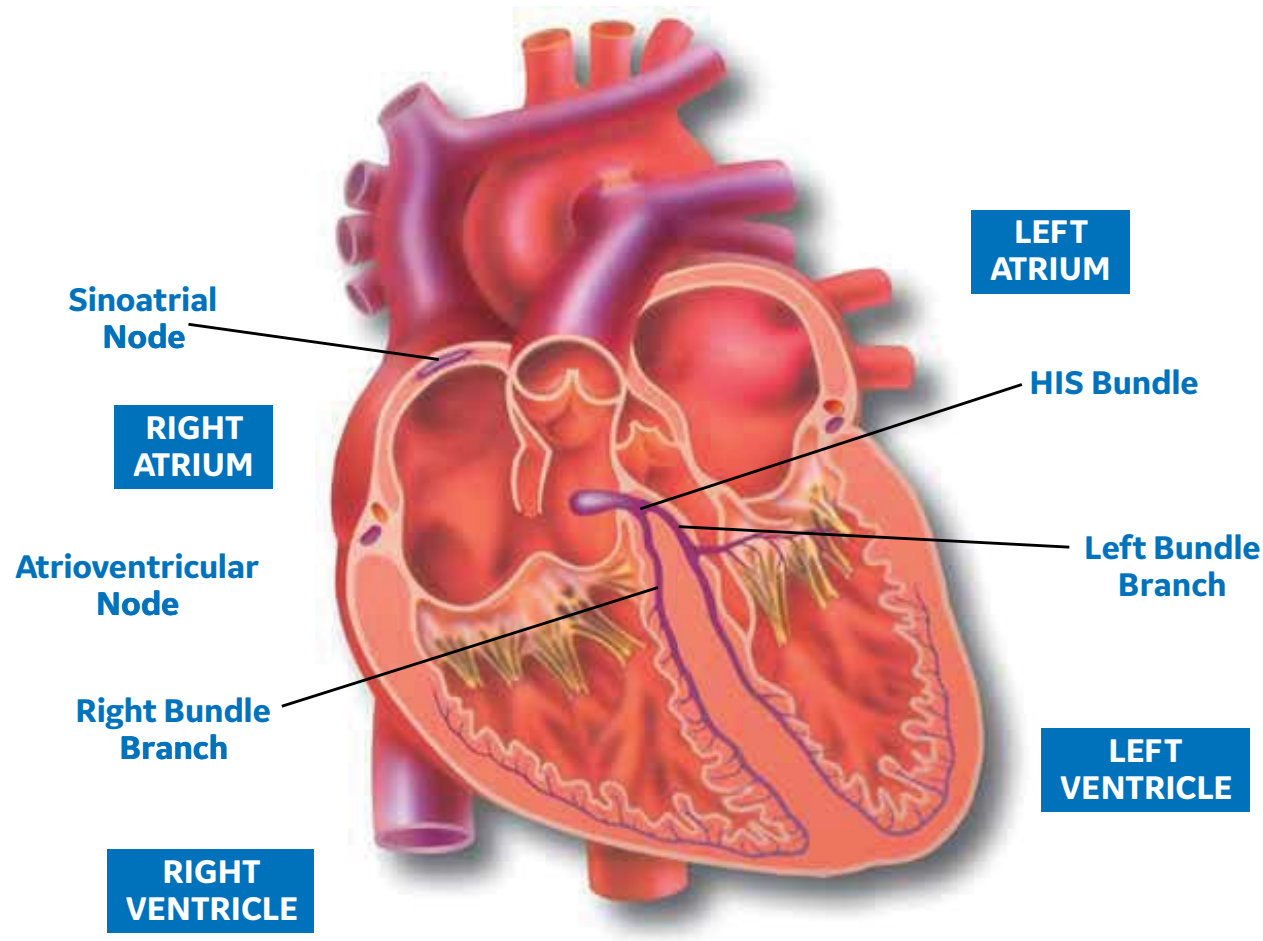


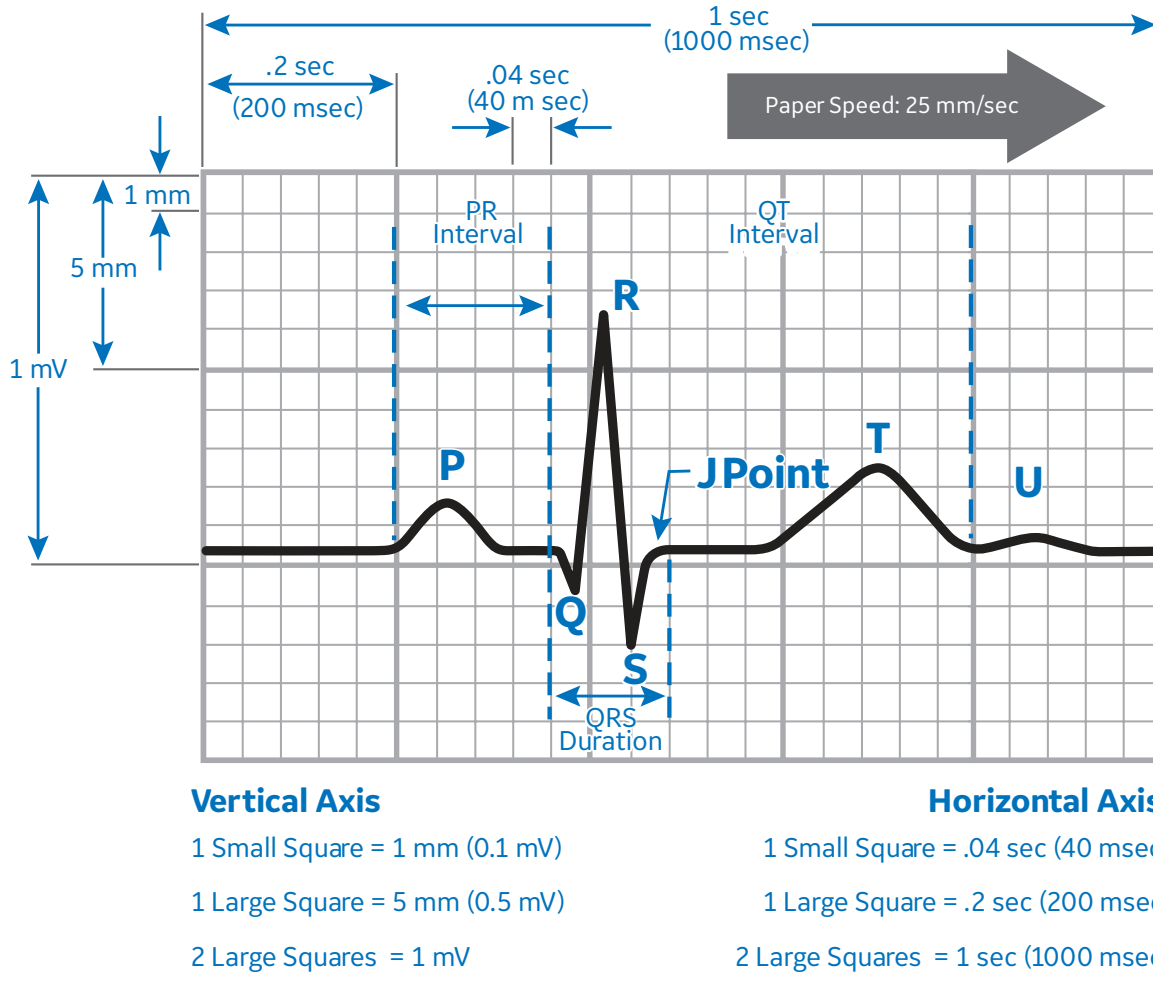
Arrhythmia Recognition



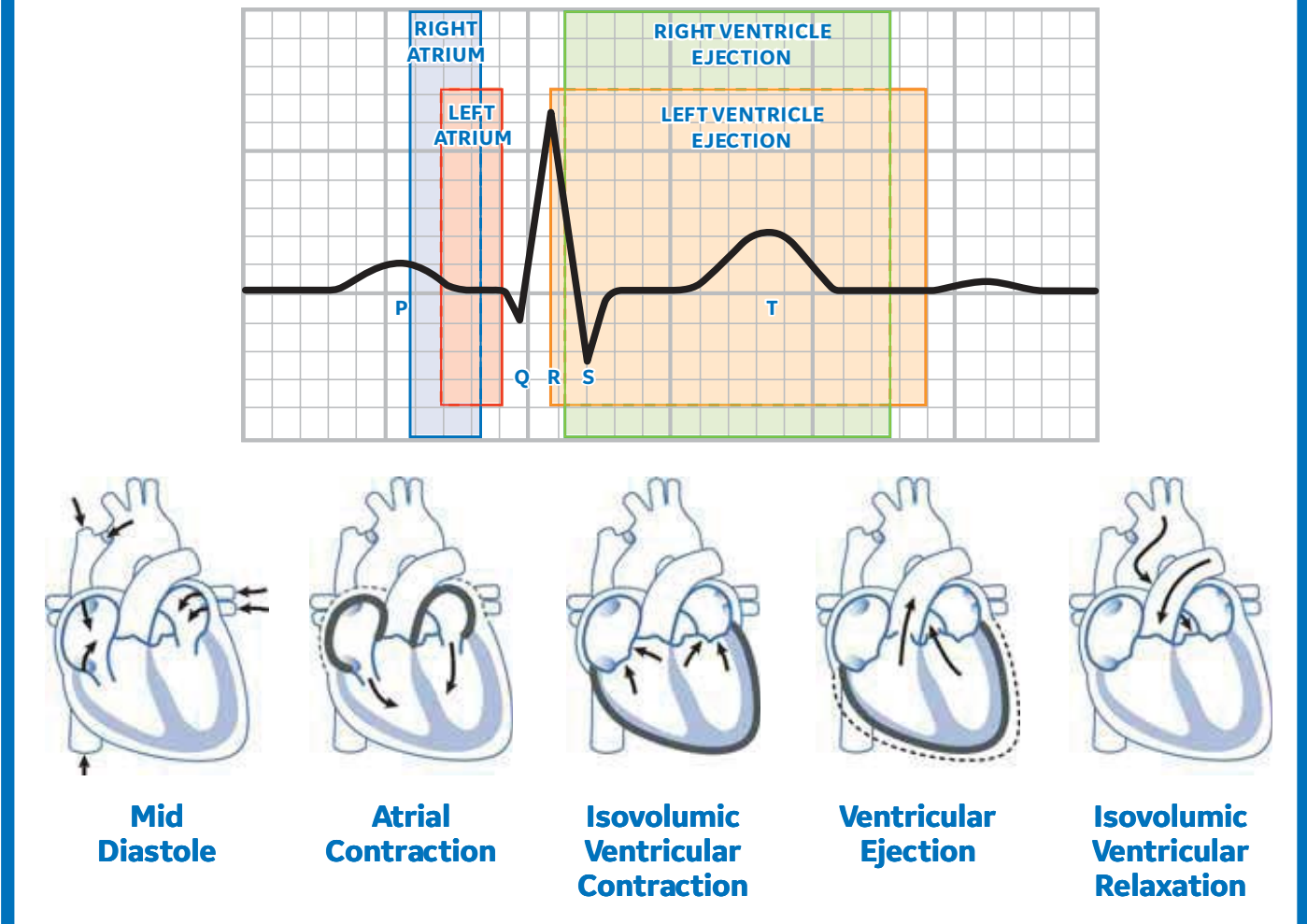
Cardiac Conduction System



ECG Components

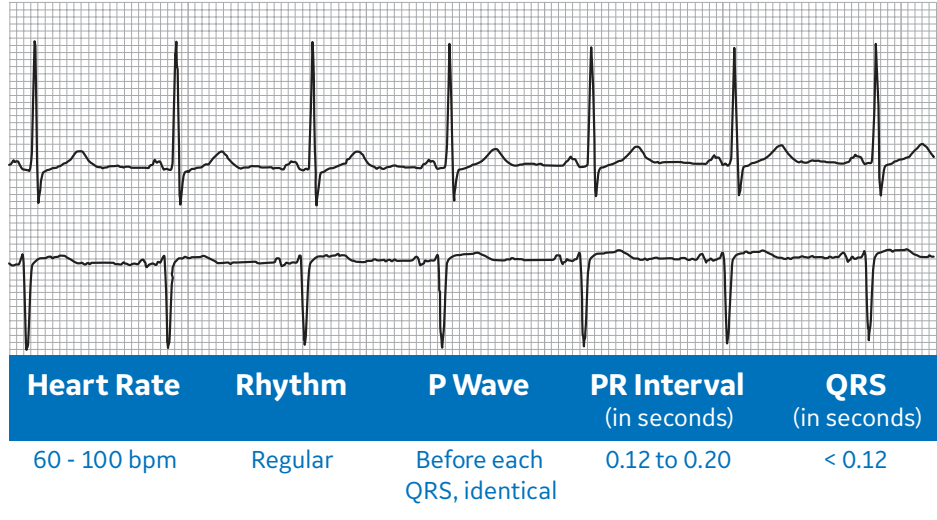


Electrical and Mechanical Events

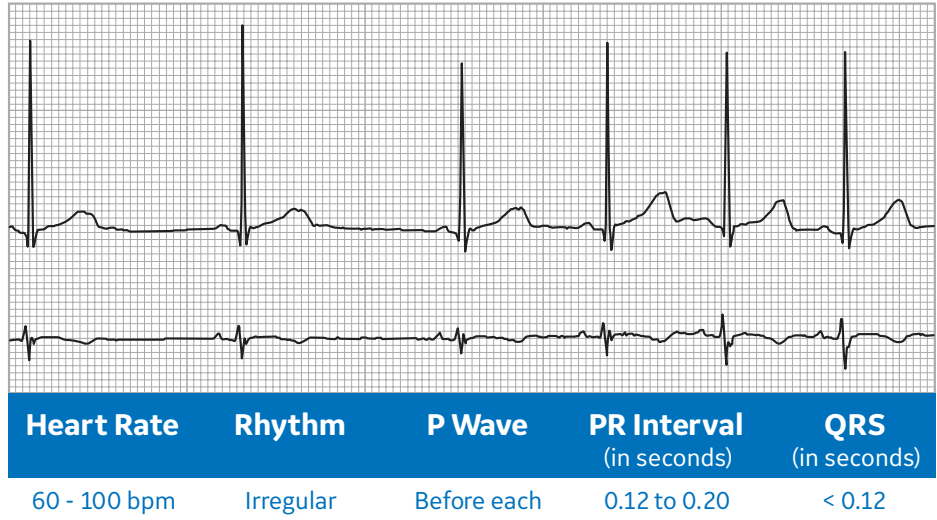


Sinus Rhythms

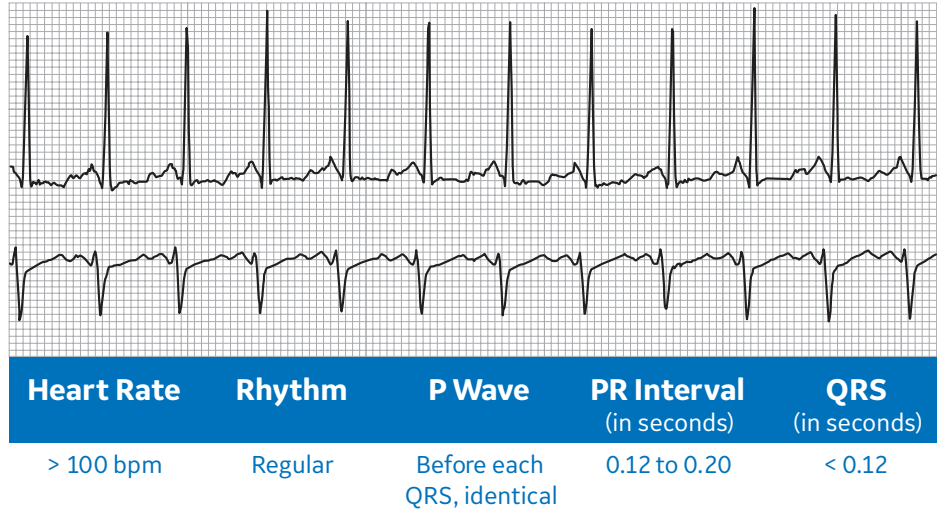
Normal Sinus Rhythm



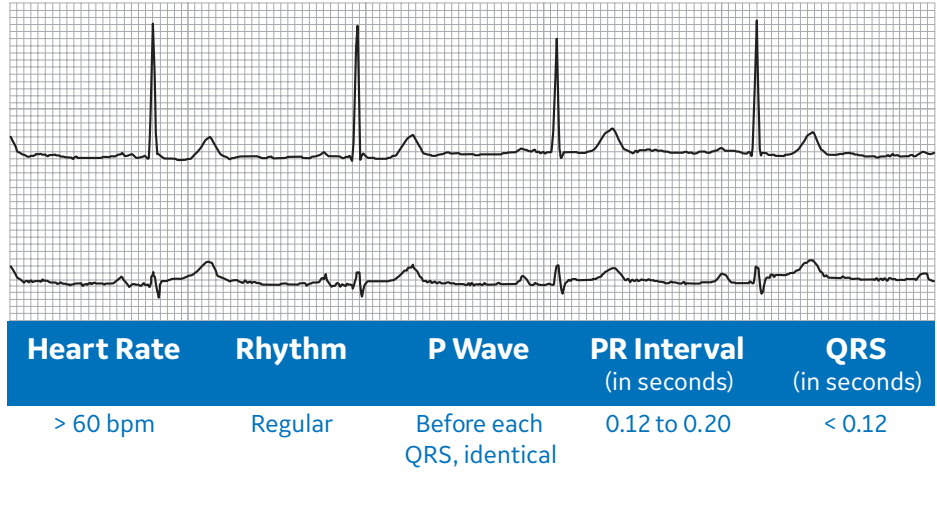
Sinus Arrhythmia



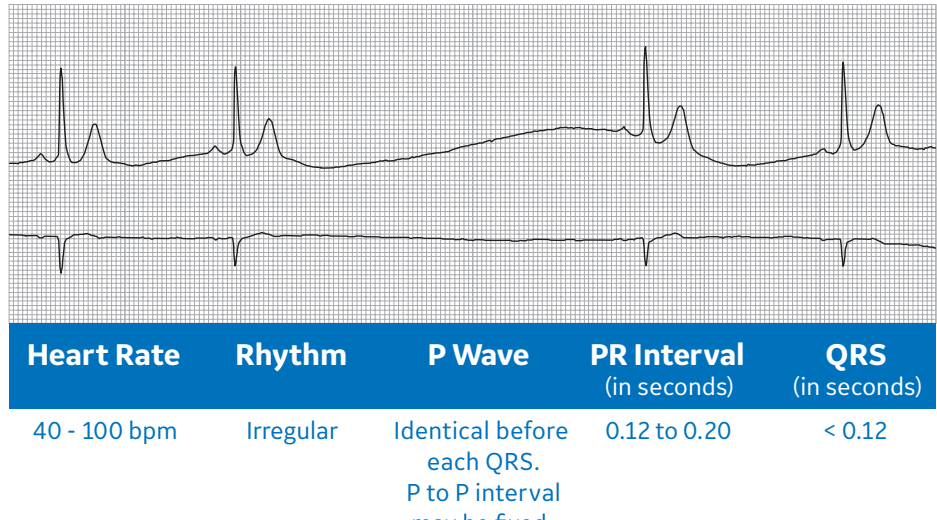
Sinus Tachycardia



Sinus Bradycardia

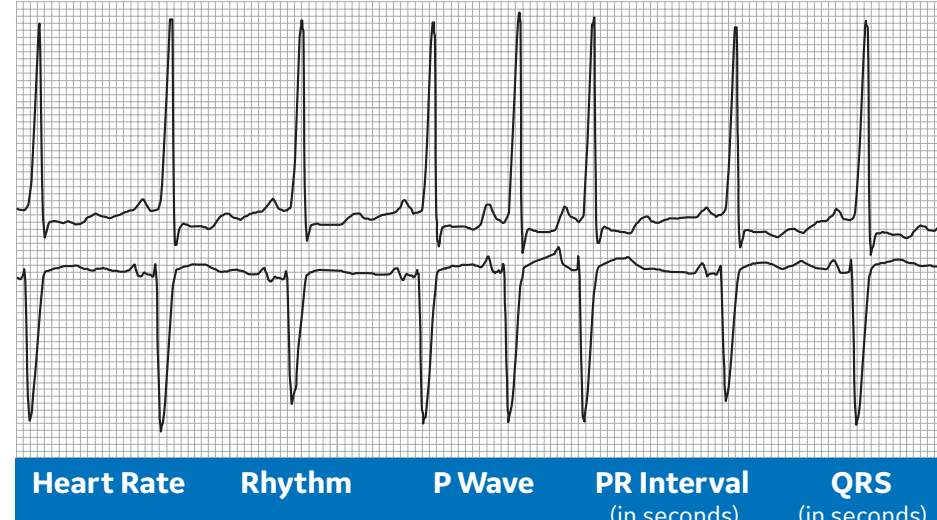


Sinus Arrest or SA Block

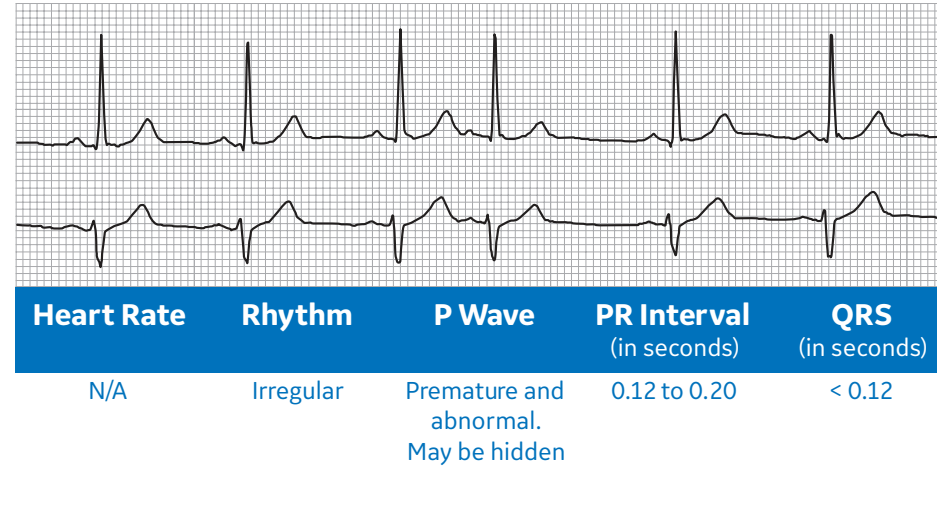


Supraventricular Rhythms

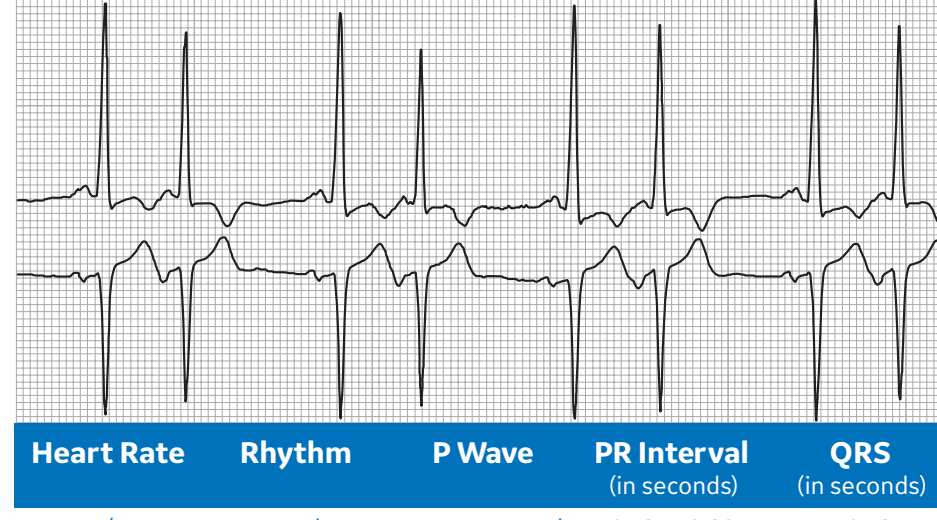
Premature Atrial Complexes - PACs



Premature Atrial Complex - Isolated PAC



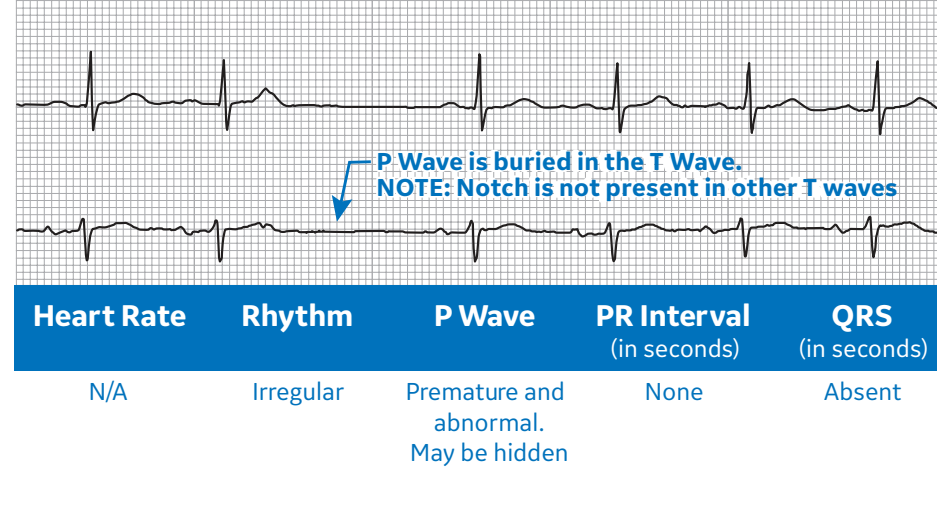
Premature Atrial Complexes (Atrial Bigeminy) Every other beat is a PAC



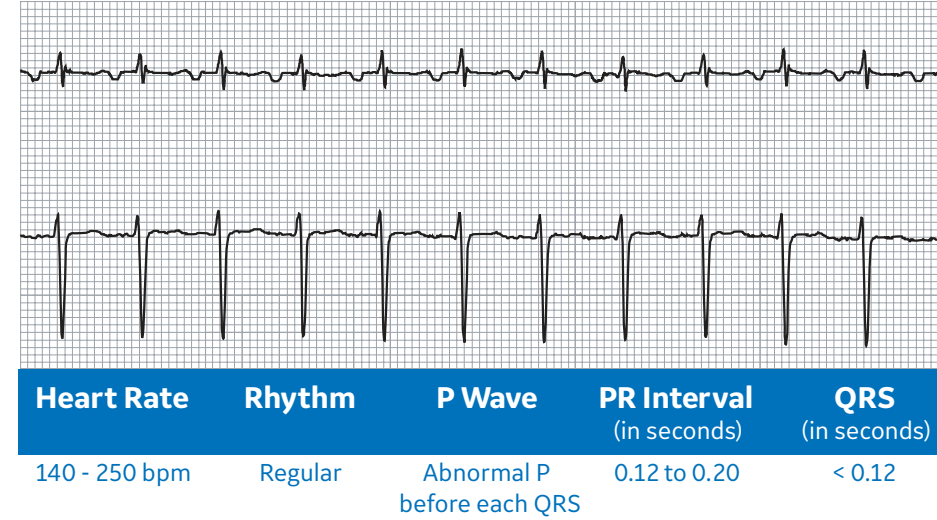
Premature Atrial Complex with Aberrancy



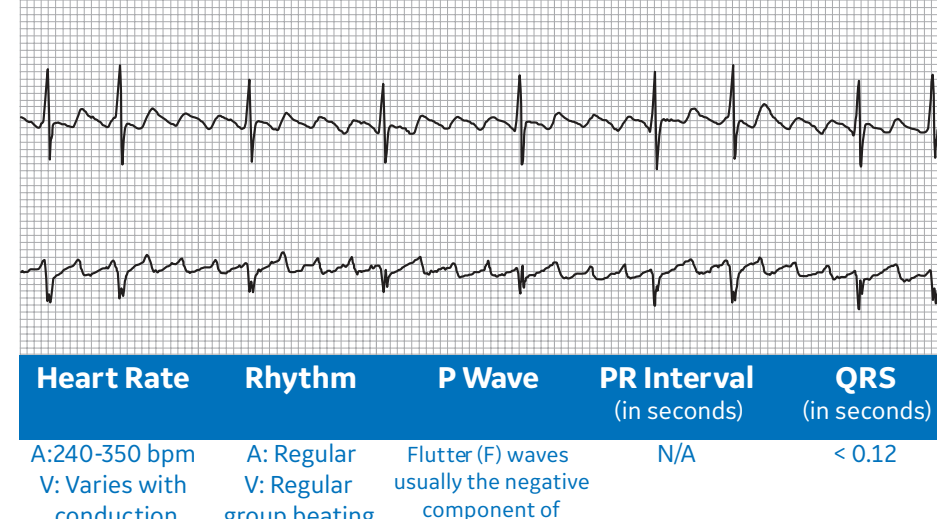
Nonconducted Premature Atrial Complex



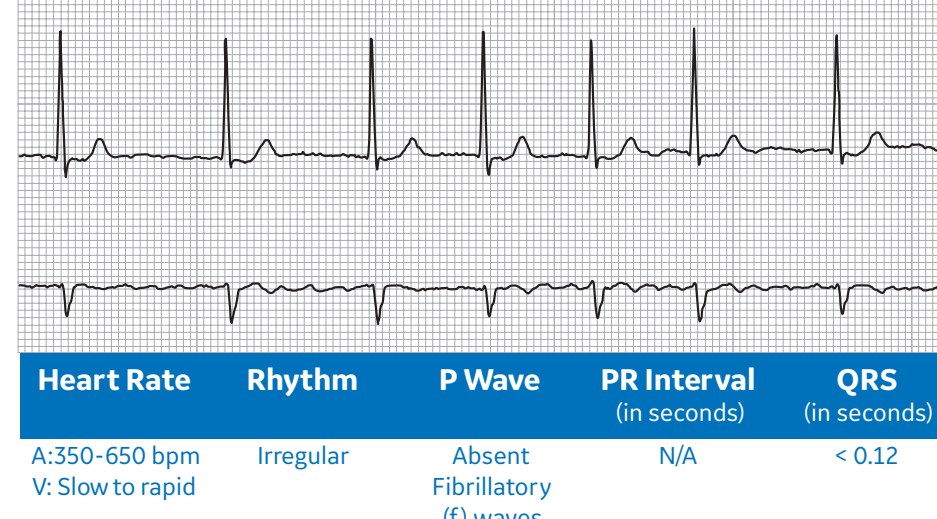
Atrial Tachycardia



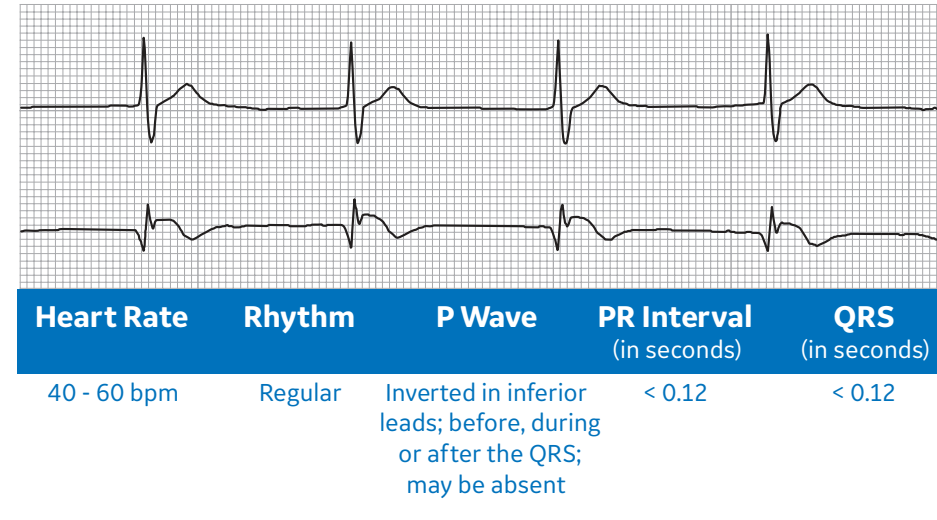
Atrial Flutter



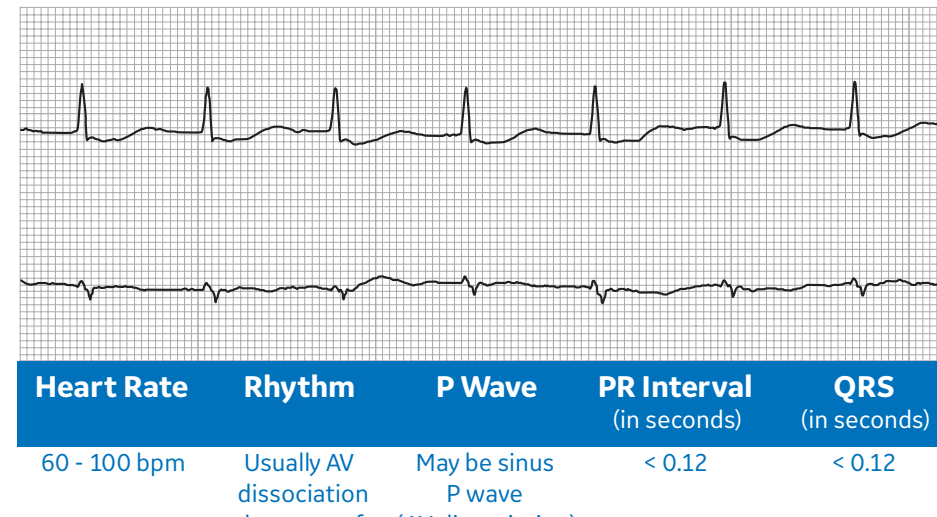
Atrial Fibrillation



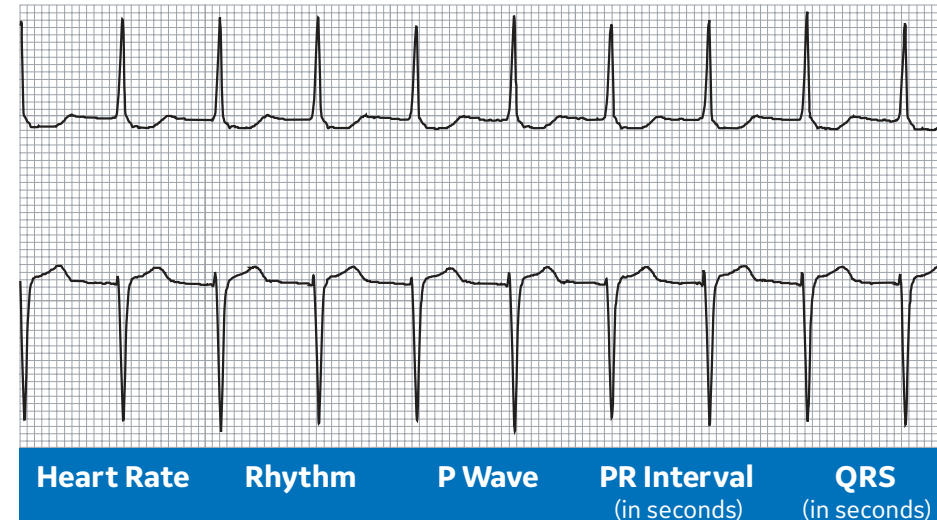
Junctional Rhythm



Accelerated Junctional Rhythm

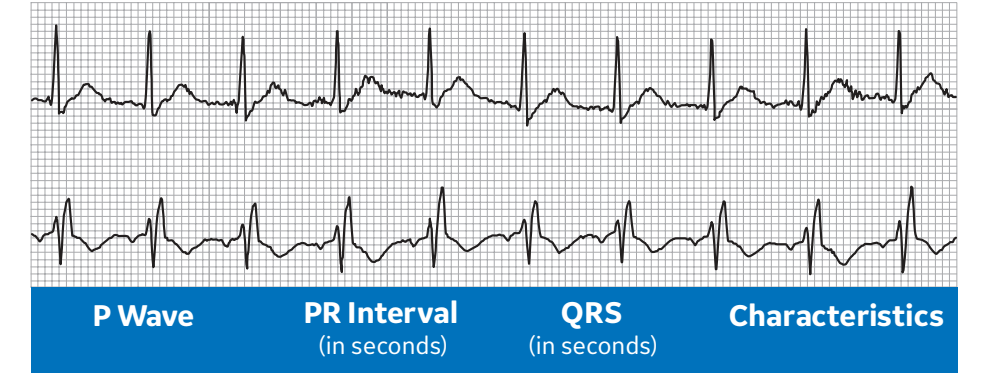


Junctional Tachycardia

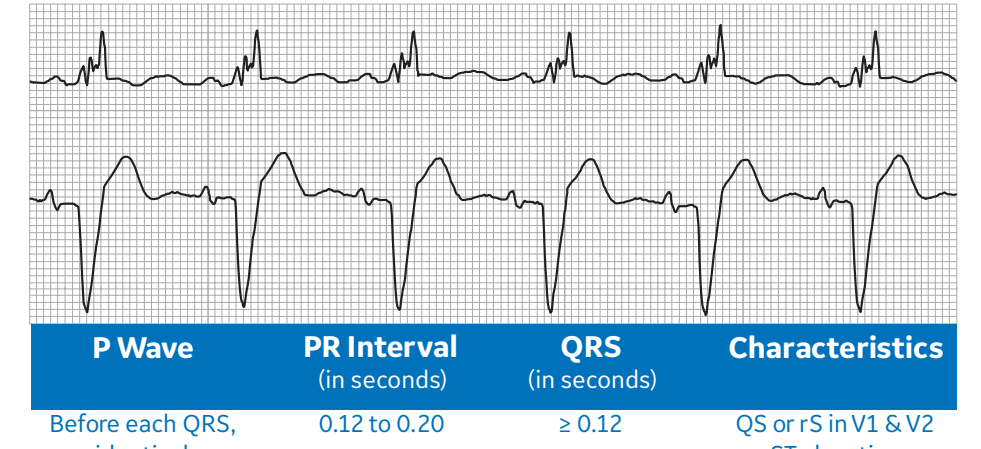


Conduction Defects

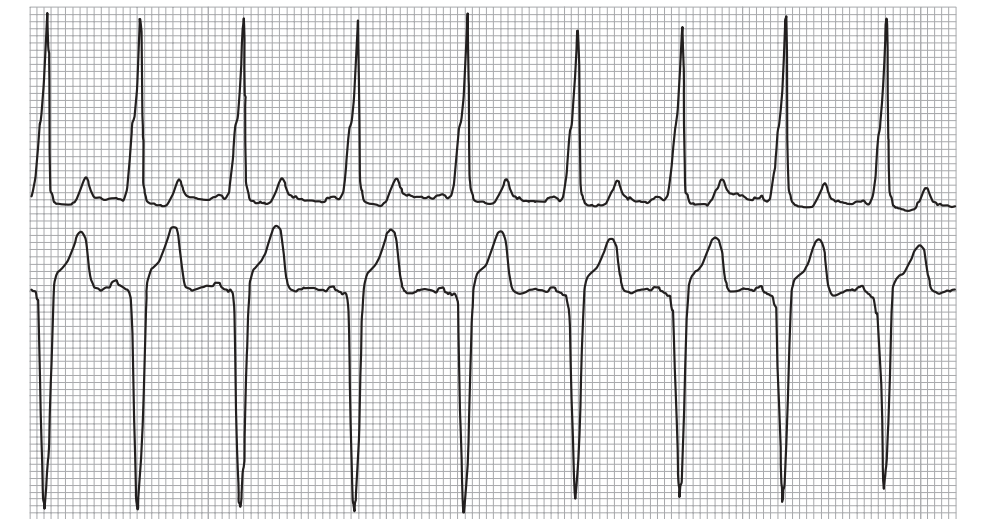
Right Bundle Branch Block



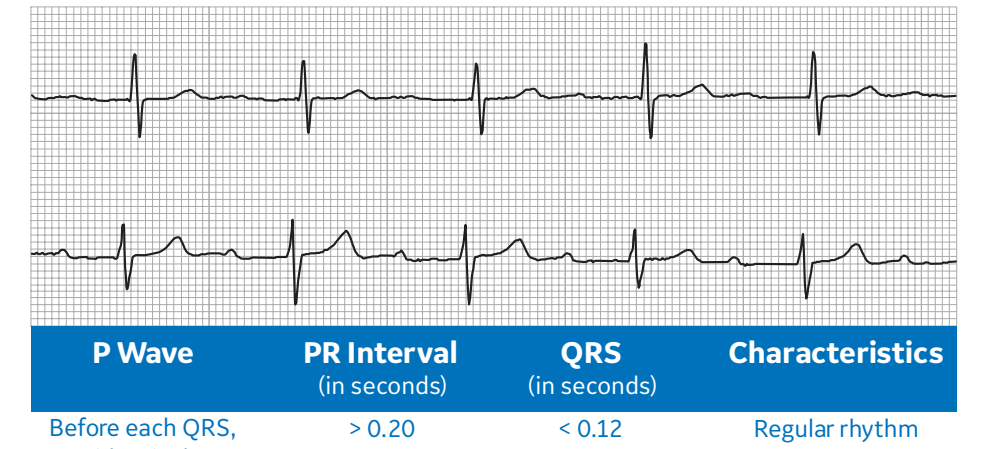
Left Bundle Branch Block



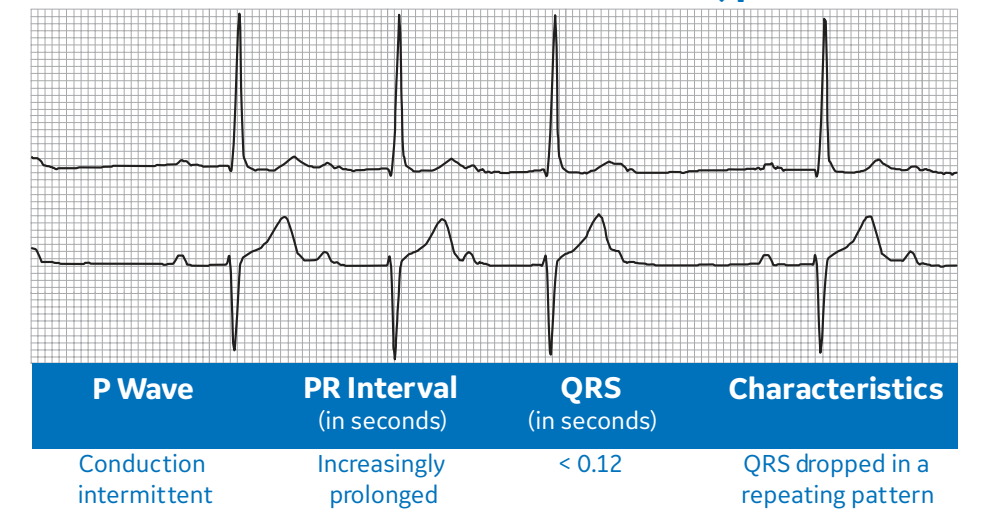
Pre-excitation Syndrome



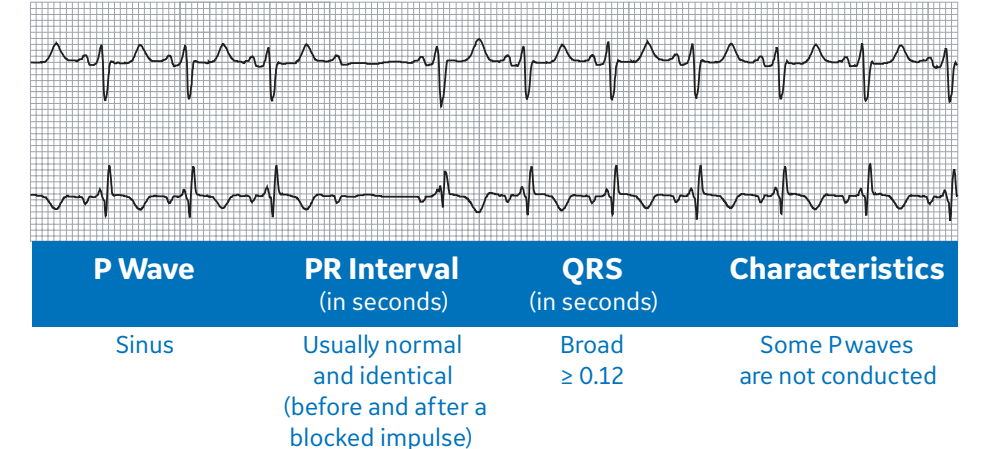
First-Degree AV Block



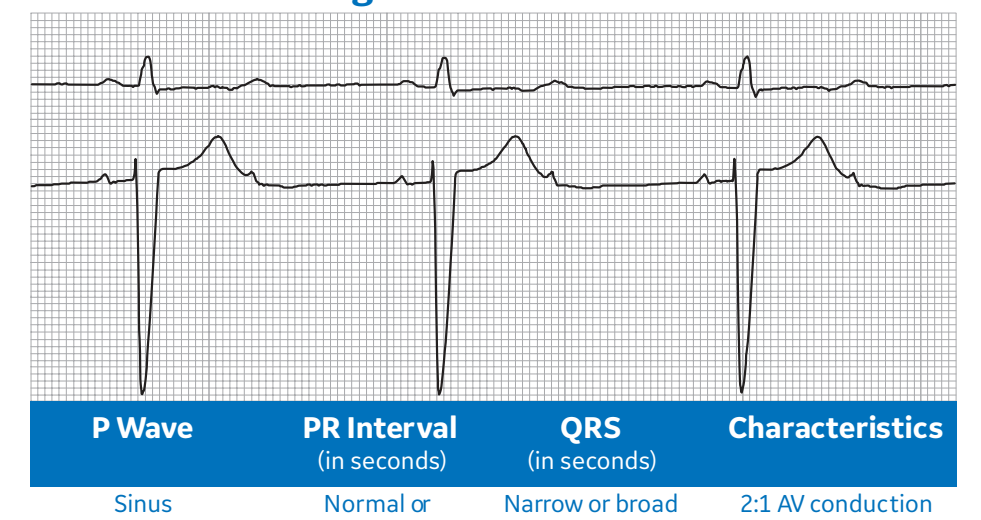
Second-Degree AV Block - Type I (AV Wenckebach or Mobitz type I)



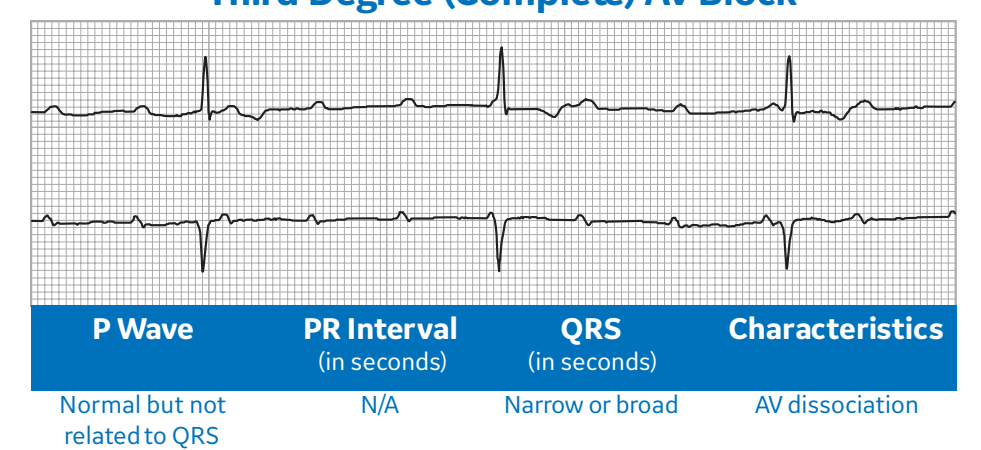
Second-Degree AV Block-Type II (Mobitz type II)



Second-Degree AV Block - 2:1 AV Block



Third Degree (Complete) AV Block



Arrhythmia Recognition (poster 1 of 2)

This is part one of two posters to assist healthcare professionals in recognizing basic arrhythmias. According to the Practice Standards for Electrocardiographic Monitoring in Hospital Settings (Circulation. 2004;110:2721-2746) in general, the mechanisms of arrhythmias are the same in both adults and children. However, the ECG appearance of the arrhythmias may differ due to developmental issues such as heart size, baseline heart rate, sinus and AV node function, and automatic innervation.

ECG terminology and diagnostic criteria often vary from text to text and from one teacher to another. There are often several terms describing similar findings (for example: Premature Atrial Contraction, Atrial Premature Complex, Atrial Extrasystole, Supraventricular Ectopic Beat, etc.) It is important to correlate the ECG interpretation with the clinical observation of the patient.

	0-1d	1-3d	3-7d	7-30d	1-3mo	3-6mo	6-12mo	1-3y	3-5y	5-8y	8-12y	12-16y
Heart Rate (bpm)	94-135 (0.22)	91-158 (0.22)	90-166 (0.22)	105-182 (0.22)	100-179 (0.22)	105-185 (0.22)	108-189 (0.22)	89-152 (0.22)	75-137 (0.22)	65-133 (0.22)	62-130 (0.22)	60-120 (0.22)
PR Interval (Lead V) (seconds)	0.08-0.16 (0.03)	0.08-0.14 (0.03)	0.07-0.15 (0.03)	0.07-0.14 (0.03)	0.07-0.13 (0.03)	0.07-0.15 (0.03)	0.07-0.15 (0.03)	0.08-0.15 (0.03)	0.08-0.14 (0.03)	0.09-0.13 (0.03)	0.09-0.13 (0.03)	0.09-0.18 (0.03)
QRS Interval (Lead V) (seconds)	0.02-0.07 (0.03)	0.02-0.07 (0.03)	0.02-0.07 (0.03)	0.02-0.08 (0.03)	0.02-0.08 (0.03)	0.02-0.08 (0.03)	0.02-0.08 (0.03)	0.03-0.08 (0.03)	0.03-0.07 (0.03)	0.03-0.08 (0.03)	0.04-0.09 (0.03)	0.04-0.09 (0.03)

All values 2nd - 98th percentile; numbers in parentheses, means. Adapted from *Pediatr Cardiol*. 1979;1:123.

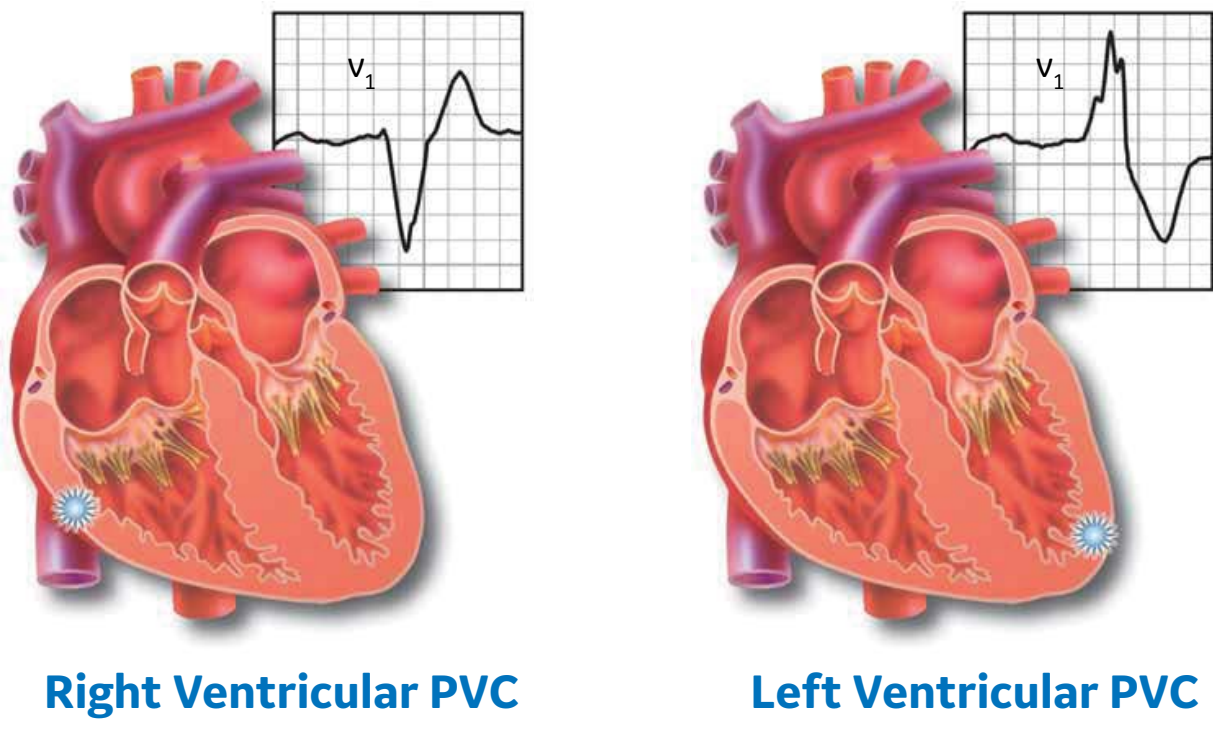
This poster includes Premature Ventricular Conduction, Pacemaker Lead Placement, ST Segment Depression, Ventricular Rhythms, Pacemaker Rhythms, Full Compensatory Pause and ECG Artifact. The ECG rhythm strips display lead II as the top waveform and lead V1 as the bottom waveform. Classic examples are shown for each rhythm to provide basic visualization and avoid complexities. The intended use of this poster is to complement a text and/or course - in addition to a reference guide for arrhythmia recognition.

- The most common ECG rate, interval, and duration measurements are from the following publications:
- Clinical Electrocardiography (Post Graduate Institute for Medicine).
 - Understanding Electrocardiography (Mary Boudreau Conover).
 - How to Quickly and Accurately Master Arrhythmia Interpretation (Dale Davis).
 - Principles of Clinical Electrocardiography (M. J. Goldman).
 - Basic Dysrhythmias Interpretation and Management (Robert Huszar).
 - An Introduction to Electrocardiography (Leo Shamroth).
 - Interpretation of Arrhythmias (Emanuel Stein).

Arrhythmia Recognition



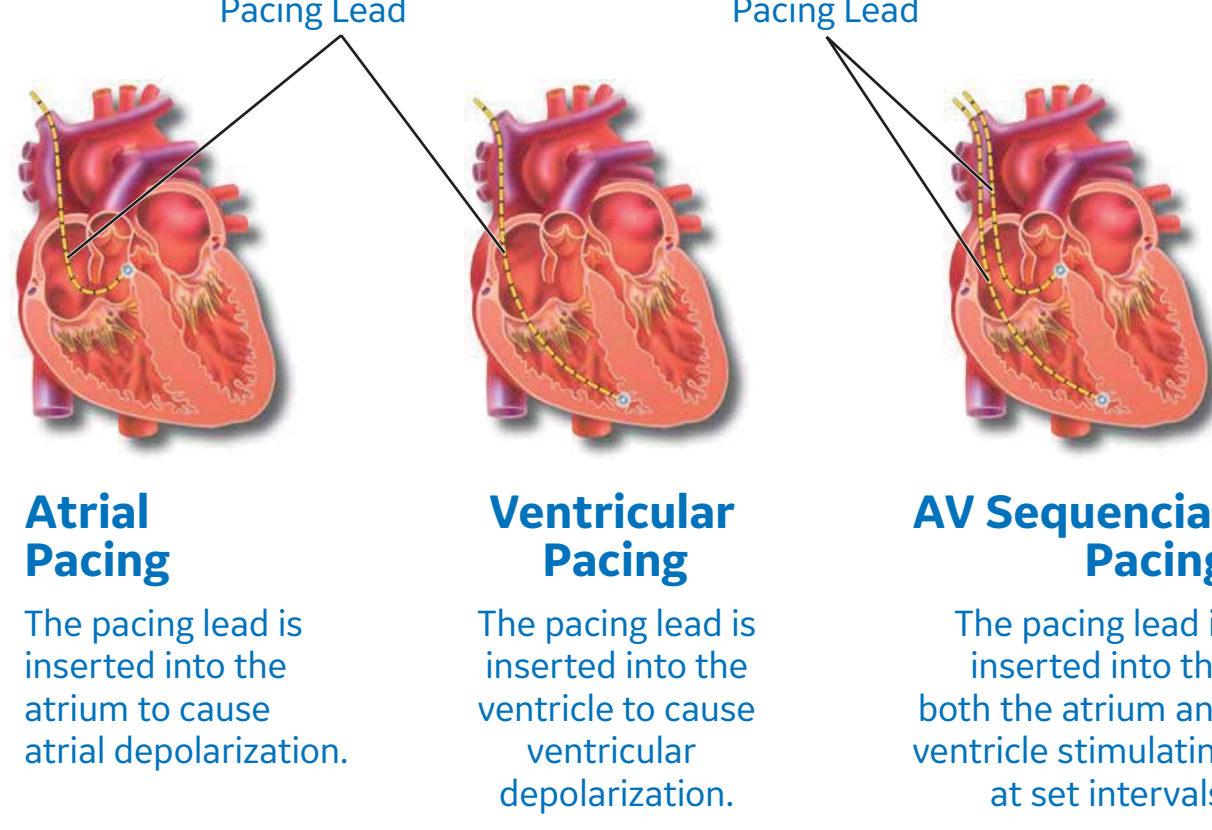
Premature Ventricular Conduction



Right Ventricular PVC

Left Ventricular PVC

Pacemaker Lead Placement



Atrial Pacing

The pacing lead is inserted into the atrium to cause atrial depolarization.

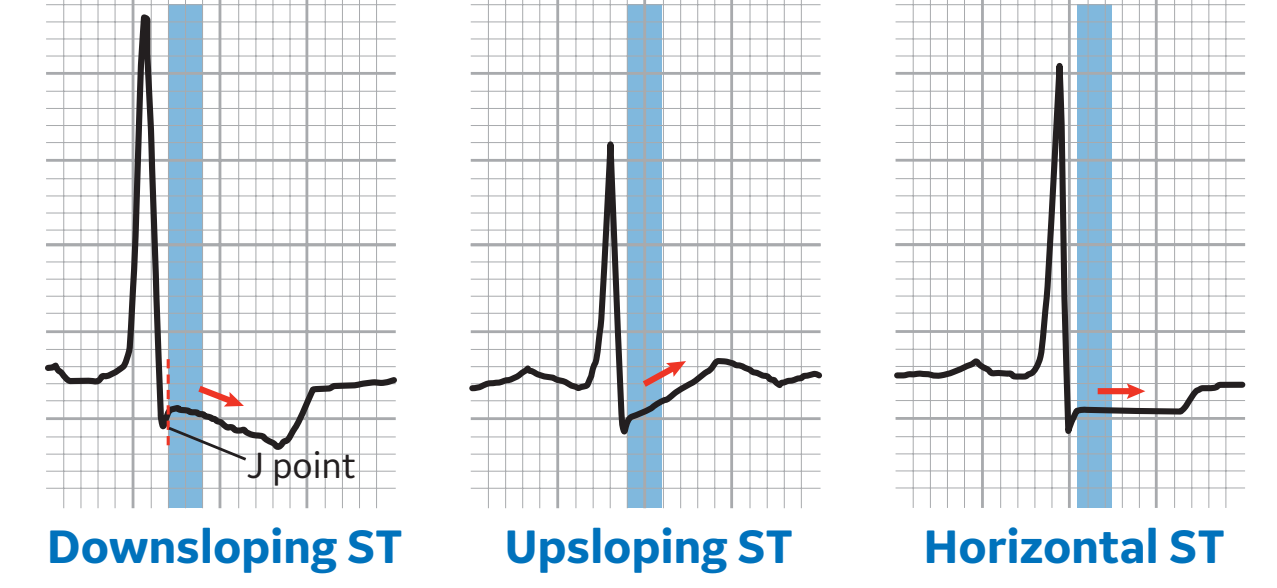
Ventricular Pacing

The pacing lead is inserted into the ventricle to cause ventricular depolarization.

AV Sequential Pacing

The pacing lead is inserted into both the atrium and ventricle stimulating at set intervals.

ST Segment Depression



Downsloping ST

Upsloping ST

Horizontal ST

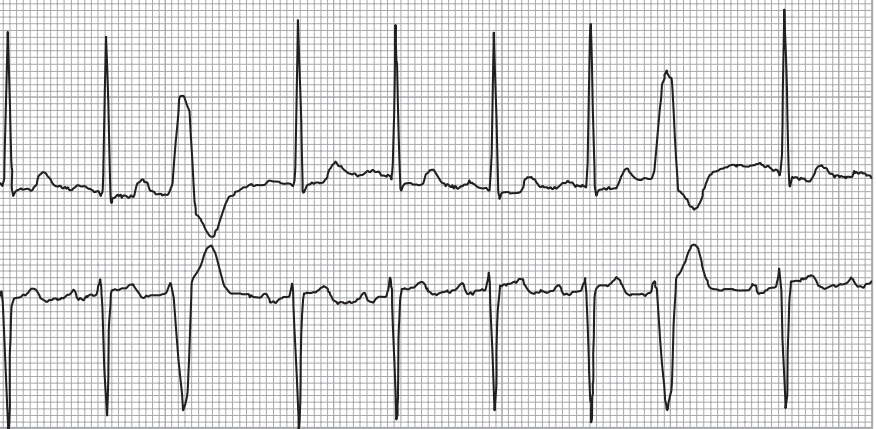
The J point occurs at the end of the QRS complex. The ST segment begins at the J point and extends to a user-defined interval.

Ventricular Rhythms

Premature Ventricular Complex - PVC

Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
N/A	Irregular with PVCs	N/A	N/A	≥ 0.12

Unifocal PVCs: Identical shapes



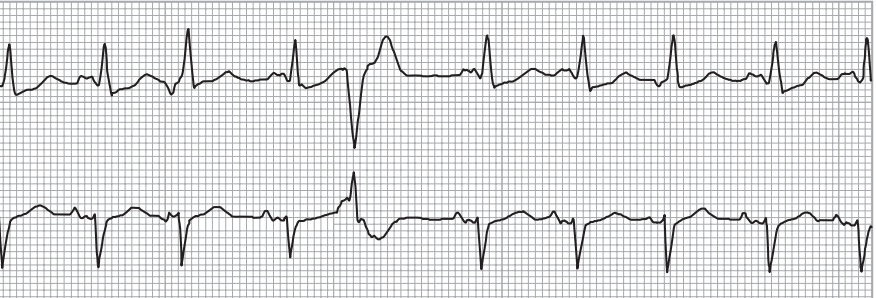
Multifocal PVCs: More than one shape



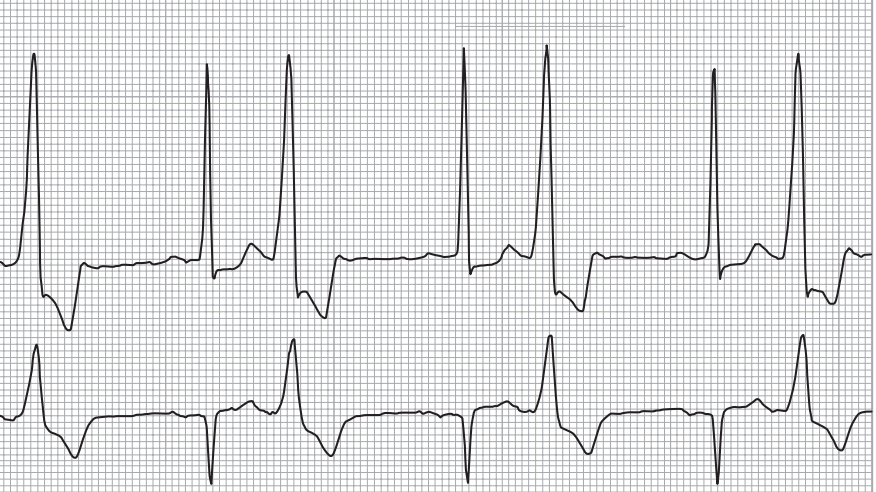
Paired PVCs (Couplet)



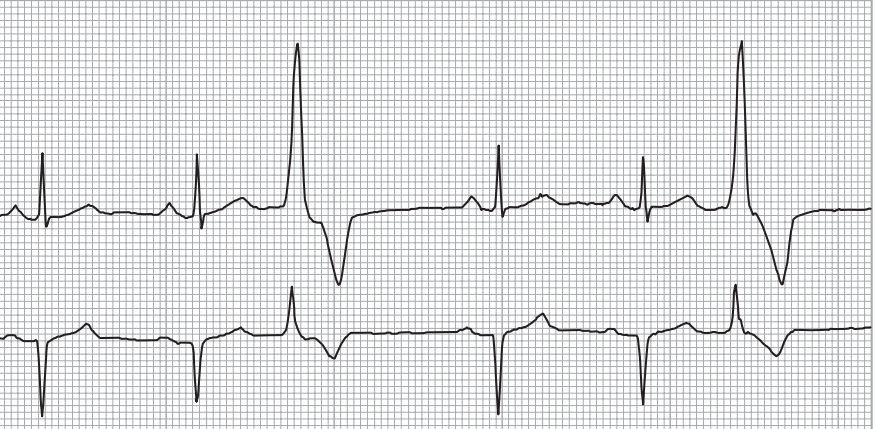
R on T Phenomenon: PVC occurs at the peak of the T wave of the preceding beat



Ventricular Bigeminy: Every other beat is a PVC



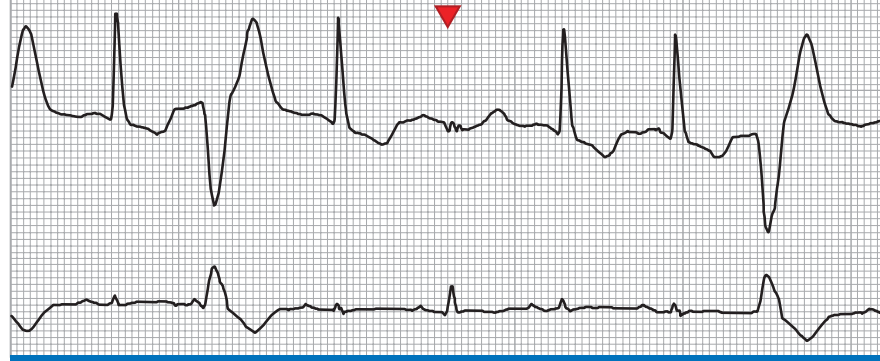
Ventricular Trigeminy: Every third beat is a PVC



Ventricular Quadrigeminy: Every fourth beat is a PVC

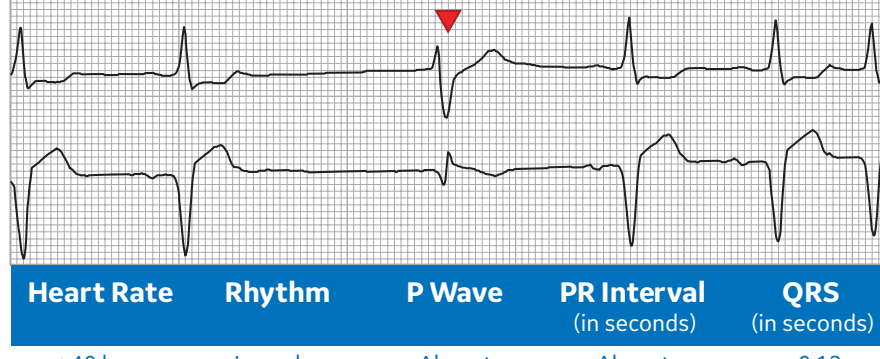


Ventricular Fusion Beat



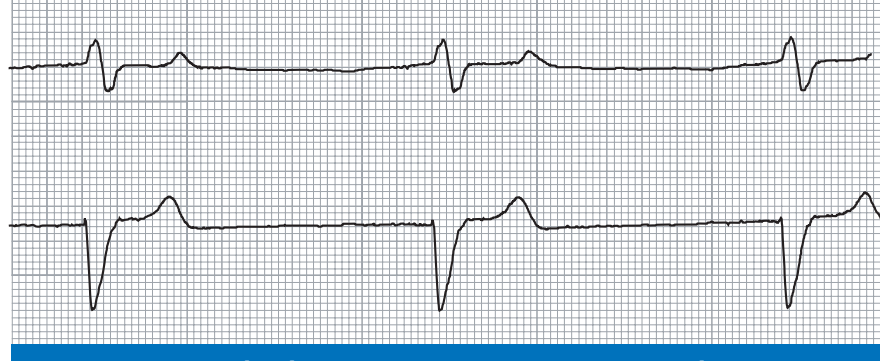
Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
N/A	N/A	Present	Same as sinus rhythm or shorter	≥ 0.12

Ventricular Escape Beat



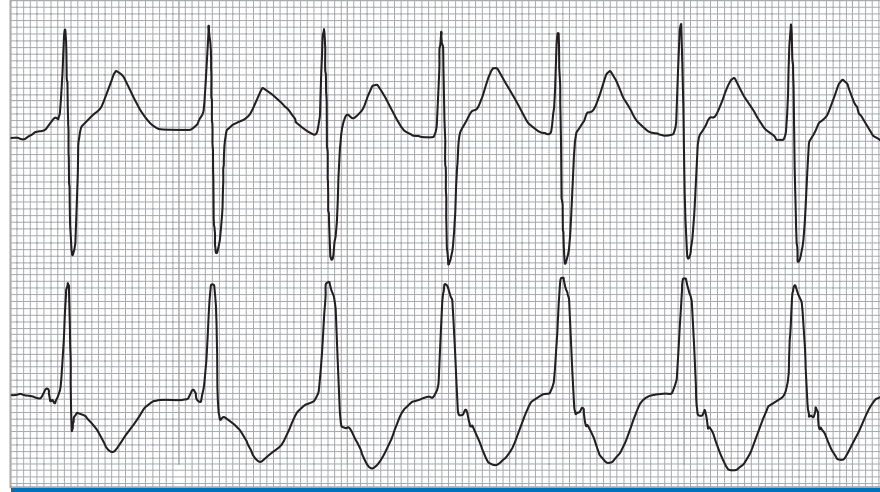
Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
< 40 bpm	Irregular	Absent	Absent	≥ 0.12

Idioventricular Rhythm



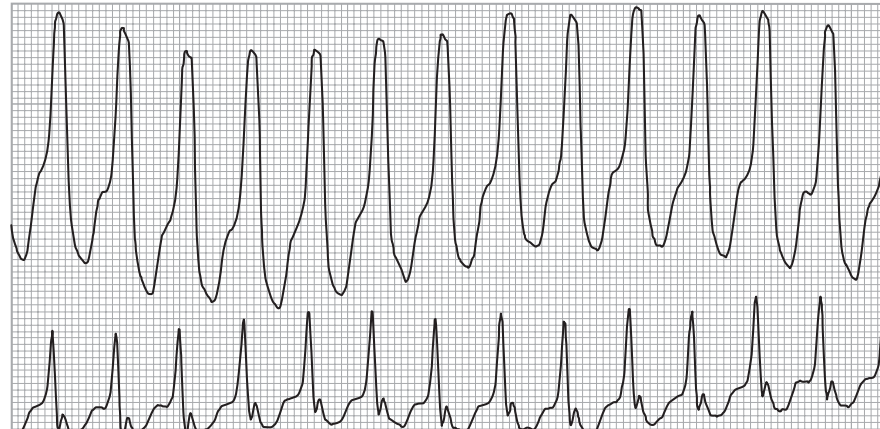
Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
20 - 40 bpm	Regular	Absent or not related	N/A	≥ 0.12

Accelerated Idioventricular Rhythm (AIVR)



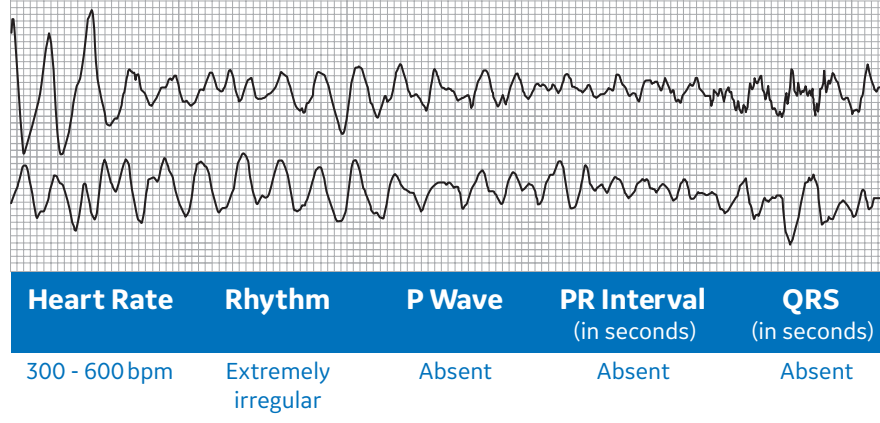
Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
40 - 100 bpm	Regular	Absent, not related or retrograde conduction	N/A	≥ 0.12

Ventricular Tachycardia (3 or more consecutive ventricular complexes)



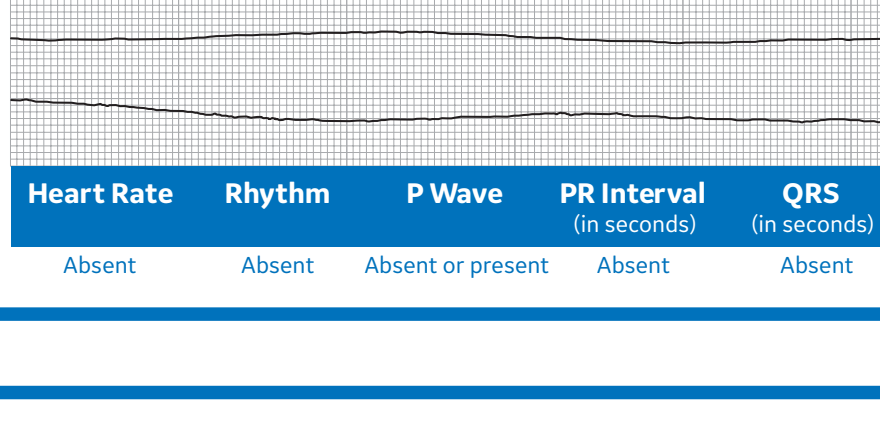
Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
> 100 bpm	Regular	Absent, not related or retrograde conduction (1:1, 1:2, or VA Wenckebach)	N/A	≥ 0.12

Ventricular Fibrillation



Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
300 - 600bpm	Extremely irregular	Absent	Absent	Absent

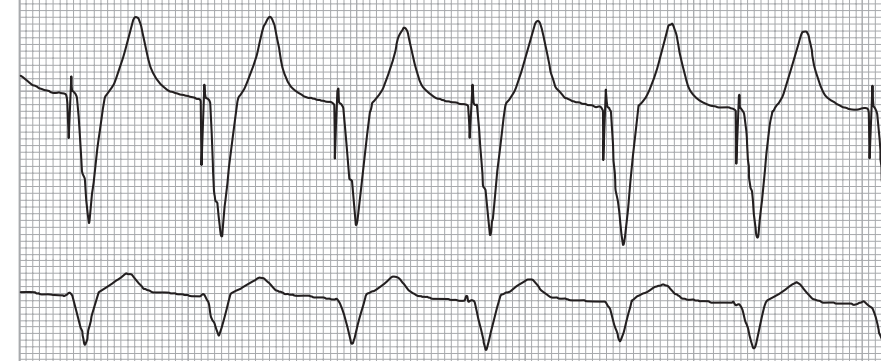
Ventricular Asystole



Heart Rate	Rhythm	P Wave	PR Interval (in seconds)	QRS (in seconds)
Absent	Absent	Absent or present	Absent	Absent

Pacemaker Rhythms

Electronic Pacemaker Spikes



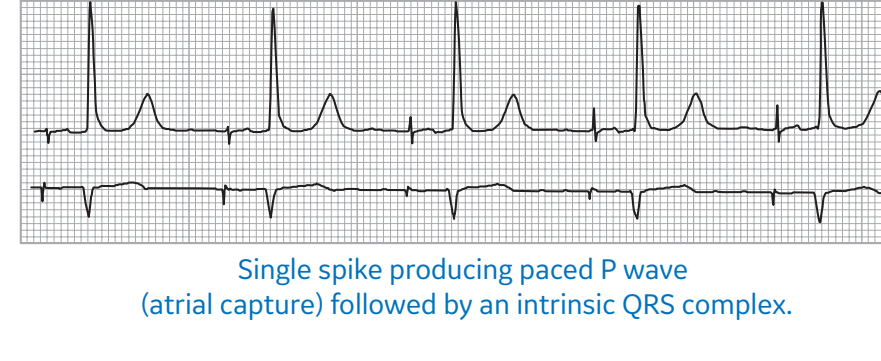
Electrical stimuli delivered by the electronic pacemaker to the endocardium are seen as a spike on the surface ECG.

Ventricular Pacemaker (single chamber)



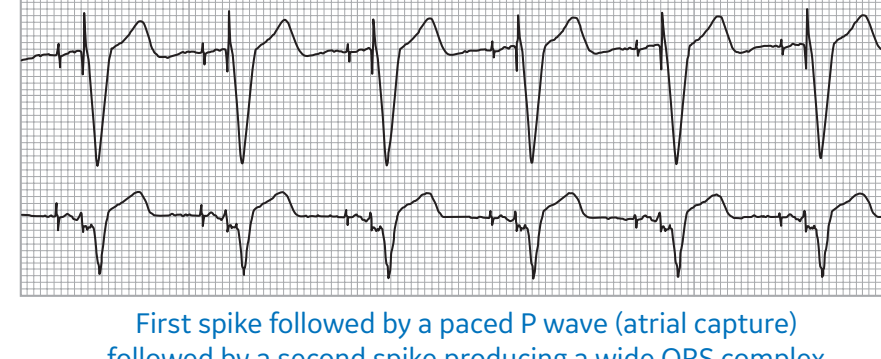
Single spike producing a wide QRS complex (ventricular capture).

Atrial Pacemaker (single chamber)



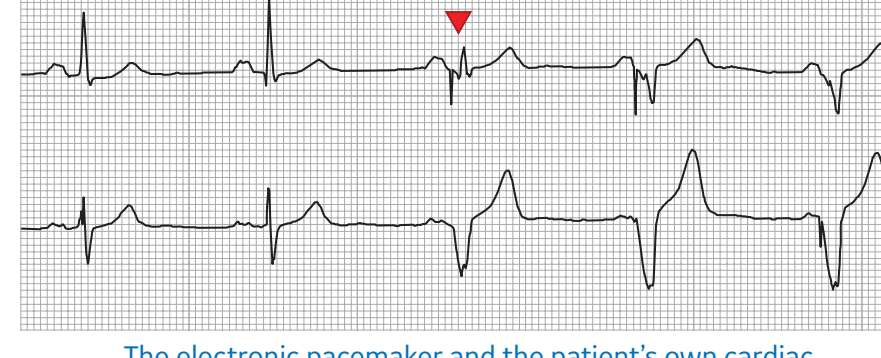
Single spike producing paced P wave (atrial capture) followed by an intrinsic QRS complex.

AV Sequential Pacemaker (dual chamber)



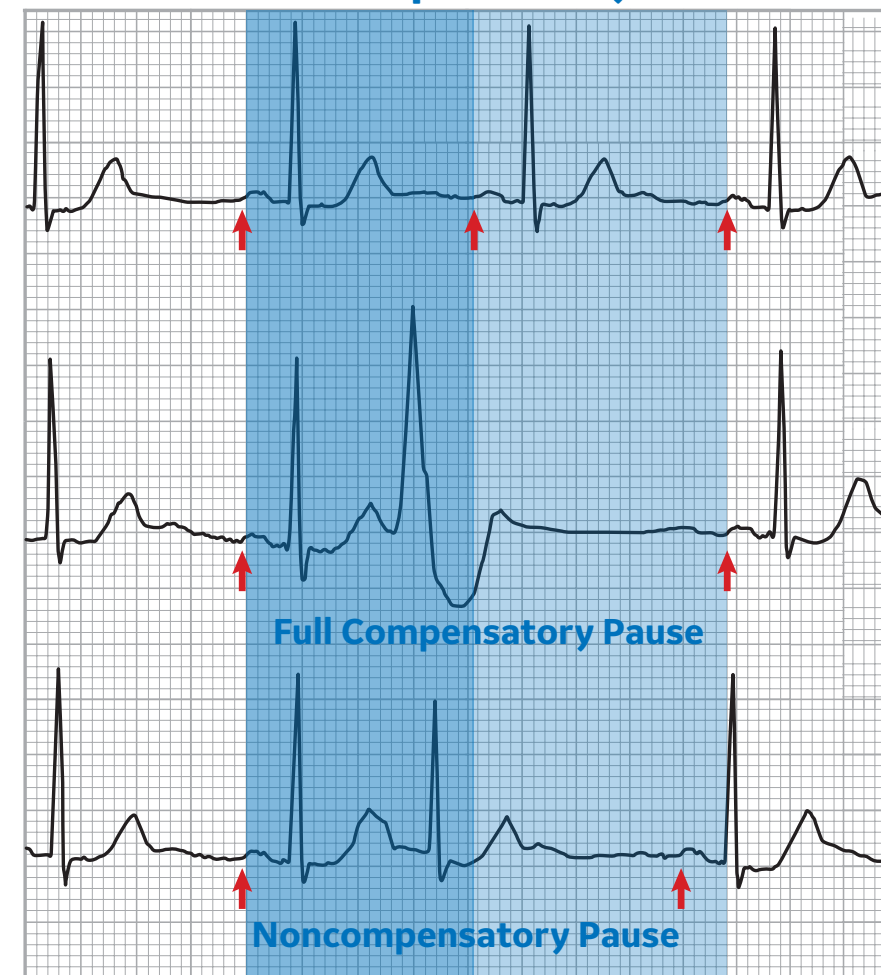
First spike followed by a paced P wave (atrial capture) followed by a second spike producing a wide QRS complex (ventricular capture).

Paced Fusion Beat



The electronic pacemaker and the patient's own cardiac rhythm occurs simultaneously producing a combination of a paced beat and an intrinsic beat.

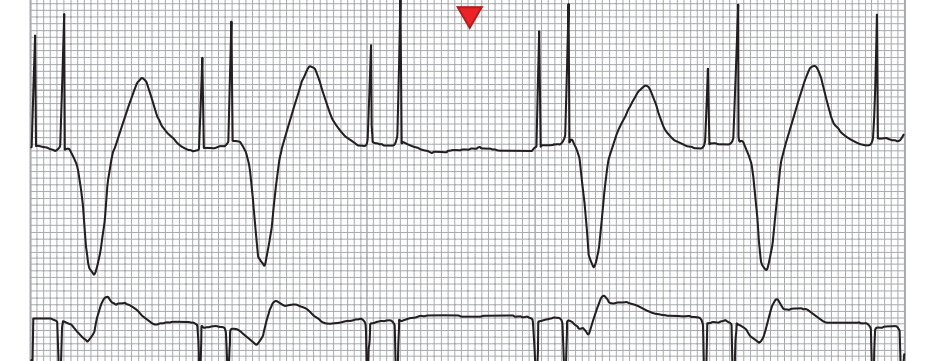
Full Compensatory Pause vs. Noncompensatory Pause



To measure a Full Compensatory Pause:

1. Mark off three normal cycles.
2. Place the first mark on the P wave of the normal cycle preceding the premature complex.
3. The third mark should fall exactly on the P wave following the premature complex to be called a compensatory pause.

Failure to Capture



The pacemaker generates a pacemaker spike but does not cause an intrinsic beat (P wave or QRS).

Failure to Sense



The pacemaker does not recognize the intrinsic beats and generates an unnecessary pacemaker spike.

Failure to Fire

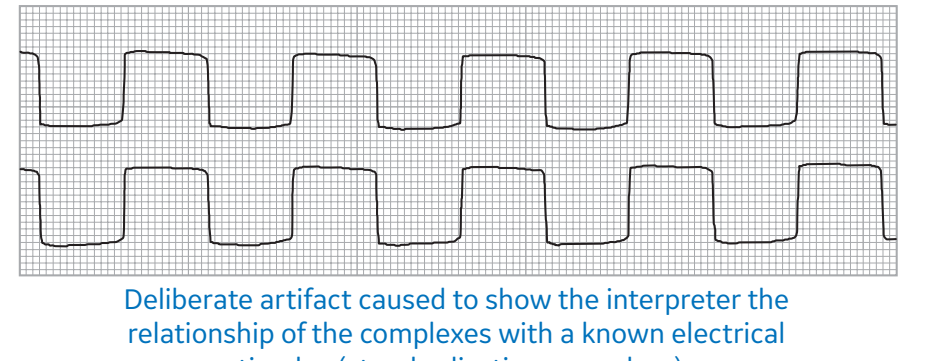


The pacemaker does not generate a pacemaker spike when it is needed.

ECG Artifact

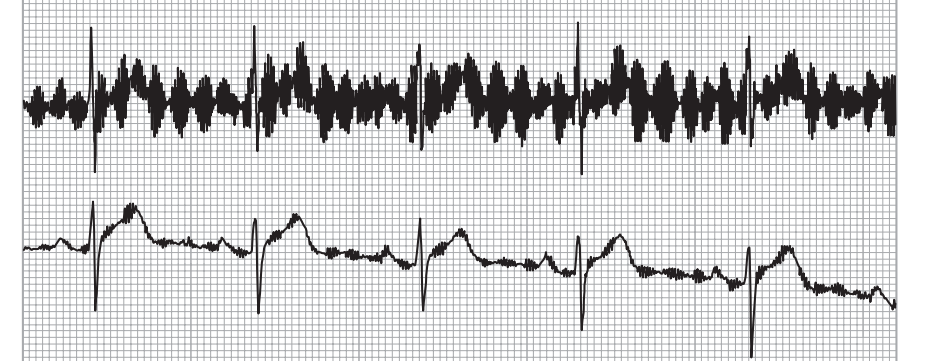
Any waveform on the ECG that is not related to the patient's cardiac events

Calibration Pulses



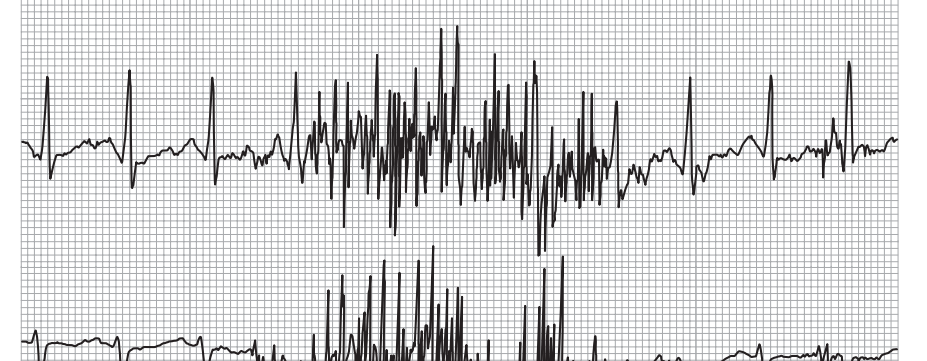
Deliberate artifact caused to show the interpreter the relationship of the complexes with a known electrical stimulus (standardization procedure).

AC Interference (60 cycle)



Sixty even, regular spikes in a one-second interval caused by electrical current near the patient.

Muscle Tremor (Somatic)



Electrical interference caused by the patient's tensed muscles.

Wandering Baseline (Draft)



An undulating baseline with waveform present.

Arrhythmia Recognition (poster 2 of 2)

This is part two of two posters to assist healthcare professionals in recognizing basic arrhythmias. According to the Practice Standards for Electrocardiographic Monitoring in Hospital Settings (Circulation. 2004;110:2721-2746) in general, the mechanisms of arrhythmias are the same in both adults and children. However, the ECG appearance of the arrhythmias may differ due to developmental issues such as heart size, baseline heart rate, sinus and AV node function, and automatic innervation.

ECG terminology and diagnostic criteria often vary from text to text and from one teacher to another. There are often several terms describing similar findings for example: Premature Atrial Contraction, Atrial Premature Complex, Atrial Extrasystole, Supraventricular Ectopic Beat, etc.) It is important to correlate the ECG interpretation with the clinical observation of the patient.

Normal ECG Standards for Children Age

	0-1y	1-3y	3-7y	7-9y	1-3mo	1-6mo	6-12mo	1-3y	3-5y	5-8y	8-12y	12-18y
Heart Rate/Min	94-158 (122)	91-158 (122)	90-166 (122)	106-182 (149)	100-179 (140)	105-185 (143)	108-169 (137)	89-152 (120)	75-137 (107)	65-133 (100)	62-130 (93)	60-120 (90)
PR Interval (seconds)	0.08-0.18 (0.107)	0.08-0.14 (0.100)	0.07-0.12 (0.100)	0.07-0.14 (0.100)	0.07-0.13 (0.098)	0.07-0.13 (0.100)	0.07-0.12 (0.100)	0.08-0.12 (0.100)	0.08-0.12 (0.100)	0.09-0.12 (0.100)	0.09-0.12 (0.100)	0.09-0.12 (0.100)
QRS Interval (seconds)	0.02-0.07 (0.05)	0.02-0.07 (0.05)	0.02-0.07 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)	0.02-0.08 (0.05)

All values 2nd - 98th percentile; numbers in parentheses, means. Adapted from *Pediatr Cardiol.* 1979;1:123.

This poster includes Premature Ventricular Conduction, Pacemaker Lead Placement, ST Segment Depression, Ventricular Rhythms, Pacemaker Rhythms, Full Compensatory Pause and ECG Artifact. The ECG rhythm Strips display lead II as the top waveform and lead V1 as the bottom waveform. Classic examples are shown for each rhythm to provide basic visualization and avoid complexities. The intended use of this poster is to complement a text and/or course - in addition to a reference guide for arrhythmia recognition.

The most common ECG rate, interval, and duration measurements are from the following publications:

- Clinical Electrocardiography (Post Graduate Institute for Medicine).
- Understanding Electrocardiography (Mary Boudreau Conover).
- How to Quickly and Accurately Master Arrhythmia Interpretation (Dale Davis).
- Principles of Clinical Electrocardiography (M. J. Goldman).
- Basic Dysrhythmias Interpretation and Management (Robert Huszar).
- An Introduction to Electrocardiography (Leo Shamroth).
- Interpretation of Arrhythmias (Emanuel Stein).