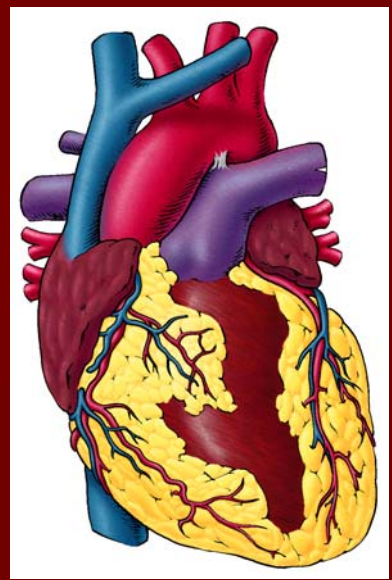
Understanding ECG's

February 2003

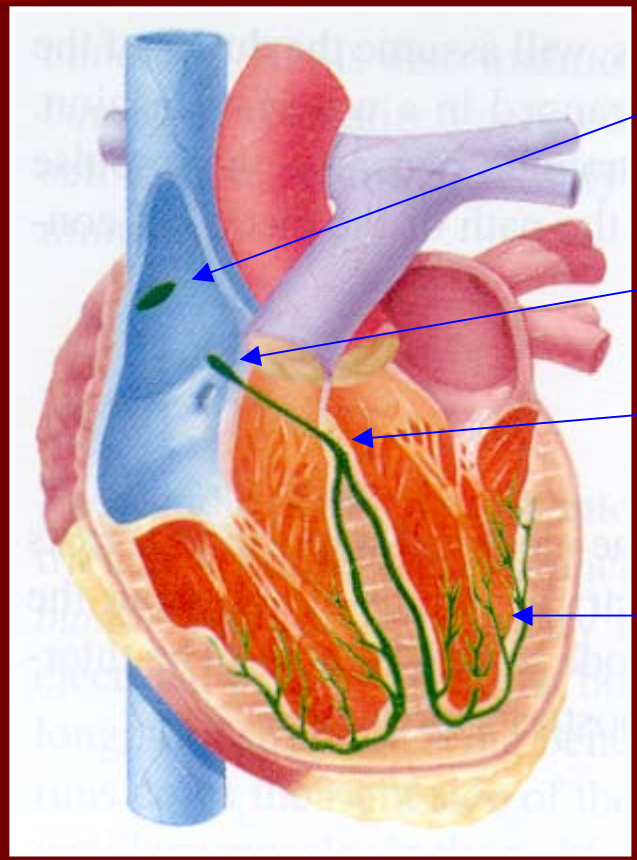
Flight Medic Course (ACLS)



Objectives

- Describe the basic approach to interpretation of ECG strips
- Explain the five steps used in interpretation of ECG strips
- Explain how to calculate heart rate, PRI, and QRS complex, given a 6-second strip
- Identify different types of ECG strips pertaining to ACLS

The Electrical Conduction System



The Electrical Conduction System

- SA node: Fastest rate of automaticity. “Primary” pacemaker of the heart.
  - Rate: 60 to 100 bpm
- AV node: Has a delay which allows for atrial contraction and a more filling of the ventricles.
  - Rate: 40-60 bpm

The Electrical Conduction System

- Bundle of His: Has the ability to self-initiate electrical activity
  - Rate: 40-60 bpm
- Purkinje Fibers: Network of fibers that carry an electrical impulses directly to ventricular muscle cells.
  - Rate: 20-40 bpm

Information Obtainable from ECG Rhythm Strip Analysis

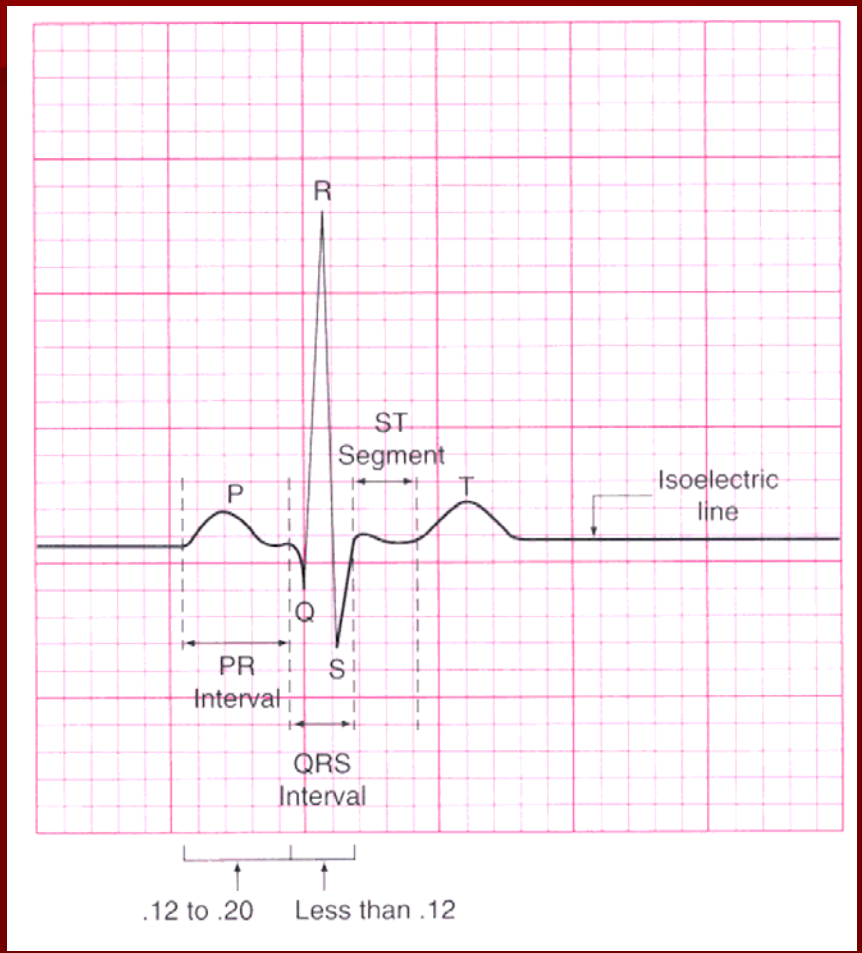
TABLE 5-1 INFORMATION OBTAINABLE FROM EKG RHYTHM STRIP ANALYSIS

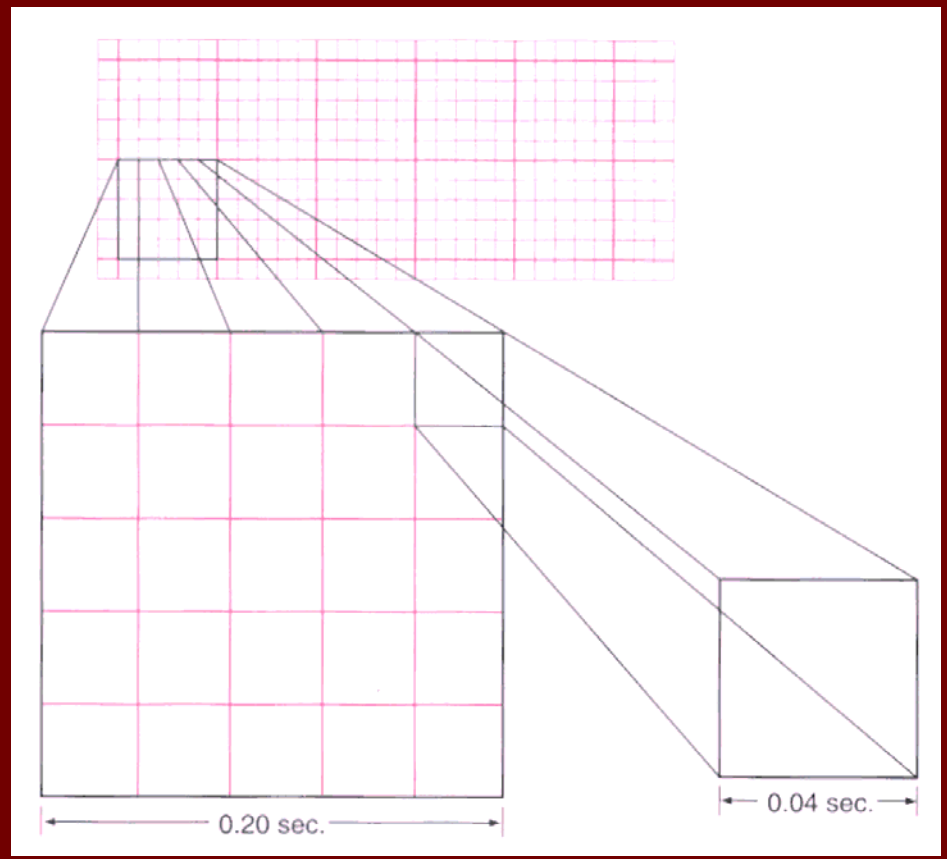
Heart rate	Yes	
Rhythm/regularity	Yes	
Impulse conduction time intervals	Yes	
Abnormal conduction pathways	Yes	
Pumping action		No
Cardiac output		No
Blood pressure		No
Cardiac muscle hypertrophy		No

The Electrocardiogram

- Defines the graphic representation of the electrical activity of the heart
- The printed record of the electrical activity of the heart is called a rhythm strip or an ECG strip.

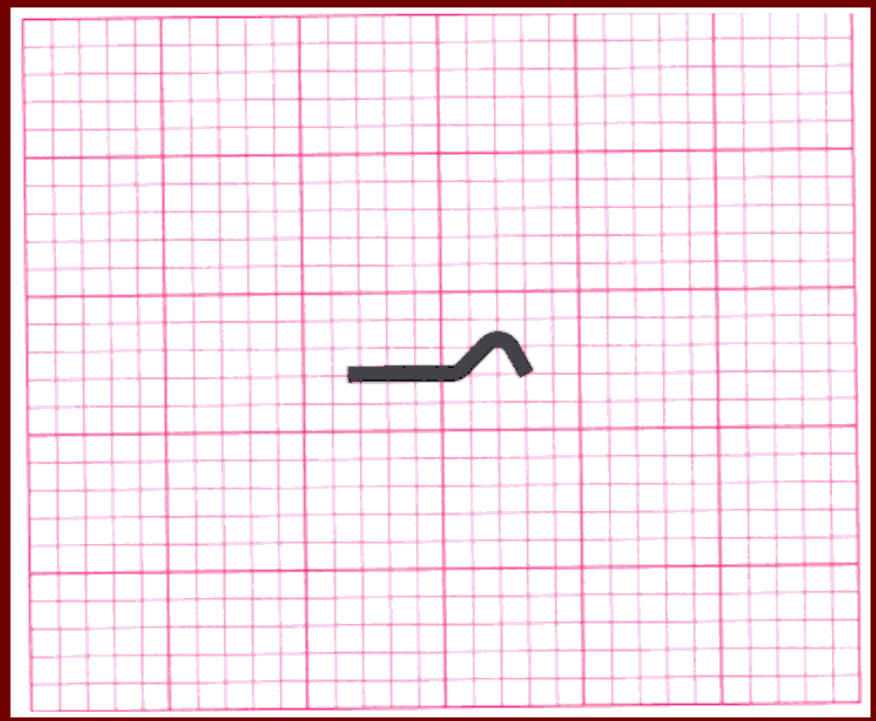
Breakdown of an ECG





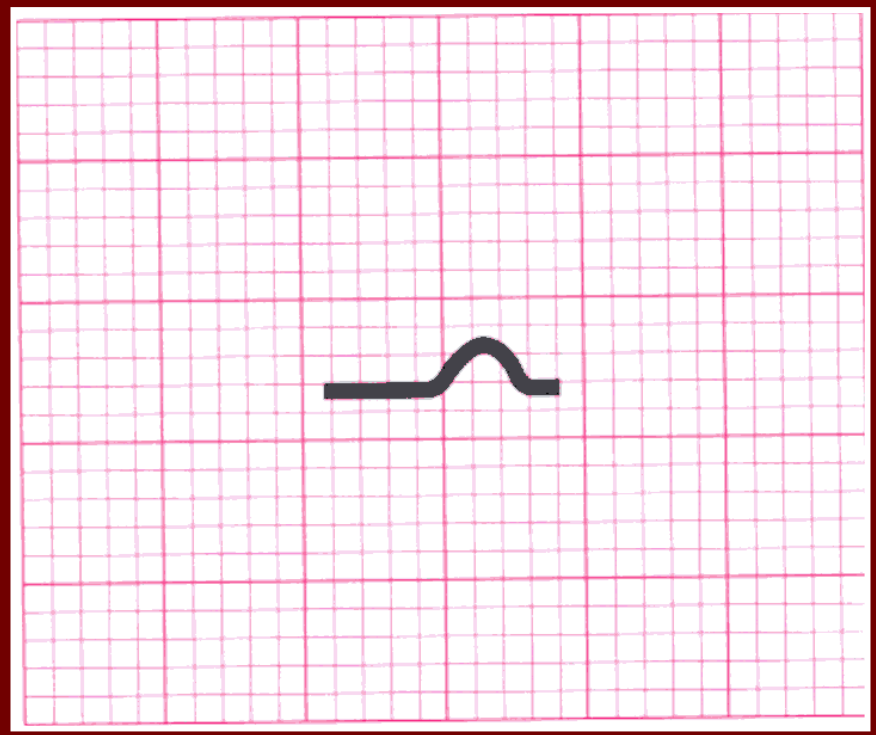
Breakdown of an ECG

- P-Wave
  - SA node fires, sends the electrical impulse outward to stimulate both atria and manifests as a P-wave.
  - Approximately 0.10 seconds in length



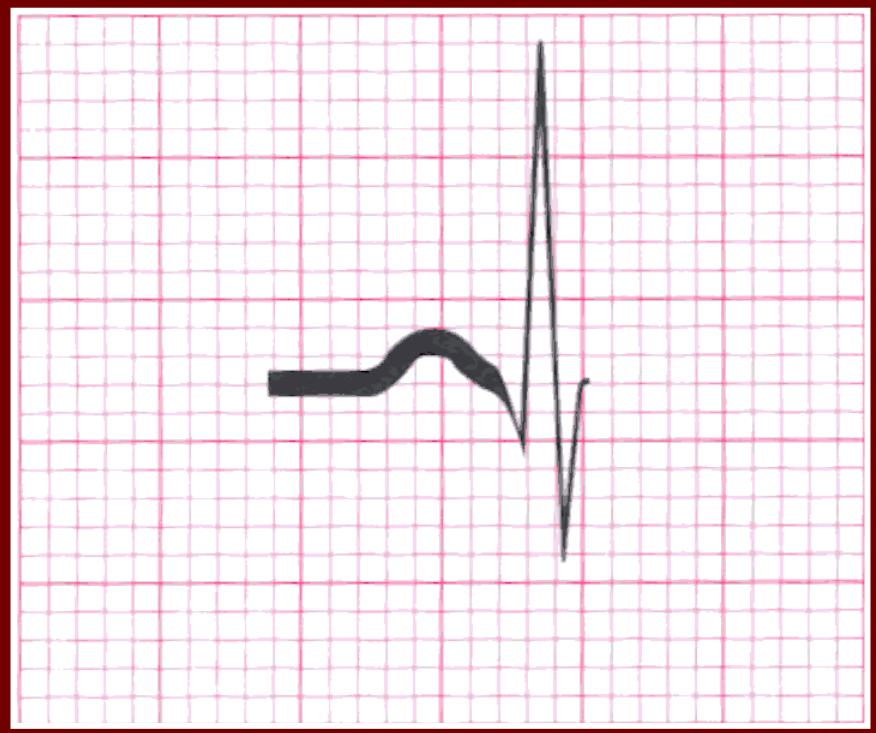
Breakdown of an ECG

- PR Interval (PRI)
  - Time which impulse travels from the SA node to the atria and downward to the ventricles



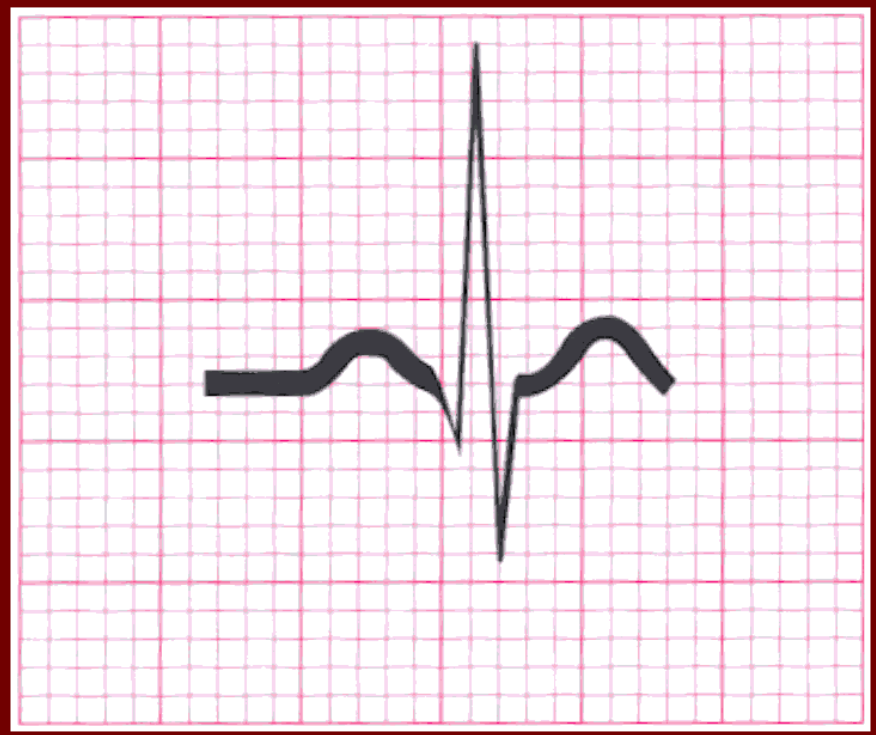
Breakdown of an ECG

- QRS Complex
  - Impulse from the Bundle of HIS throughout the ventricular muscles
  - Measures less than 0.12 seconds or less than 3 small squares on the ECG paper



Breakdown of an ECG

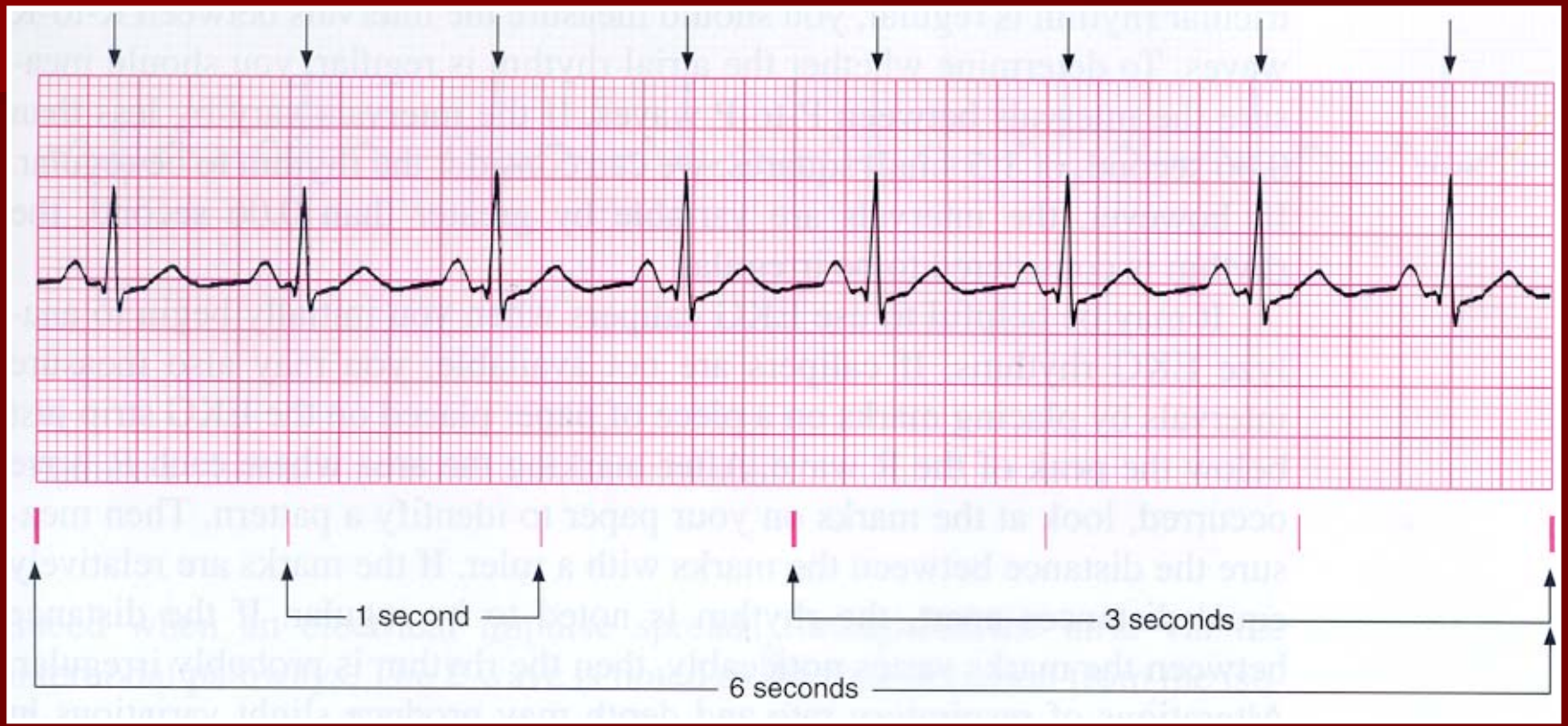
- T-Wave:
  - Ventricular repolarization, meaning no associated activity of the ventricular muscle
  - Resting phase of the cardiac cycle



Interpretation of an ECG Strip

- Step 1: Heart Rate
- Step 2: Heart Rhythm
- Step 3: P-Wave
- Step 4: PRI
- Step 5: QRS Complex

Heart Rate



- 6-Second Method: Have a six second strip, count the QRS complexes and multiple by 10.

Heart Rate

- What is the rate on this rhythm strip?

Heart Rhythm

- Heart rhythm are classified as regular or irregular.
- Can calculate the heart rhythm involves establishing a pattern of QRS complexes occurrence.
- Measure ventricular rhythm by measuring the interval between R-to-R waves and atrial rhythm by measuring the P-to-P waves.
- Interval > than 0.06 seconds, irregular.

The P-Wave

- 5 questions:
  - 1. Are P-Waves present?
  - 2. Are P-Waves occurring regularly?
  - 3. Is there a P-Wave for each QRS?
  - 4. Are the P-Waves smooth, rounded, and upright in appearance, or are they inverted?
  - 5. Do all P-Waves look similar?

The PRI

- Normal length of the PRI is 0.12 to 0.20 second (3-5 small squares)
- 3 Questions to ask:
  - 1. Are PRI greater that 0.20 seconds?
  - 2. Are PRI less than 0.12 seconds?
  - 3. Are the PRI's constant across the ECG strip?

The QRS Complex

- 3 questions to ask:
  - 1. Are QRS intervals greater than 0.12 second (wide)? If so, the complex may be ventricular in orgin.
  - 2. Are QRS intervals less than 0.12 seconds (narrow)? If so, the complex is most likely supraventricular in origin.
  - 3. Are QRS complexes similar in appearance across the ECG strip?

First Rhythm Strip to Identify

Tricky

Artifact

- Step 1: Heart Rate
- Step 2: Heart Rhythm
- Step 3: P-Wave
- Step 4: PRI
- Step 5: QRS Complex

Artifact

- Four Common Causes:
  - Patient Movement
  - Loose or defective electrodes
  - Improper grounding
  - Faulty ECG apparatus
- Patient assessment is critical

Enough playing!

Types of Rhythms

- Rate:
  - Bradycardia = rate of <60 bpm
  - Normal = rate of 60-100 bpm
  - Tachycardia = rate of >100-160 bpm
- Where its coming from:
  - Sinus; SA node
  - Atrial; SA node fails, impulse comes from the atria (internodal or the AV node)
  - Ventricular; SA node or AV junction fails, ventricles will shoulder responsibility of pacing the heart

Sinus Rhythms

- Normal Sinus Rhythm (NSR)
- Sinus Bradycardia
- Sinus Tachycardia

NSR Rhythm

TABLE 7-3 NORMAL SINUS RHYTHM

Question 1–5

What is the rate?	60–100 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Yes Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Less than 0.12 sec (3 small squares)

Sinus Bradycardia Rhythm

TABLE 7-4 SINUS BRADYCARDIA RHYTHM

Questions 1–5

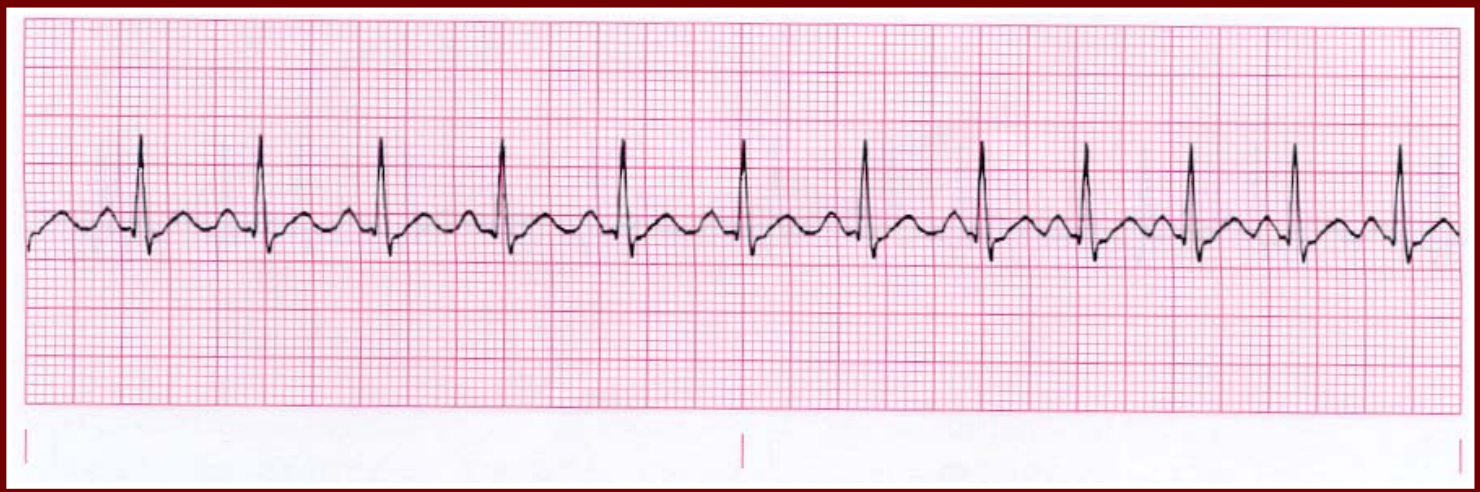
What is the rate?	LESS THAN 60 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Yes Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Less than 0.12 sec (3 small squares)

Sinus Tachycardia Rhythm

TABLE 7-5 SINUS TACHYCARDIA RHYTHM

Questions 1–5

What is the rate?	100–160 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS?	Yes
Are the P waves upright and uniform?	Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is . . . ?	Less than 0.12 sec (3 small squares)



Atrial Rhythms

- SA node fails to generate an impulse, the atrial tissue or areas in the internodal pathways may initiate an impulse.
- These are called atrial dysrhythmias
- Generally not considered life-threatening or lethal careful and deliberate patient assessment must be continuous.

Types of Atrial Rhythms

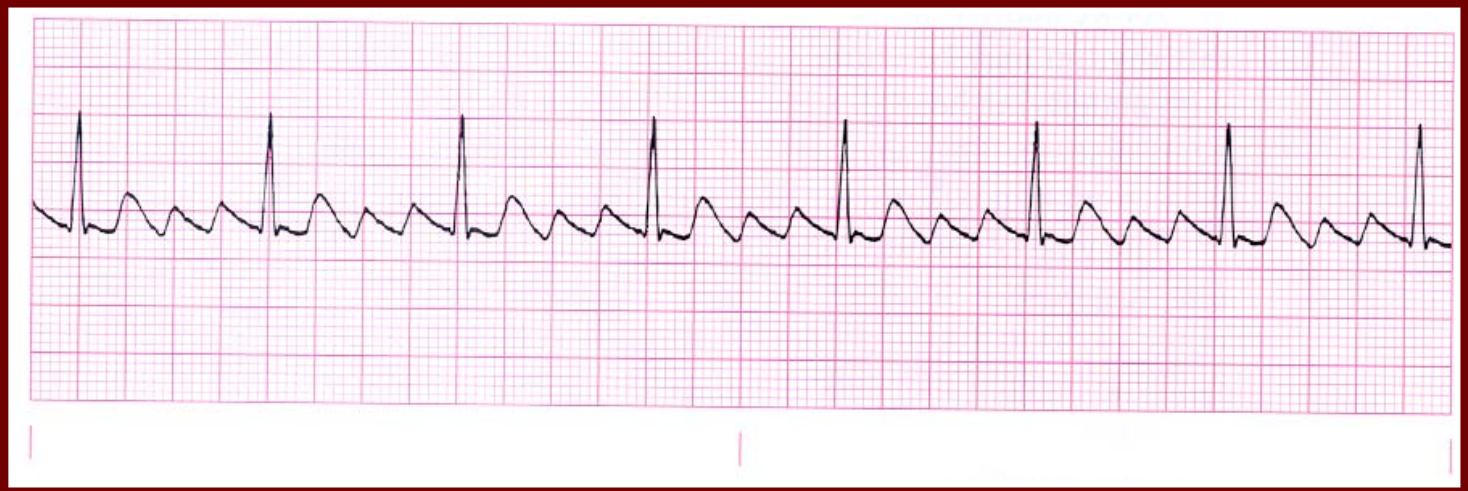
- Atrial Flutter
- Atrial Fibrillation
- Supraventricular Tachycardia

Atrial Flutter

TABLE 8-3 ATRIAL FLUTTER

Questions 1–5

What is the rate?	Atrial—250–300 BPM Ventricular—variable
What is the rhythm?	Atrial—regular Ventricular—regular or irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Normal P waves are absent; replaced by F waves (sawtooth)
What is the length of the PR interval?	Not measurable
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is?	Usually less than 0.12 sec (3 small squares)



Atrial Fibrillation

TABLE 8-4 ATRIAL FIBRILLATION

Questions 1–5

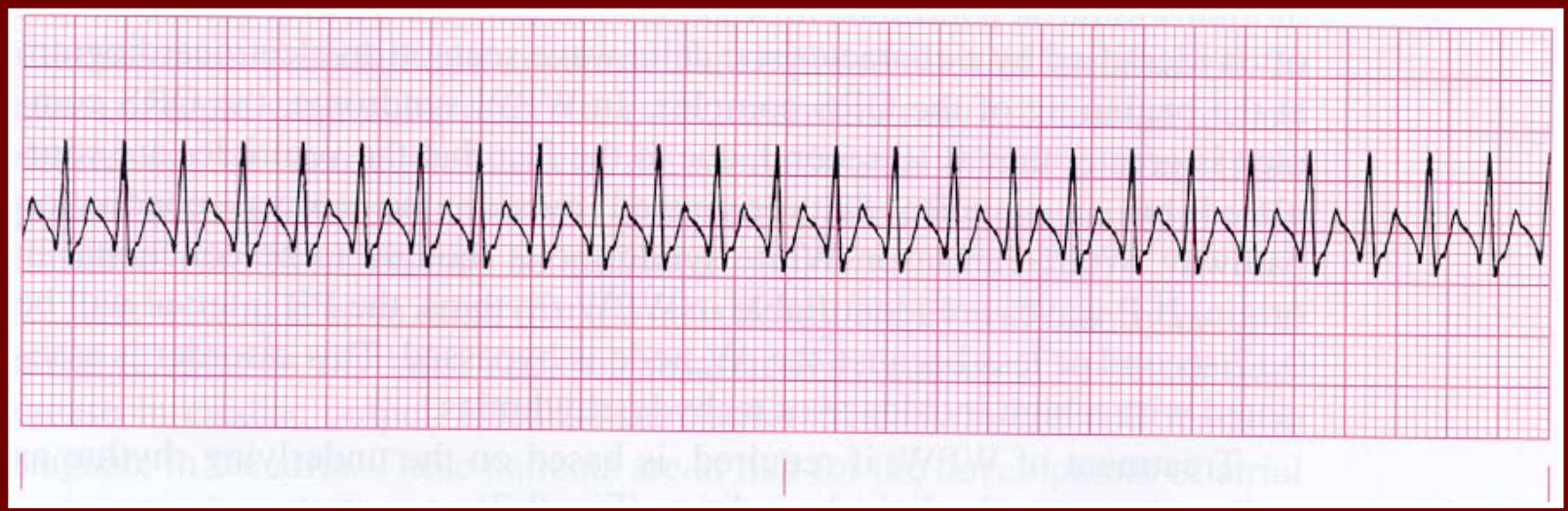
What is the rate?	Atrial—350–400 BPM Ventricular—variable
What is the rhythm?	Irregularly irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Normal P waves are absent; replaced by f waves
What is the length of the PR interval?	Not discernable
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Usually less than 0.12 sec

Supraventricular Tachycardia

TABLE 8-5 SUPRAVENTRICULAR TACHYCARDIA

Questions 1–5

What is the rate?	Atrial—150–250 BPM Ventricular—150–250 BPM
What is the rhythm?	Regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Usually not discernable, especially at the high-rate range
What is the length of the PR interval?	Usually not discernable
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Usually less than 0.12 sec



Ventricular Rhythms

- SA node or the AV junctional tissue fails to initiate an electrical impulse, the ventricles will shoulder the responsibility of pacing the heart.
- This group of rhythms are called ventricular dysrhythmias.
- An electrical impulse can be instigated from any pacemaker cell in the ventricles, including the bundle branches or the fibers of the Purkinje fibers.

Types of Ventricular Rhythms

- Premature Ventricular Complexes
- Ventricular Tachycardia
- Torsades de Pointes
- Ventricular Fibrillation
- Asystole
- Pulseless Electrical Activity (PEA)

Premature Ventricular Complexes (PVCs)

TABLE 10-3 PREMATURE VENTRICULAR COMPLEXES

Questions 1–5

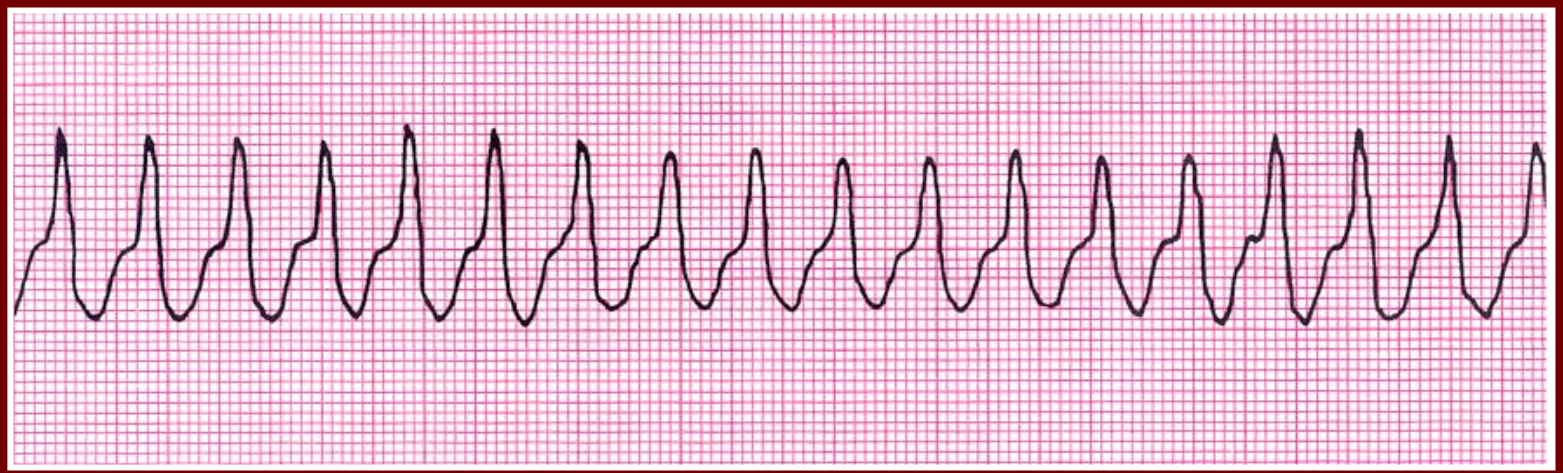
What is the rate?	Dependent on rate of underlying rhythm and number of PVCs
What is the rhythm?	Occasionally irregular; regular if interpolated PVC
Is there a P wave before each QRS? Are the P waves upright and uniform?	No P waves associated with PVC; P waves of underlying rhythm may be present
What is the length of the PR interval?	PRI not present with PVCs
The length of the QRS complexes is . . . ? What do the QRS complexes look like?	Greater than or equal to 0.12 sec (3 small squares); usually wide and bizarre

Ventricular Tachycardia

TABLE 10-5 VENTRICULAR TACHYCARDIA RHYTHM

Questions 1–5

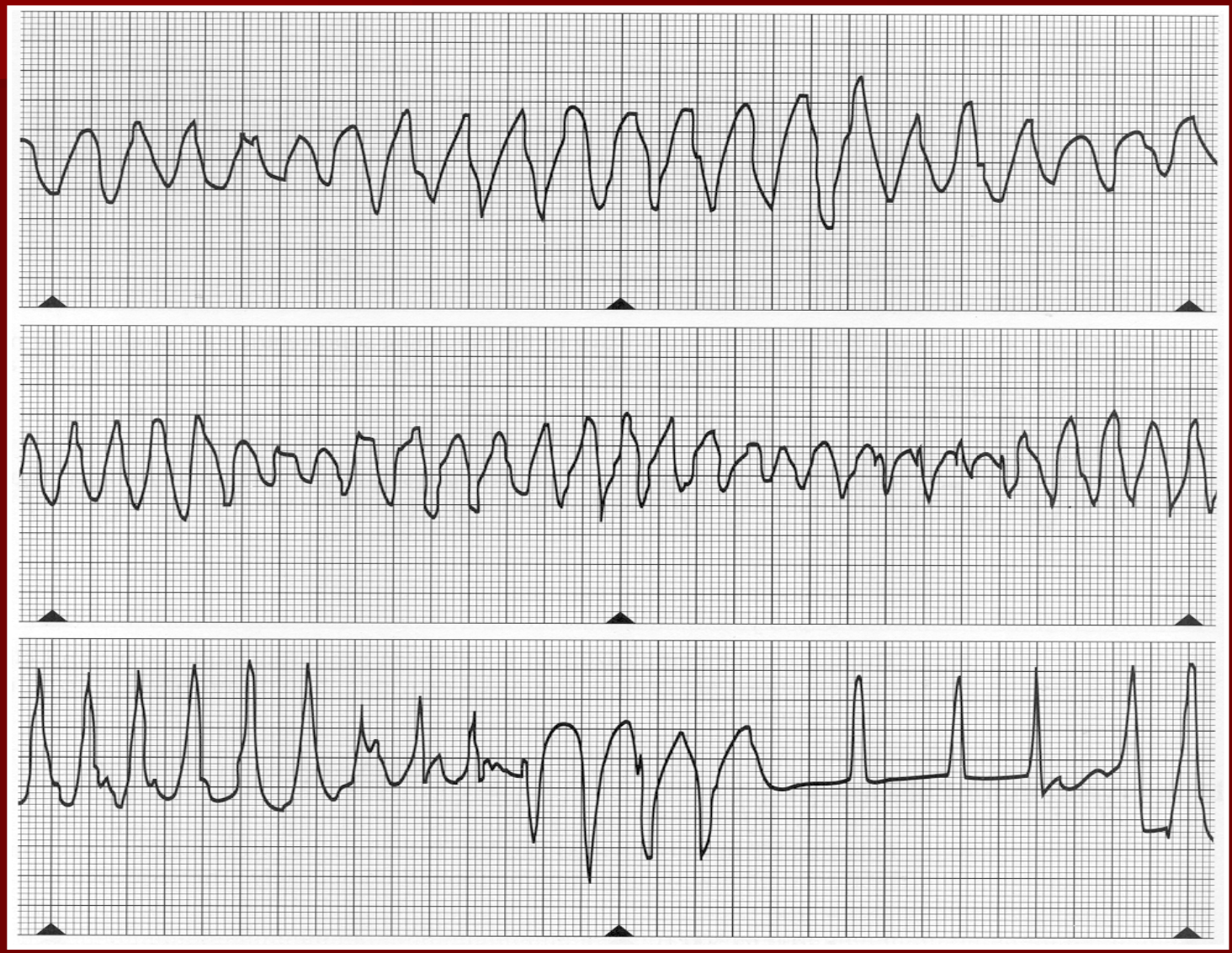
What is the rate?	100–250 BPM
What is the rhythm?	Atrial rhythm not distinguishable Ventricular rhythm usually regular
Is there a P wave before each QRS?	May be present or absent; not associated with QRS complexes
What is the length of the PR interval?	None
Do all the QRS complexes look alike?	Yes (except in torsades rhythm); bizarre QRS morphology
The length of the QRS complexes is . . . ?	Greater than 0.12 sec



Torsades de Pointes

- French term that signifies the “twisting of the points”.
- May wax and wane in amplitude and may “flip” or “twist” on its electrical axes.
- Similar to ventricular tachycardia
- Caused by hypomagnesemia or by antiarrhythmic drugs

Torsades de Pointes

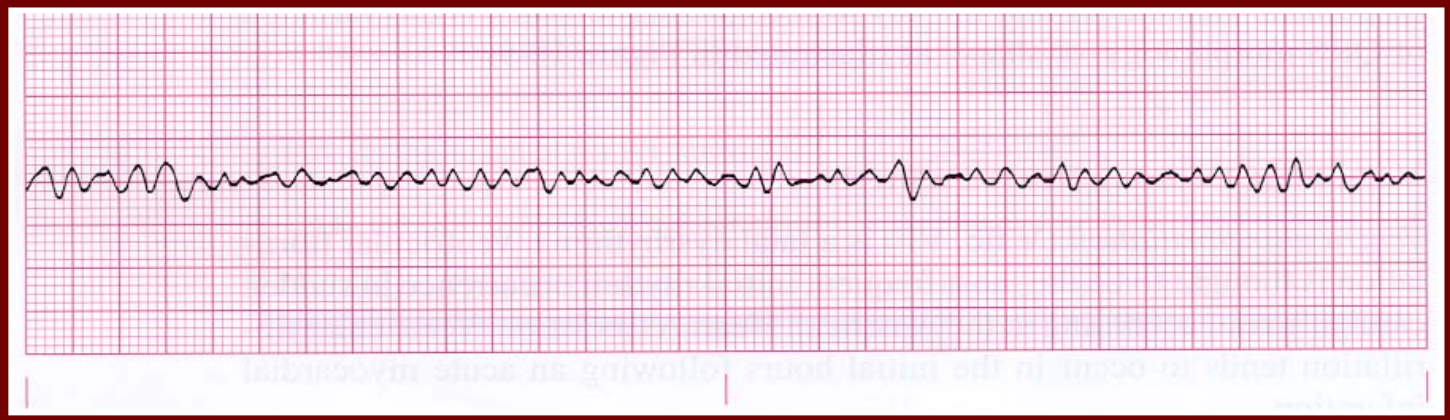


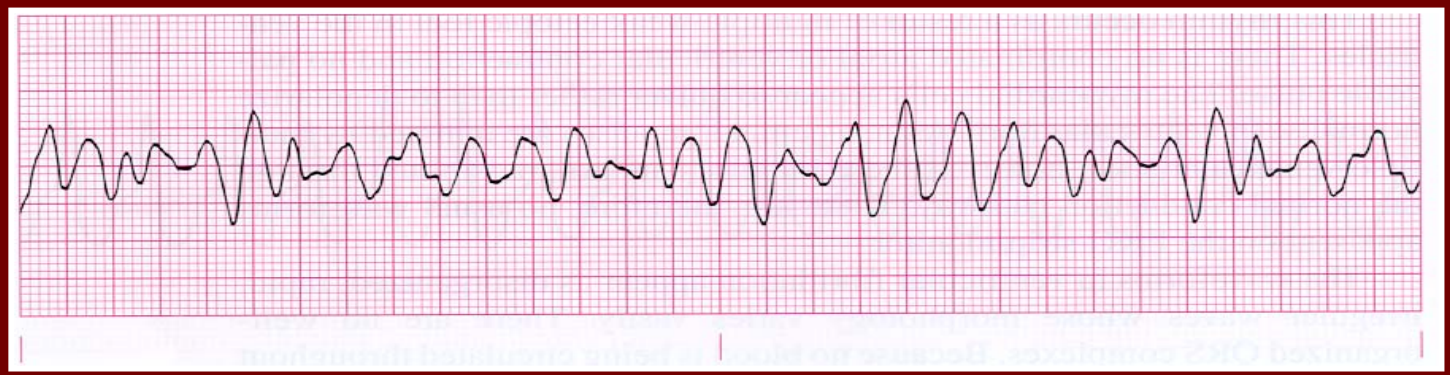
V. Fibrillation

TABLE 10-6 VENTRICULAR FIBRILLATION

Questions 1–5

What is the rate?	Rate cannot be discerned
What is the rhythm?	Rapid, unorganized Rhythm not distinguishable
Is there a P wave before each QRS?	No
What is the length of the PR interval?	None present
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	None present



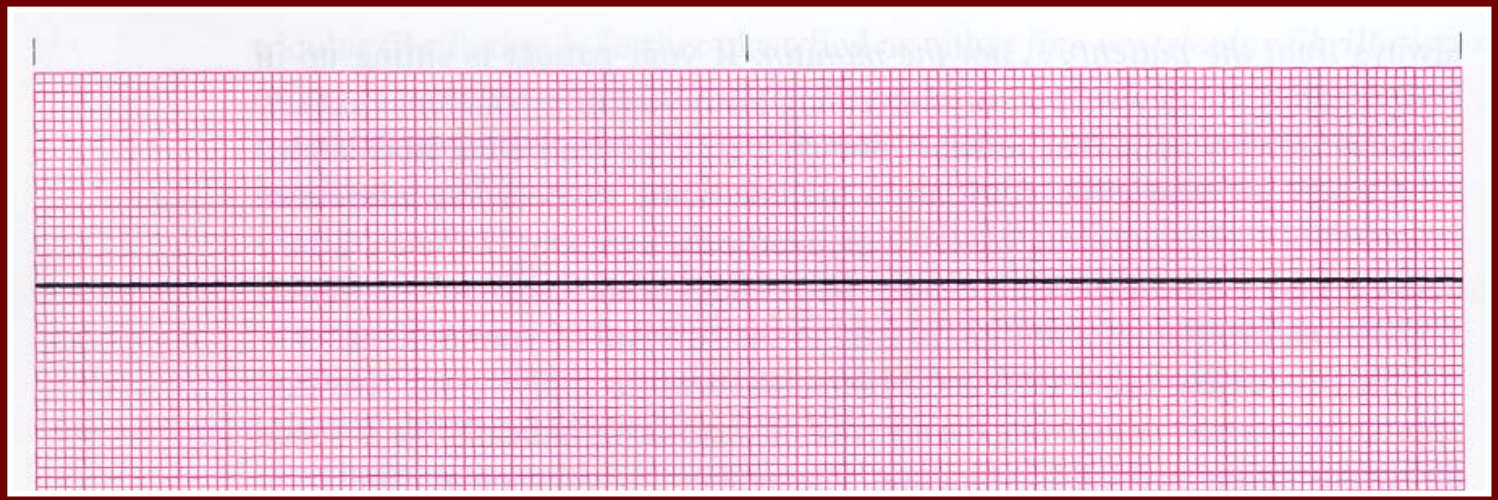


Asystole

TABLE 10-7 VENTRICULAR ASYSTOLE

Questions 1–5

What is the rate?	Absent
What is the rhythm?	Absent Rhythm not distinguishable
Is there a P wave before each QRS?	No
What is the length of the PR interval?	None present
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	None present



Pulseless Electrical Activity (PEA)

- The absence of a palpable pulse and myocardial muscle activity with the presence of organized electrical activity (excluding VT and VF) on cardiac monitor.
- It is **not** an actual rhythm, it represents a clinical condition wherein the patient is clinically dead, despite the fact that some type of organized rhythm appears on the monitor.

Types of Heart Blocks

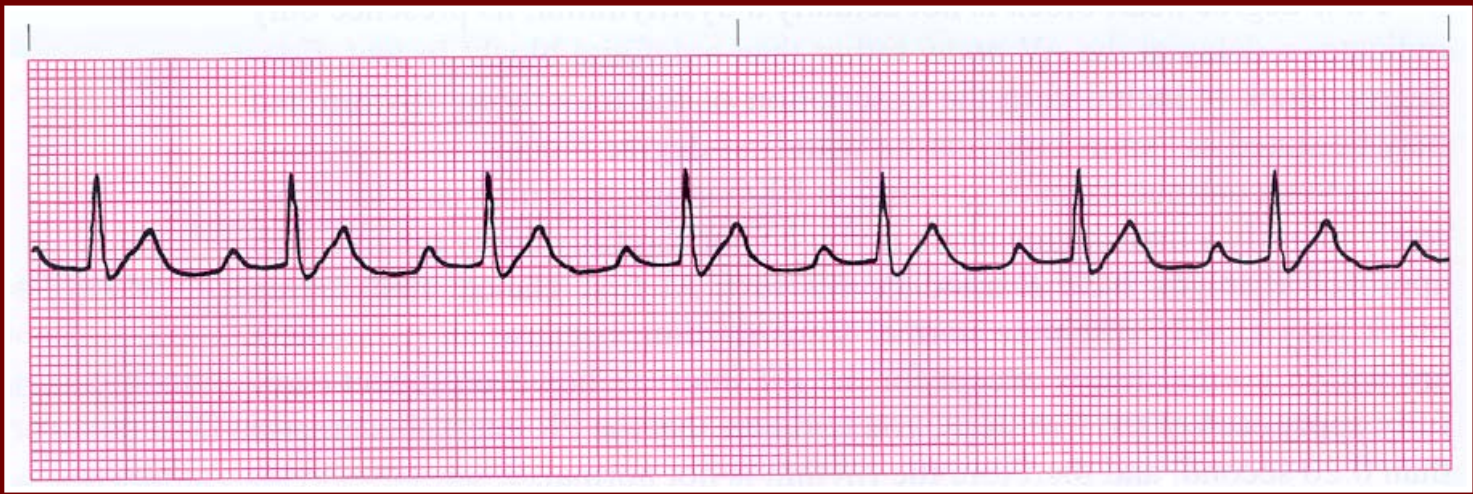
- First Degree AV Block
- Second-Degree AV Block (Mobitz Type I) or Wenckebach
- Second-Degree AV Block (Mobitz Type II)
- Third Degree AV Block (Complete)

First Degree AV Block

TABLE 11-1 FIRST-DEGREE AV BLOCK

Questions 1–5

What is the rate?	Based on the rate of the underlying rhythm
What is the rhythm?	Usually regular
Is there a P wave before each QRS?	Yes
Are the P waves upright and uniform?	Yes
What is the length of the PR interval?	Greater than 0.20 sec (5 small squares)
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is . . . ?	Less than 0.12 sec (3 small squares)



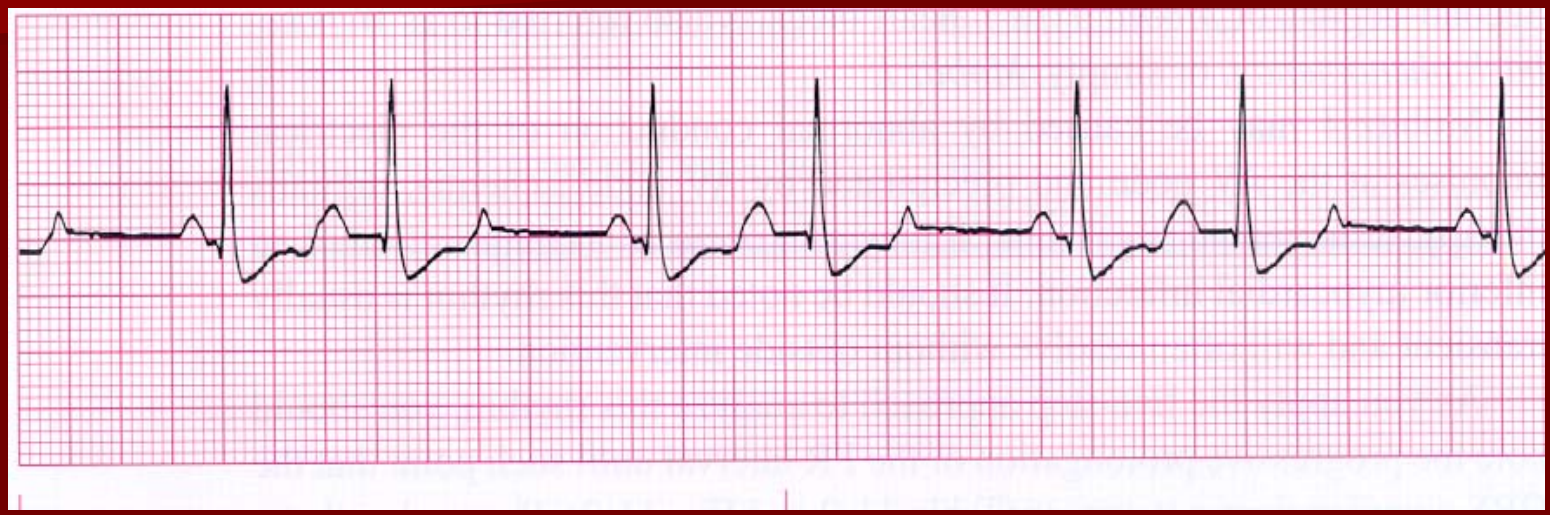
Second-Degree AV Block (Mobitz Type I) or Wenckebach

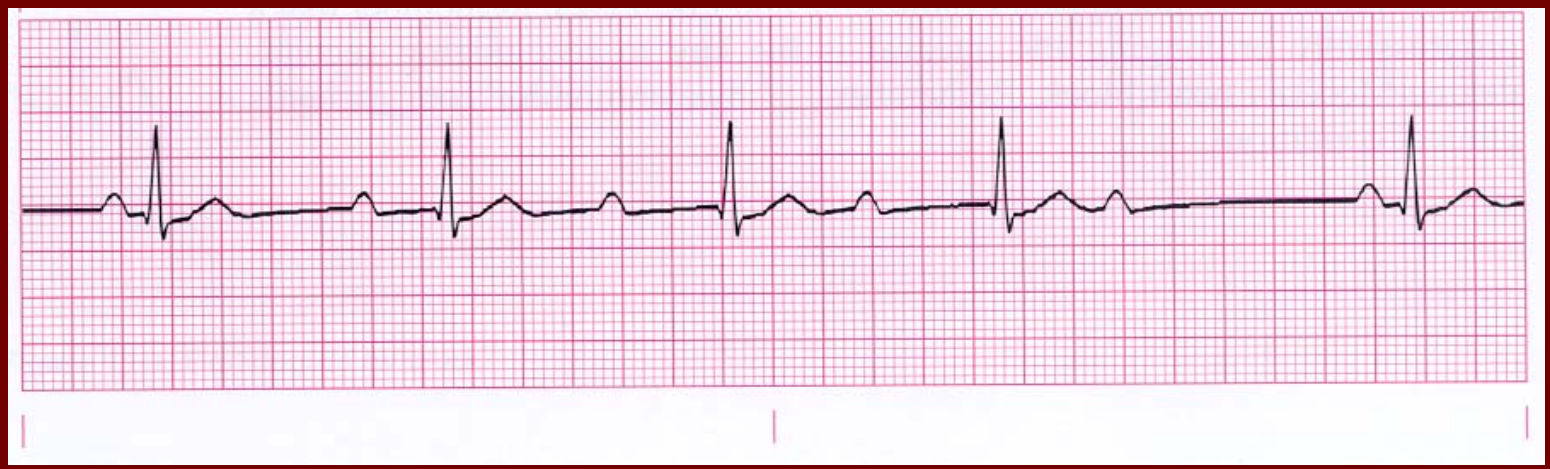
TABLE 11-2 SECOND-DEGREE BLOCK, MOBITZ TYPE I

Questions 1–5

What is the rate?	Atrial unaffected Ventricular rate is usually slower than atrial
What is the rhythm?	Atrial rhythm regular Ventricular rhythm irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Yes Yes, for conducted beats
What is the length of the PR interval?	Progressively prolongs until a QRS is not conducted
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Less than 0.12 sec

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





Second-Degree AV Block (Mobitz Type II)

TABLE 11-3 SECOND-DEGREE BLOCK, TYPE MOBITZ II

Questions 1–5

What is the rate?	Atrial rate regular Ventricular rate may be bradycardic
What is the rhythm?	Atrial rhythm regular Ventricular rhythm irregular
Is there a P wave before each QRS?	Yes; some P waves are not followed by a QRS complex
Are the P waves upright and uniform?	P waves are usually upright and uniform
What is the length of the PR interval?	Constant for conducted beats
Do all the QRS complexes look alike?	Yes; intermittently absent
The length of the QRS complexes is . . . ?	Greater than or equal to 0.12 sec

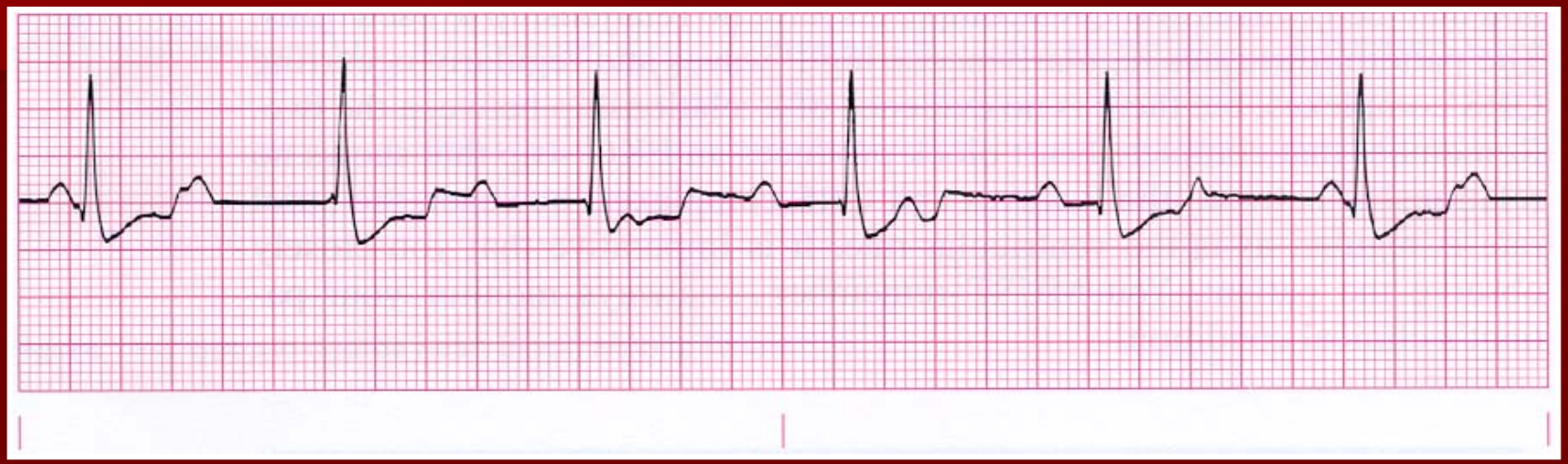
Third Degree AV Block (Complete)

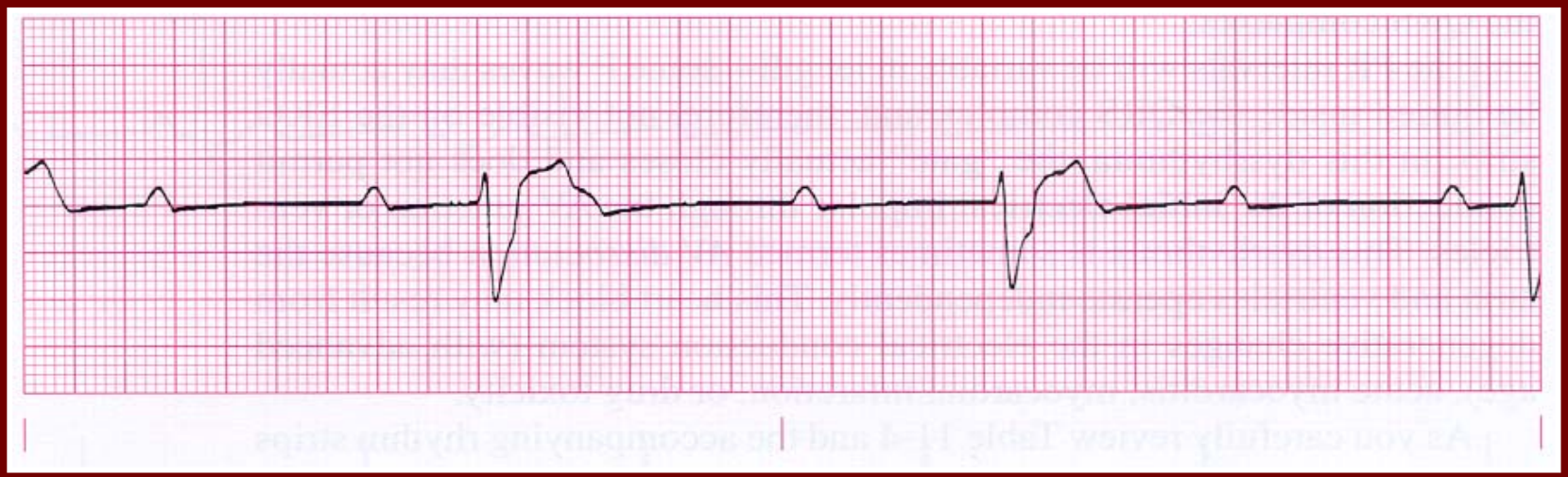
TABLE 11-4 THIRD-DEGREE (COMPLETE) HEART BLOCK

Questions 1–5

What is the rate?	Atrial rate usually 60 to 100 BPM Ventricular rate based on site of escape pacemaker
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	No relationship to QRS complexes Yes
What is the length of the PR interval?	Totally variable; no pattern
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Based on site of escape pacemaker

Third Degree AV Block (Complete)





Artificial Pacemaker

TABLE 12-1 ARTIFICIAL PACEMAKER RHYTHM

Questions 1–5

What is the rate?	Varies according to preset rate of pacemaker (usually 70 BPM)
What is the rhythm?	Regular if pacing is fixed, irregular if demand-paced
Is there a P wave before each QRS? Are the P waves upright and uniform?	May be absent or present, based on type of artificial pacemaker
What is the length of the PR interval?	Variable, depending on type of artificial pacemaker
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Usually; greater than or equal to 0.12 sec; bizarre morphology; presence of spikes

Practice Strips

Atrial Fibrillation with PVC's

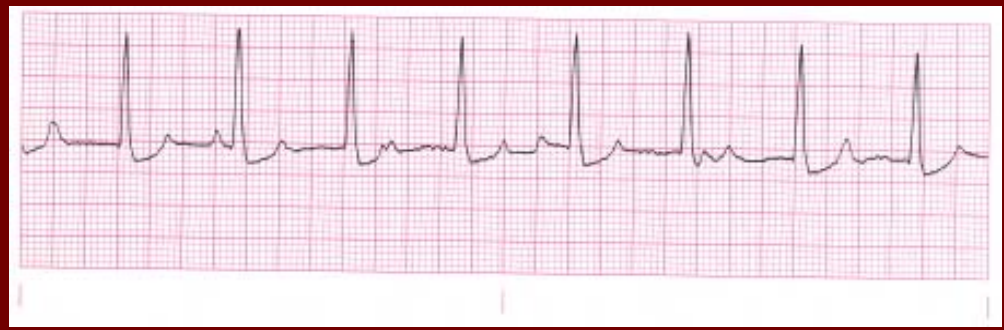
NSR

Sinus Bradycardia

Practice Strips

Ventricular Fibrillation

Third-Degree Heart Block

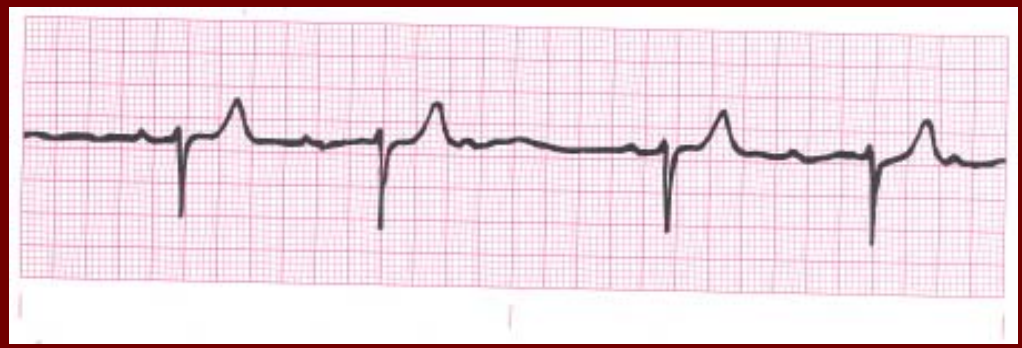


Asystole

Practice Strips

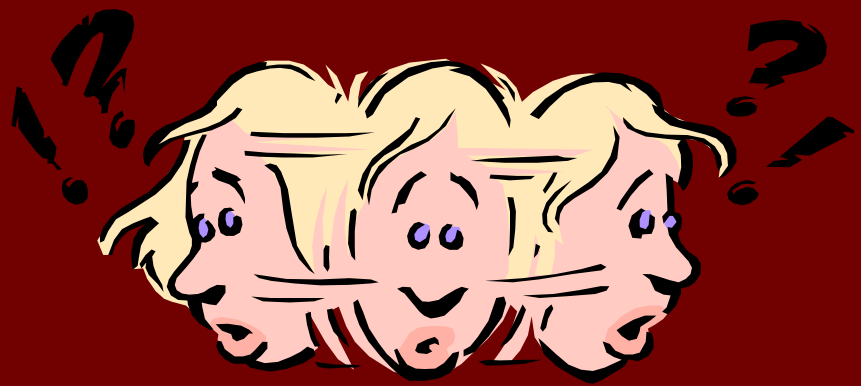
Sinus Tachycardia

Second-Degree AV Block
Mobitz Type I, Wenckebach



Atrial Flutter

Questions/Confused



Student Brain