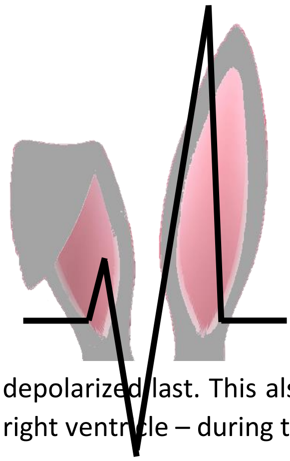
More About "Rabbit Ears" and Repolarization Abnormalities



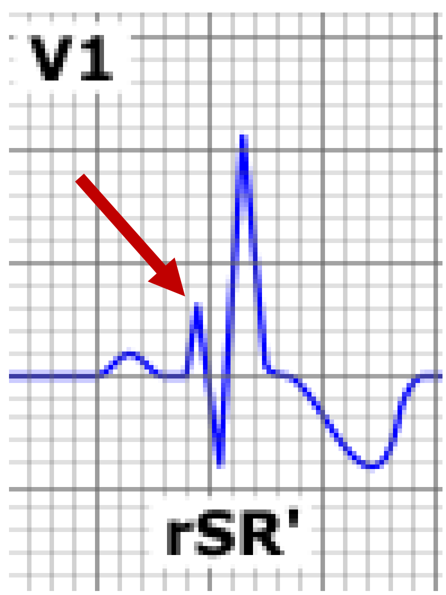
Since my last post about "Rabbit Ears" has become so popular, I thought it was about time to post a little more information.

"Rabbit ears" occur when there is a delay or block in the right bundle branch. However, not *every* delay or block in the right bundle branch results in "rabbit ears." You *can* see a qR or a monophasic R in Lead V1 during right bundle branch delay or block, but the classic rSR´ ("rabbit ears") is much more common. And we DO want the R´ to be the taller of the two R waves. It is also vitally important that the R´ be the *last deflection of the QRS interval*.

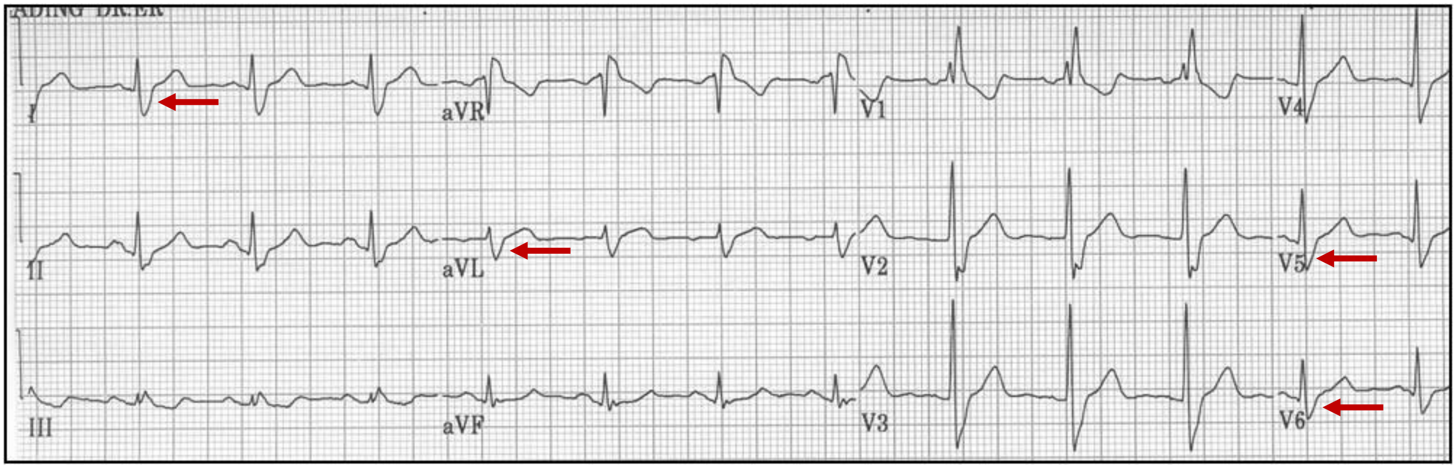
A delay or block in the right bundle branch means that the right ventricle is going to be depolarized last. This also means that all the depolarization vectors are going to be pointing to the right – towards the right ventricle – during the second half of depolarization – i.e., during the second half of the QRS interval.

What should that look like? Well, if a recording electrode overlooks the right ventricle, such as leads aVR, V1 and V2 (and sometimes even Lead III), it will see an impulse traveling TOWARD it and will inscribe a positive deflection. Since there is only one type of positive deflection during the QRS interval, that would be an R wave.

But remember: the left ventricle has usually already completed depolarization:



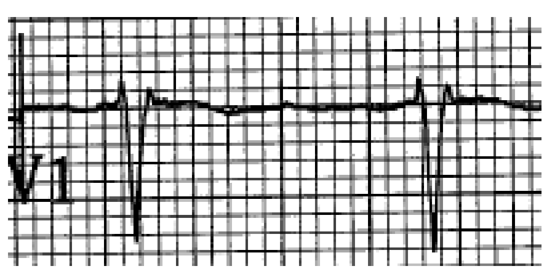
So, there is already one R wave that has been inscribed. In Lead V1 that R wave is usually small and so we typically designate it as an "r wave" using a lower-case "r". So now we have an r wave and an R´. We add a "prime" symbol (´) to each additional R wave after the first one; in other words, if there were a third R wave, it would be designated R´´ ("R double-prime") etc. The "primes" do not suggest or indicate anything unique about the R waves. Their only function is to label each R wave so we can refer to each one specifically and avoid any confusion. They have no other meaning! There does not have to be an S wave separating the two R waves, but the first R wave should *return to the baseline* and the second R wave should *start at the baseline*. If the second R wave begins before the first R wave has returned to the baseline, the deflection is formally designated a *notched monophasic R wave*. However, the presence of other ECG findings suggestive of RBBB (or delay) tells us that it really *does* represent an r and an R´.



We discussed what a recording electrode sees when it overlies the right ventricle in the path of the depolarization vectors; but what of the other leads – the ones overlooking the opposite side of the heart? Those leads are very important in confirming the diagnosis also! Left-sided leads will see the last part of the depolarization wave travelling AWAY from the left ventricle and their recording electrodes will inscribe a negative deflection (S wave) during the second half of depolarization, i.e., the second half of the QRS interval. Those leads are Leads I, aVL, V5 and V6. This is a very, very important finding in right bundle branch block or delay! You must see evidence of depolarization finishing toward the right!

Well, we have established that not all right bundle branch blocks or delays have rabbit ears (here's an example):

Do all rabbit ears (rSR´) represent right bundle branch block or delay? The answer is… *NO!* A complex in V1 composed of an rSR´ can occur if the V1 and V2 electrodes have been placed 1 or 2 intercostal spaces too high on the chest wall. Also, many people under the age of 40 or 45 years end ventricular depolarization in the area of the right ventricular outflow tract which is connected with the *crista interventricularis*. This can result in an rSR´ also (we used to call that a *cristal pattern*). The difference here, however, is that the rSR´ of the electrode misplacement and the termination in the right ventricular outflow tract are typically of normal duration (0.010 seconds or less)!



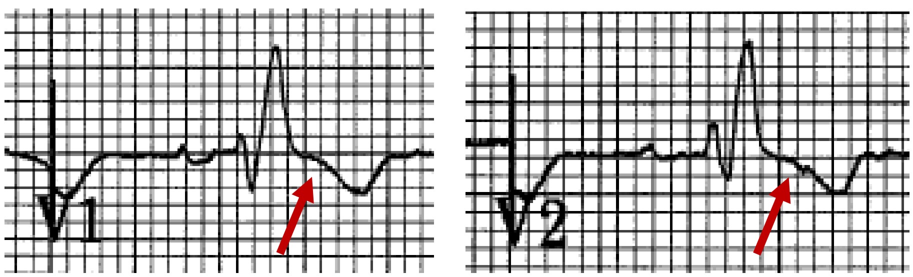
Repolarization Abnormalities

When there is a delay or block of the right bundle branch, one must focus on more than just depolarization – i.e., the QRS. Repolarization (represented by the ST segment and T wave) is also very unique and important!

Under normal circumstances, depolarization begins in the subendocardium and repolarization begins in the epicardium. This is changed during bundle branch blocks and delays. Depolarization begins as usual but repolarization begins in the subendocardium also – not in the epicardium! This causes the ST segment vector and the T wave vector to point in the opposite direction. So, on the ECG, we see an ST segment and a T wave oriented in the direction opposite depolarization. This phenomenon is referred to as a *repolarization abnormality*.

Now here is a very important point: this change in direction of repolarization occurs *only in the blocked ventricle – not in the ventricle with normal conduction!* So, not every lead will show this change. Only the leads overlooking the ventricle with the blocked or delayed conduction will demonstrate a repolarization abnormality. In the case of right bundle branch delay or block, look at the rightward leads (V1, V2, aVR, sometimes Lead III) for the repolarization abnormality.

What should a repolarization abnormality look like during right bundle branch block or delay?



Repolarization begins at the "J point." "J" is the initial for "junction" and refers to the junction of the end of the QRS and the beginning of the ST segment. Although there is an "S" in QRS and an "S" in ST segment, there needn't be any S wave present at all – these are just names. As a matter of fact, if you look at the two examples (above) of right bundle branch block or delay, you will clearly see that the ST segment does not connect with the "s" wave in the QRS interval – there is an R´ separating them.

The ST segment and T wave of a repolarization abnormality following the QRS of a right bundle branch block or delay has a very unique and distinctive appearance. The ST segment demonstrates a slow descent from the J point. On occasion, the descent appears to begin at a point slightly below the baseline, but typically it begins at the baseline. (***Pearl:*** The "J" point is not required to be *on* the baseline – it can be *above* or *below* the baseline.)

As the ST segment makes its descent, you will notice that there is a slight, even subtle, *upward convexity* to the segment – as though some force is under the ST segment pushing it upwards (arrow). (***Another Pearl:*** When we discuss *convexity* and *concavity*, we are always referring to the ***upward direction*** – an *upward* concavity or an *upward* convexity. *Never downward!*)

As we follow the descent of the ST segment even further, it gradually reaches the *nadir* (bottom) of an inverted T wave. There should be *no obvious transition from ST segment to T wave* (just as in a normal upright ST segment and T wave). The descent into the inverted T wave has been very gradual but now *the return to the baseline is much more abrupt*. On occasion, the ascending limb of the T wave goes slightly past the baseline then immediately returns to it (not seen here). This is referred to as *overshoot* and is not generally of any concern.

Caveat!! Ideally, there should be ***NO plateau between the J point and the onset of the T wave***. *The descent of the ST segment should begin at the J point!* If there is, consider that you may *not* be seeing a repolarization abnormality but rather an *ischemic change*. Also, the inverted T wave of a repolarization abnormality is ***NEVER symmetrical!*** *It is always ASYMMETRICAL!*

All bundle branch blocks and all bundle branch delays that have caused the QRS interval to widen to at least 0.120 seconds ***MUST HAVE A REPOLARIZATION ABNORMALITY! IF THERE IS NO REPOLARIZATION ABNORMALITY, YOU ARE <u>NOT</u> SEEING A BUNDLE BRANCH BLOCK! <u>IT ABSOLUTELY MUST BE THERE!</u>***

Caveat!! Cardiologists are still being called for "ischemia" that turns out to be nothing more than a bundle branch block or delay or a ventricular hypertrophy (which may or may not have a repolarization abnormality). Don't make that mistake.

Right Bundle Branch Block… *or Delay!*

Throughout this monograph, I have persistently referred to right bundle branch block ***or delay!*** Why delay?

Many, if not most, "bundle branch blocks" are not actually blocks but rather just a delay in the conduction fibers. Consider this:

> It takes 0.060 seconds (60 msec) for an impulse to cross the interventricular septum in a normal, healthy heart – in either direction. There are no conducting fibers in the interventricular septum, so conduction is always cell-to-cell. If the right bundle branch were to have a delay that lasts longer than 60 msec, then the left ventricle would have time to depolarize, cross the interventricular septum and then start depolarizing the right ventricle. On the ECG paper strip this would look *exactly* like a complete right bundle branch block – *except there never was any actual block present*. Only an electrophysiology study could distinguish the two.

I hope you have learned from this short monograph on "rabbit ears" and right bundle branch block… or delay! Take a moment to check out our website and learn how you can improve your ECG interpretation skills!