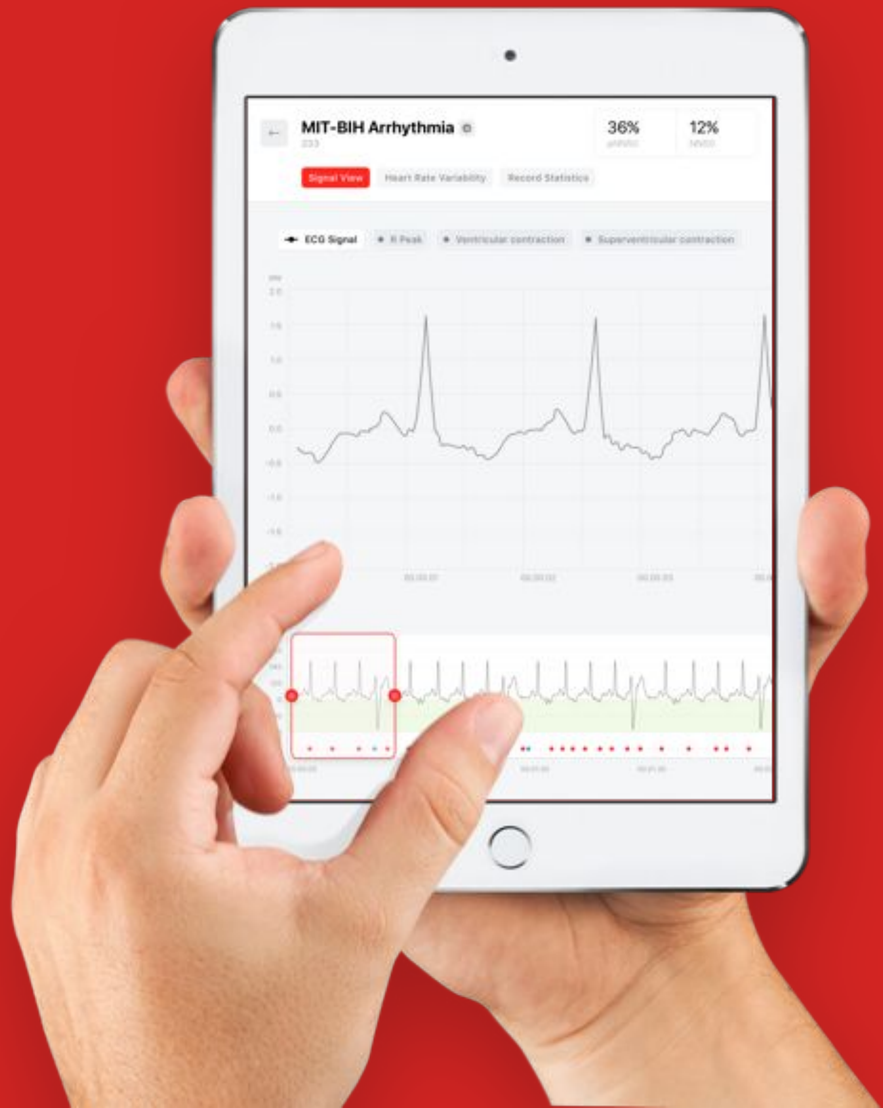
Cardiomatics

ECG tutorial: Basic principles of ECG analysis

Cardiomatics for Education



About Cardiomatics

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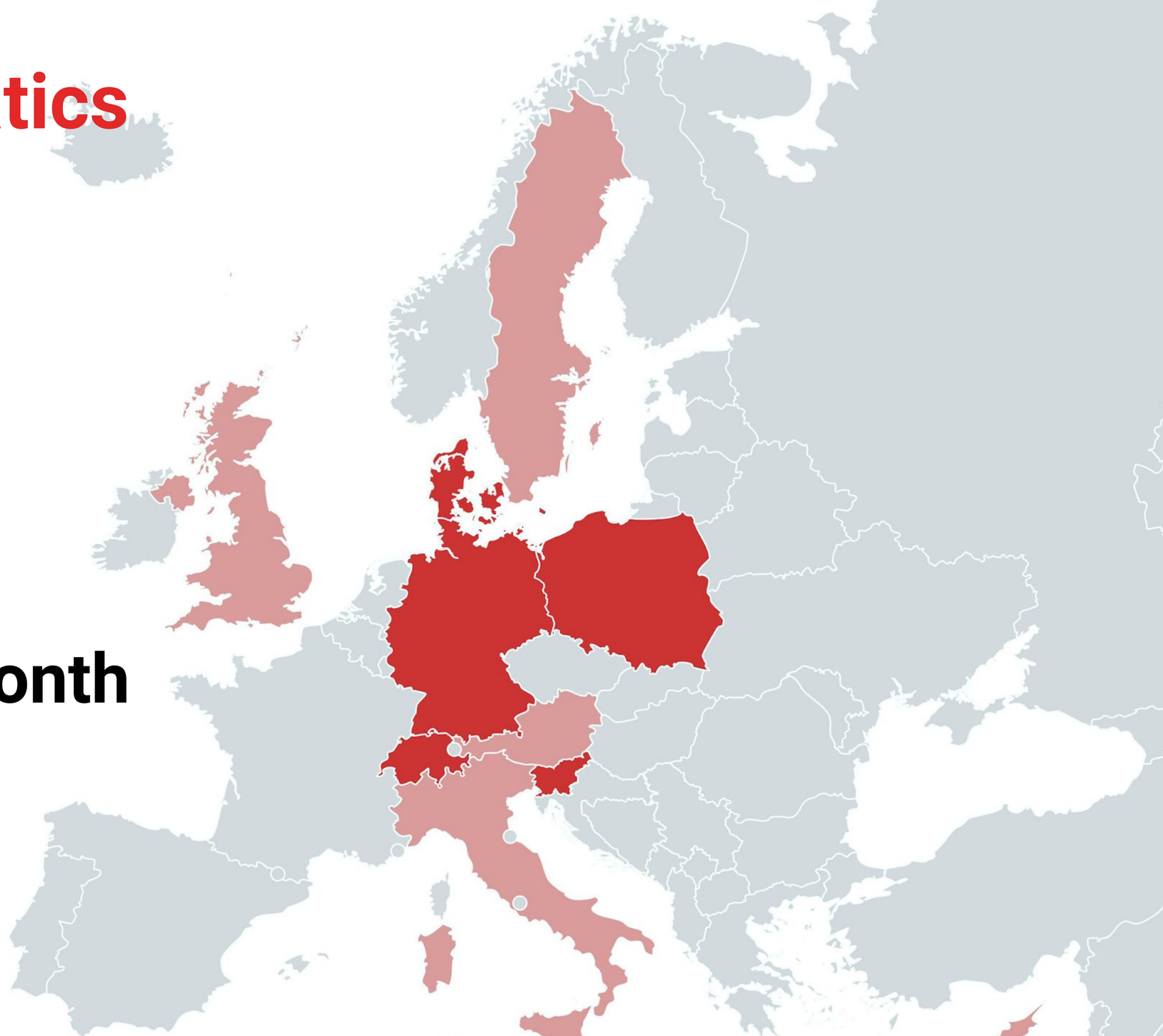
AI based ECG interpretation tool with clinically-proven value delivered in seconds

Available input data formats: ISHNE ECG, EDF/EDF+, WFDB, GETEMED, MEDEA

About Cardiomatics

250+ active users

Thousands of examinations analysed every month



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Basic principles of ECG analysis

ECG Strips

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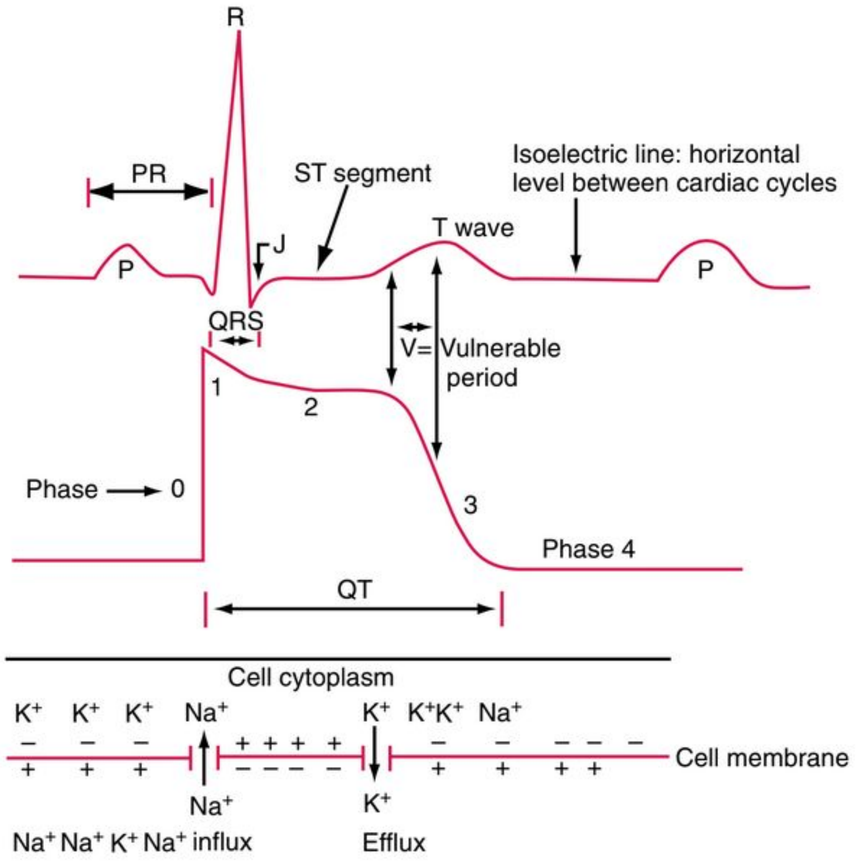

An ECG waveform can include several components which indicate electrical activity during a heart beat. These components are labeled P, Q, R, S, T and U.

The P wave is the first short upward movement of the ECG tracing. It indicates atrial contraction with blood moving into the ventricles from the atria.

The QRS complex, normally starts with a downward deflection, Q; a larger upwards deflection, a peak (R); and then a downwards S wave. The QRS complex marks ventricular depolarization and contraction.

The PR interval indicates the transit time for the electrical signal to travel from the sinus node to the ventricles.

The T wave is normally a smaller upwards waveform, representing ventricular re-polarization.

ECG Paper

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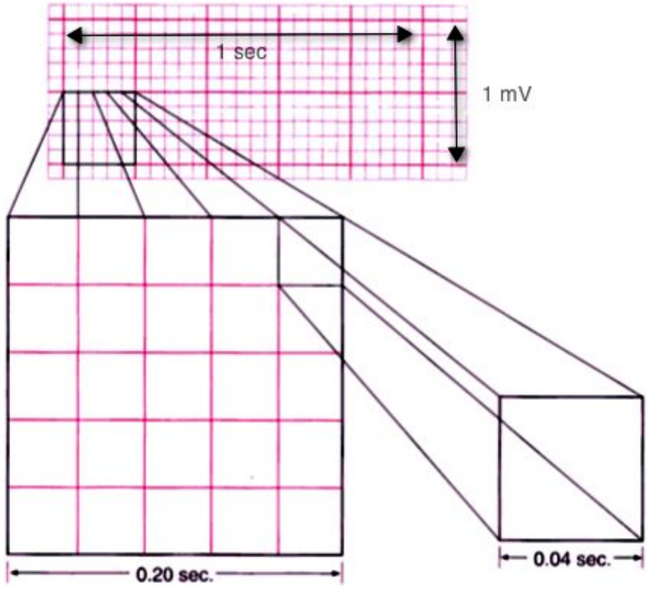

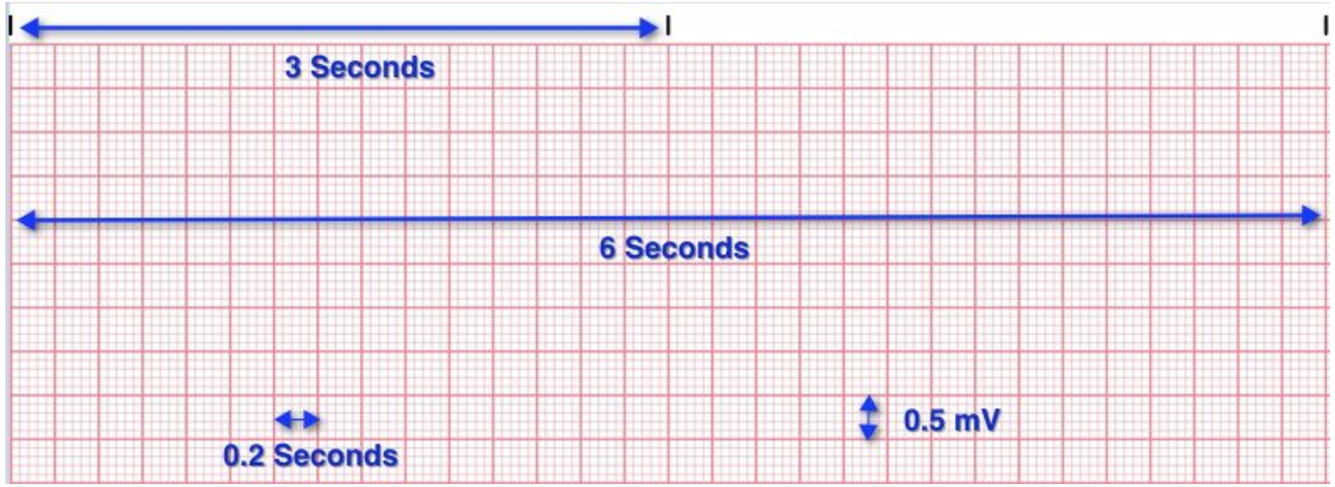

ECG tracings are recorded on grid paper. The horizontal axis of the ECG paper records time, with black marks at the top indicating 3 second intervals.

Each second is marked by 5 large grid blocks. Thus each large block equals 0.2 second. The vertical axis records EKG amplitude (voltage). Two large blocks equal 1 millivolt (mV). Each small block equals 0.1 mV.

Within the large blocks are 5 small blocks, each representing 0.04 seconds.

Heart Rate

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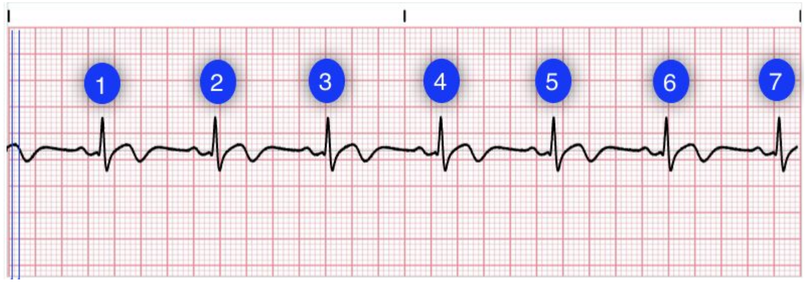

There are several methods for determining heart rate.

First method is simple. Count the number of QRS complexes over a 6 second interval. Multiply by 10 to determine heart rate. This method works well for both regular and irregular rhythms. In the first image, we can count 7 QRS complexes, so the heart rate is 70.

The second method uses boxes. Count the number of small boxes for a typical R-R interval. Divide this number into 1500 to determine heart rate. In the second image, the number of small boxes for the R-R interval is 21.5. The heart rate is 1500/21.5, which is 69.8. If the rhythm is regular, count the number of large squares between QRS complexes and divide this number into 300. The heart rate is 300/4.3, which is 69.8.

Rhythm analysis

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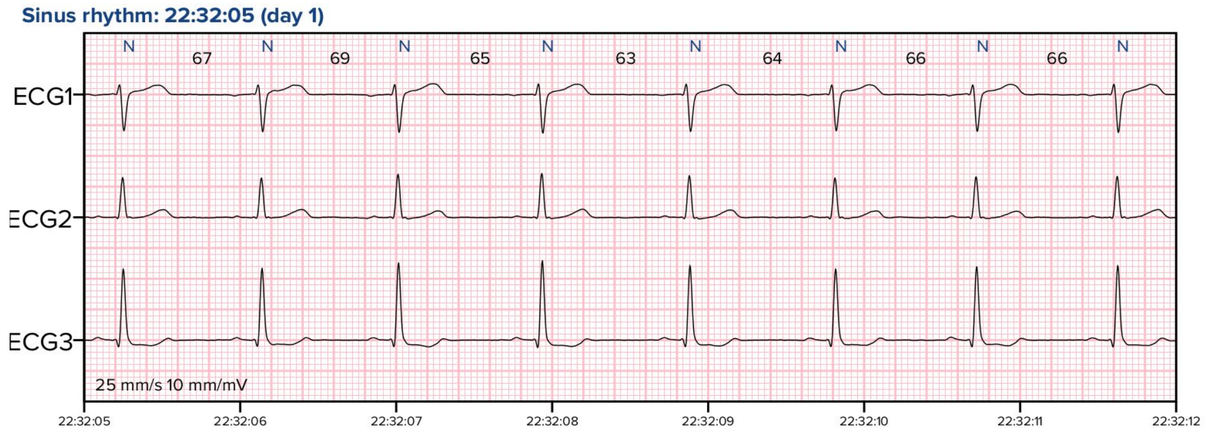

Sinus rhythms originate from the sinus node, the normal cardiac pacemaker. It is the primary physiologic mechanism of the heartbeat. You diagnose it by finding P waves and the HR between 60 and 100 bpm.

Sinus rhythm with a heart rate of less than 60 beats/min is called sinus bradycardia.

Rhythm analysis

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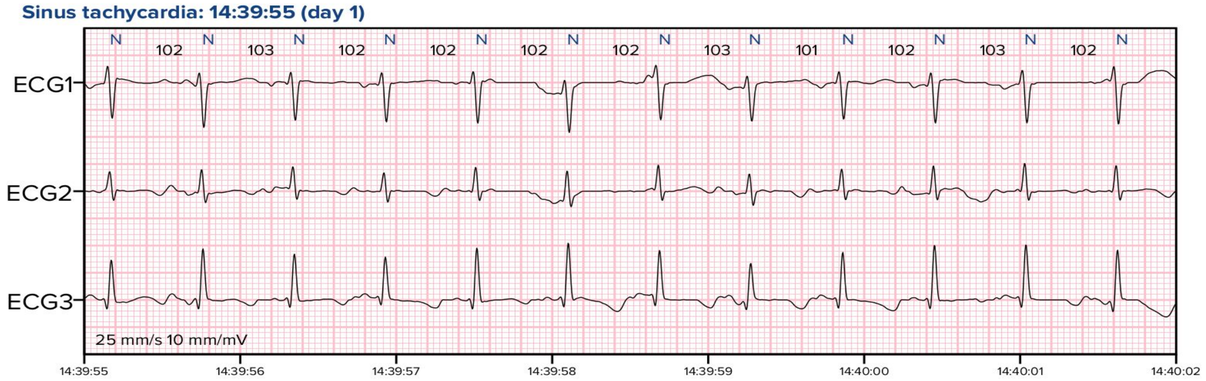

Sinus rhythm with a heart rate greater than 100 beats/min is termed sinus tachycardia

Atrial fibrillation - the waves between each QRS complex are random and indistinct; in essence, they're a mess. Furthermore, the R-R intervals are consistently irregular. This pattern emerges when several ectopic pacemakers emerge in the atrial muscle and all fire more rapidly than the sinuatrial node.

Rhythm analysis

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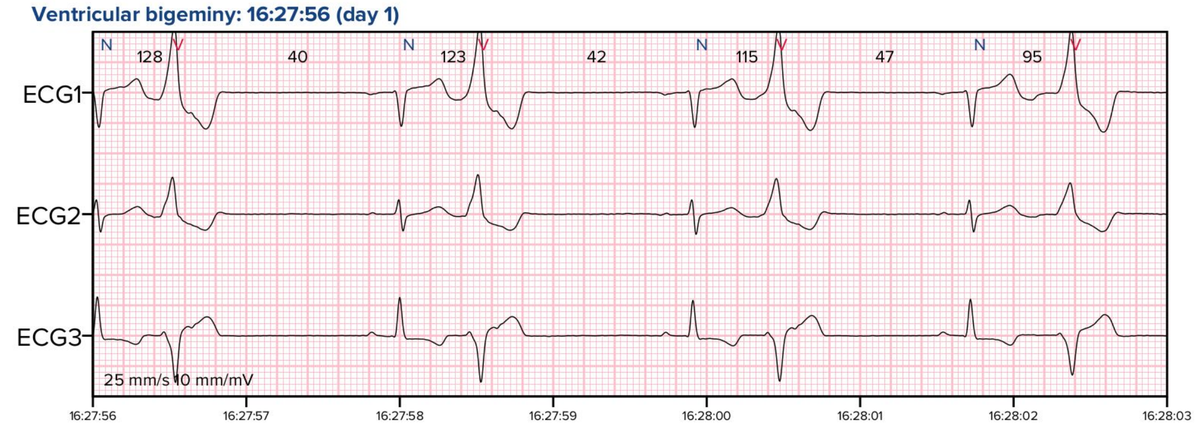

Broad QRS complex (≥ 120 ms) with abnormal morphology is called ventricular beat.

On ECG premature ventricular contractions have a specific appearance of the QRS complexes and T waves, which are different from normal readings. By definition, a PVC occurs earlier than the regular normally conducted beat. Subsequently, the time between the PVC and the next normal beat is longer as the result of a compensatory pause.

Sometimes PVCs occur in a predictable pattern. Depending whether there are one, two, or three normal beats between each PVC, the rhythm is called bigeminy, trigeminy, or quadrigeminy. If 3 or more PVCs occur in a row it may be called ventricular tachycardia.

Rhythm analysis

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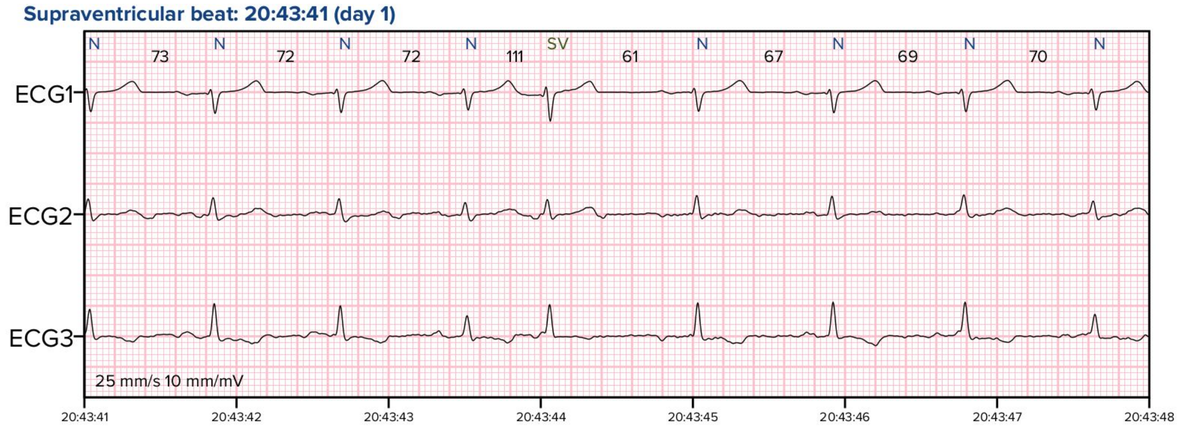

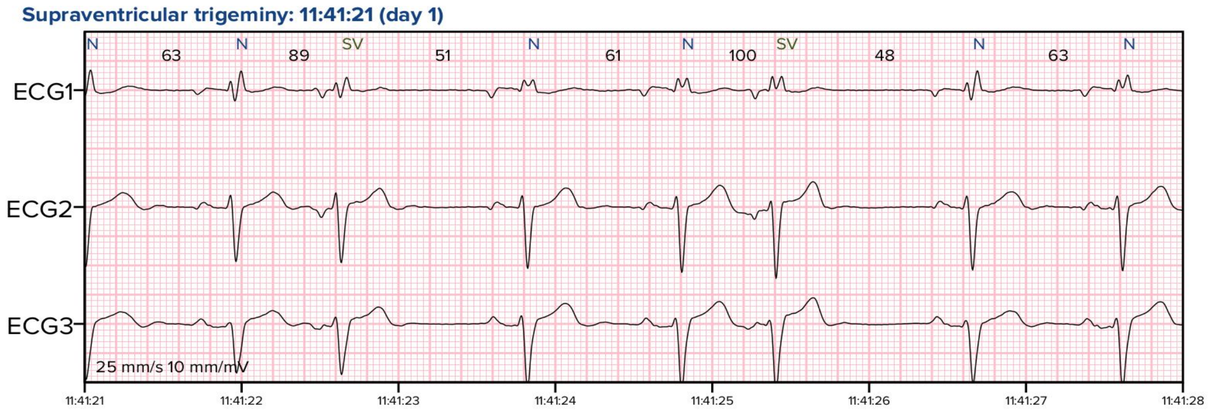

Supraventricular premature beats represent premature activation of the atria from a site other than the sinus node and can originate from the atria or the atrioventricular node.

They have a premature and abnormal-looking P wave followed by a normal QRS complex. Atrial premature beats are associated with an incomplete compensatory pause, meaning that the interval between the preceding and following sinus beats is less than two complete cycles.

Sometimes beats occur in a predictable pattern. Depending whether there are one, two, or three normal beats between each SV, the rhythm is called bigeminy, trigeminy, or quadrigeminy.

Check your knowledge!

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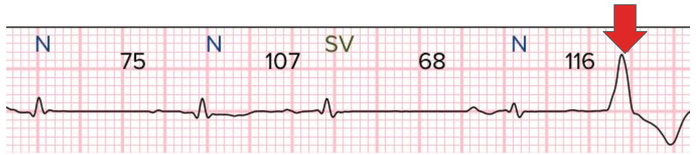
1. P wave is the first short upward movement of the ECG tracing. It indicates ...

A. ventricular depolarization
B. atrial contraction
C. ventricular contraction

2. Look at picture below.

HR is equal:
A. 40 bpm
B. 68 bpm
C. 81 bpm

3. Look at picture below. Broad QRS complex is a...



A. ventricular beat
B. supraventricular premature beat
C. normal beat

4. Look at picture below. Which kind of heart rhythm is it?

A. Atrial Fibrillation
B. Sinus Bradycardia
C. Sinus Rhythm

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