVH. [JAAPA](#)