Level 8: Premature beats

Some of the unexpected beats that were introduced in the previous chapter can be categorized as **premature** or **ectopic beats**. The term "ectopic" describes their origin as coming from a region outside the sinus node. The term "premature" refers to the fact that they occur earlier than expected.

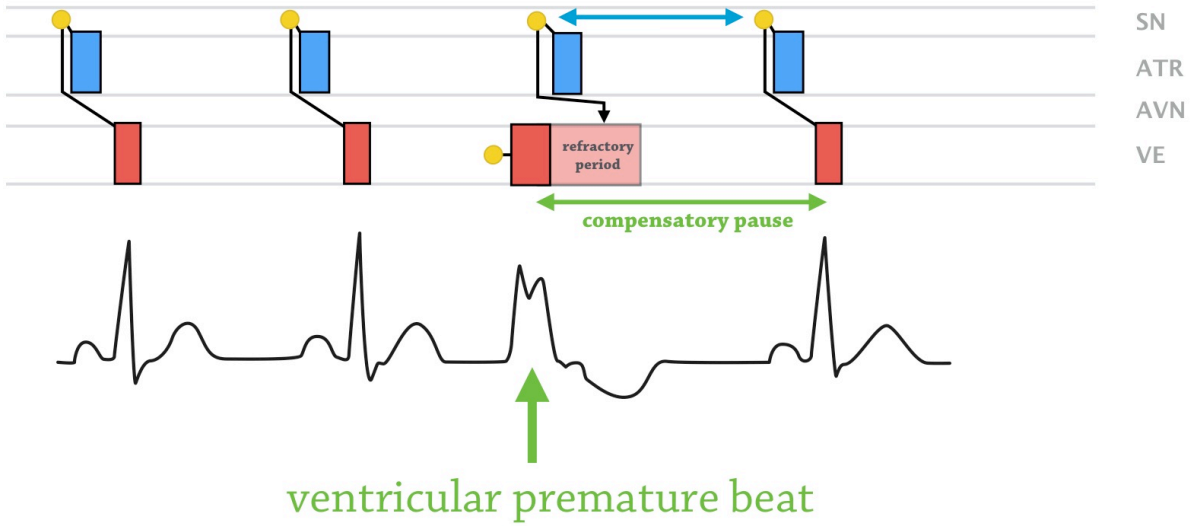
This ectopic pacemaker location can be anywhere in the heart. The resulting beat will have a very characteristic appearance depending on the location of its origin.

Ventricular premature beats

Here's a **ventricular premature beat (VPB)** in action. Note two key characteristics:

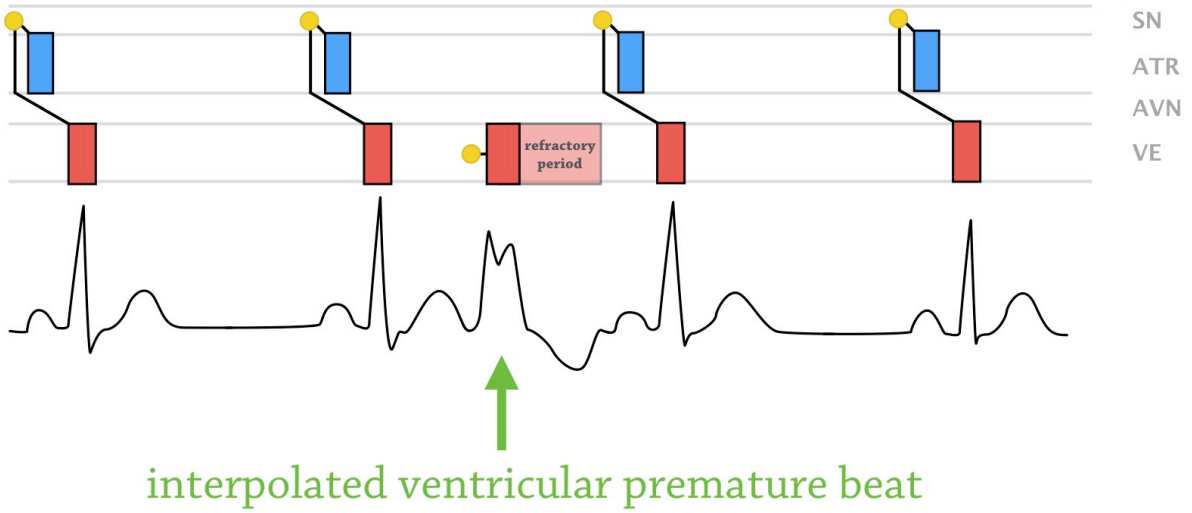
1. There's no P wave preceding it.
2. The QRS is broad (≥ 0.12s in duration).

A premature broad QRS complex without a P wave preceding it is a clear sign of a VPB.



You should also note what's happening in the atria: the sinus node continues to fire at its regular rate. However, the impulse number 3 reaches the ventricles at a point in time when they are still in their refractory period (of the VPB) and the respective P wave is hidden within the QRS or the ST segment. We have to wait until the next sinus interval is over (blue arrow) before the subsequent P wave is generated and conducted down into the ventricles. This is the reason why we see a **compensatory pause** following the VPB.

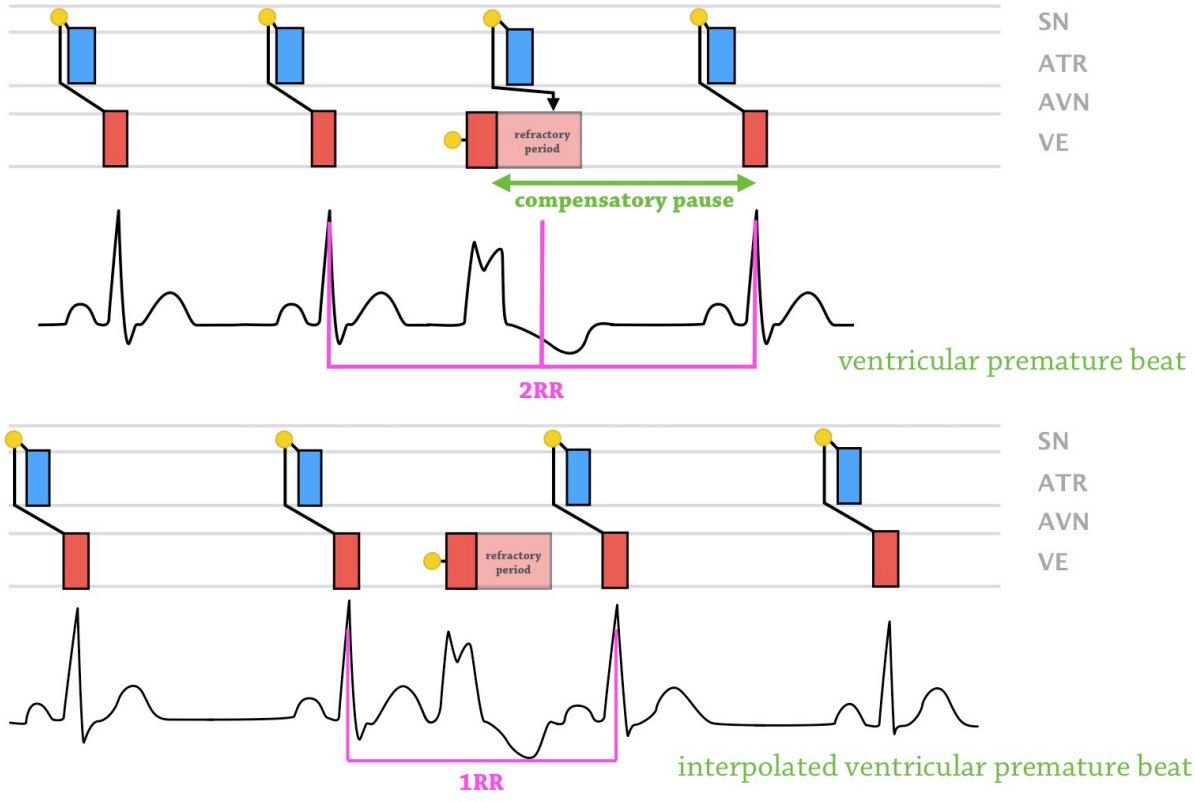
However there's also another kind of VPB in which this looks slightly different:



The refractory period of this VPB is already over before the next sinus impulse reaches the ventricles. Therefore, we do not see a compensatory pause following the premature QRS. This type of VPB is called an **interpolated ventricular premature beat**.

Differentiating between ventricular and supraventricular premature beats

There is one important measurement that will come in handy when we learn about supraventricular premature beats: the distance from the last normal QRS preceding the VPB to the next normal QRS following it.



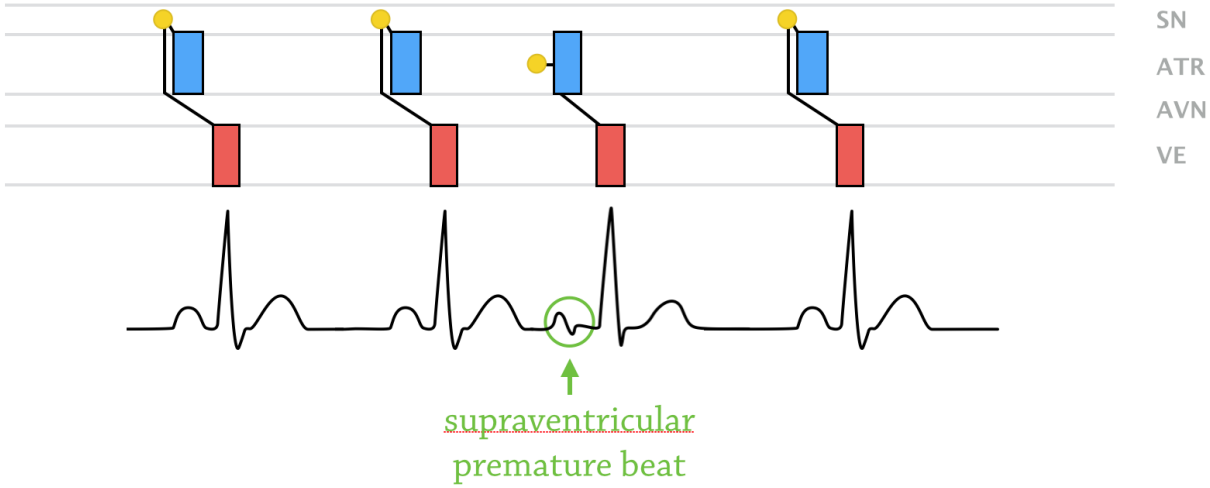
As you can see in the illustration above, the distance between the last normal QRS preceding the VPB and the next normal QRS following the VPB is either:

- Equal to **two normal R-to-R intervals,** in the case of **VPBs with a compensatory pause**.
  or
- Equal to **one normal R-to-R interval,** in the case of **interpolated VPBs**.

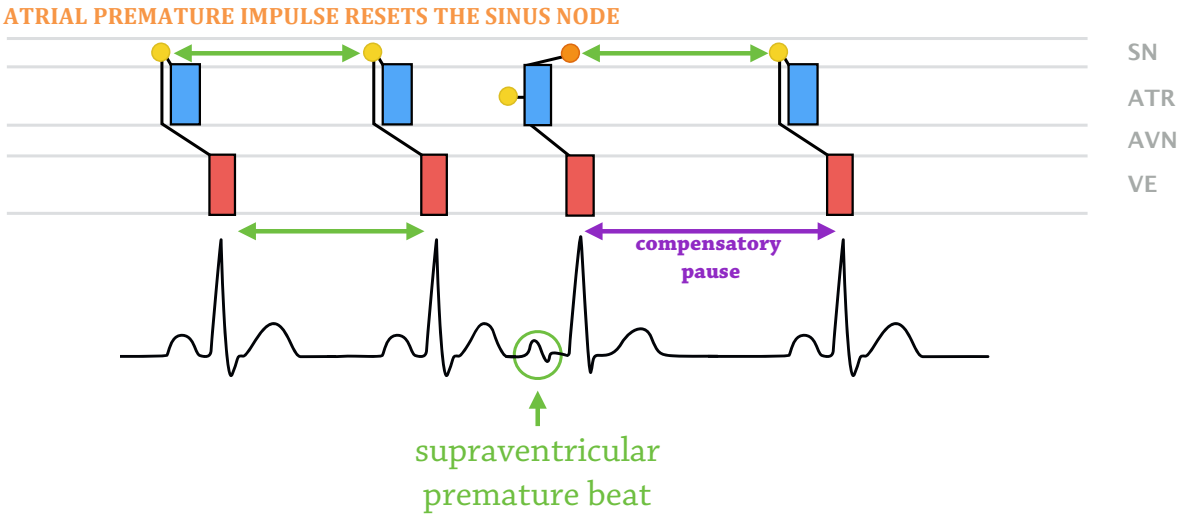
In the next section, you will learn how this measurement differs in supraventricular premature beats.

Supraventricular premature beats

Here's an example of a **supraventricular premature beat (SPB)**. Notice that the premature P wave looks different than the normal P waves because it's coming from a different region within the atria than the sinus node. The premature QRS on the other hand looks completely normal and narrow because the impulse is using the normal conduction pathways.



And what else is going on in the atria? Once the premature supraventricular impulse depolarizes the atria, it also "resets" the sinus node (orange dot). So the sinus node thinks that it has just discharged, and it will generate the next sinus impulse at the preset sinus interval (green arrows).

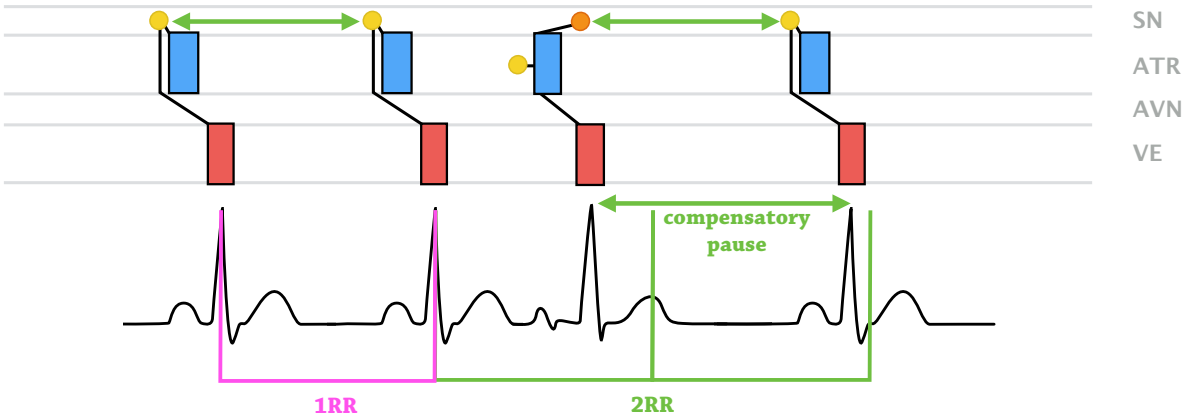


Practically all supraventricular premature beats are followed by a compensatory pause, sometimes clearly evident, sometimes very close to the R-to-R interval.

So remember these two key characteristics for identifying supraventricular premature beats:

1. They always have a premature P in front of their premature QRS.
2. The distance between the last normal QRS preceding the premature beat and the one following it is shorter than two normal R-to-R intervals.

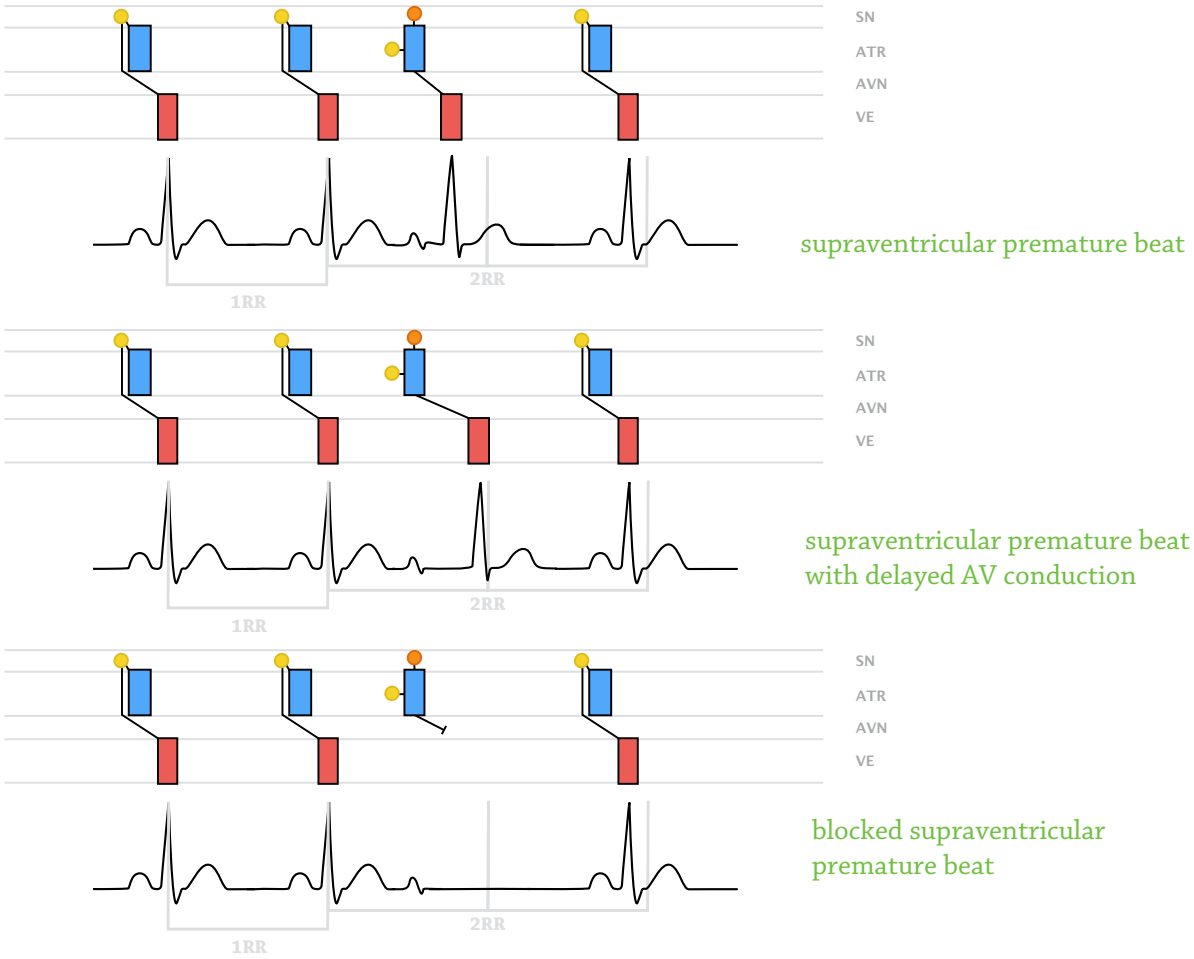
SUPRAVENTRICULAR PREMATURE BEAT



Note how the last beat (i.e., the normal QRS complex following the premature beat) comes in before the end of two normal RR intervals. In other words, the distance from the normal QRS preceding the premature beat to the normal QRS following it is shorter than two normal RR intervals.

Sometimes the premature atrial impulse reaches the AV node at a point in time at which it is still unable to conduct the impulse properly. When this happens, conduction down the AV node is either **delayed** or **completely blocked**. In the former, the PR interval will be prolonged, in the latter, the QRS complex will be completely blocked.

No matter if conduction through the AV node is normal or not, the distance between the normal QRS preceding the premature beat and the QRS following the premature beat is still less than two normal RR intervals.



So in summary, supraventricular premature beats are characterized by a premature P wave. **The QRS complex can**:

- Be narrow.
- Have a bundle branch block morphology.
- Be missing (as in blocked supraventricular premature beats).

The **PR interval can**:

- Be normal.
- Be prolonged.