

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 leads are 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 Triangeminy: Every third beat is a PVC

Ventricular Quadrigeminy: Every fourth beat is a PVC

Ventricular Asystole

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

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, 2:1, or VA Wenckebach	N/A	≥ 0.12

Ventricular Fibrillation

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

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.

Full Compensatory Pause vs. Noncompensatory Pause

Full Compensatory Pause

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.

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 (Drift)

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 autonomic 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)	94-159	91-158	90-166	106-182	120-179	105-185	108-169	89-152	73-137	65-133	62-130	60-120
PR Interval (seconds)	0.08-0.16	0.08-0.14	0.07-0.13	0.07-0.14	0.09-0.16	0.09-0.16	0.09-0.16	0.08-0.15	0.08-0.14	0.09-0.16	0.09-0.17	0.09-0.18
QRS Interval (seconds)	0.02-0.07	0.02-0.07	0.02-0.07	0.02-0.08	0.02-0.08	0.02-0.08	0.02-0.08	0.03-0.08	0.03-0.07	0.03-0.08	0.04-0.09	0.04-0.09
Lead V1 (seconds)	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.061	0.061	0.061	0.061	0.071

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 Electrocardiology (Mary Boultree Conover).
- How to Quickly and Accurately Master Arrhythmia Interpretation (Dale Davis).
- Principles of Clinical Electrocardiology (M. J. Goldman).
- Basic Dysrhythmias Interpretation and Management (Robert Huzar).
- An Introduction to Electrocardiology (Leo Shamroth).
- Interpretation of Arrhythmias (Emanuel Sieni).