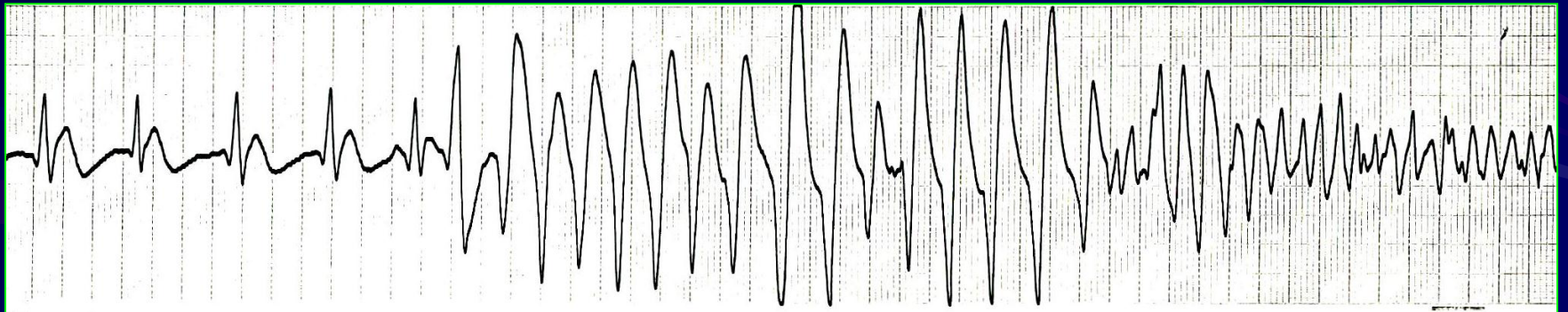


Electrocardiographic Interpretation

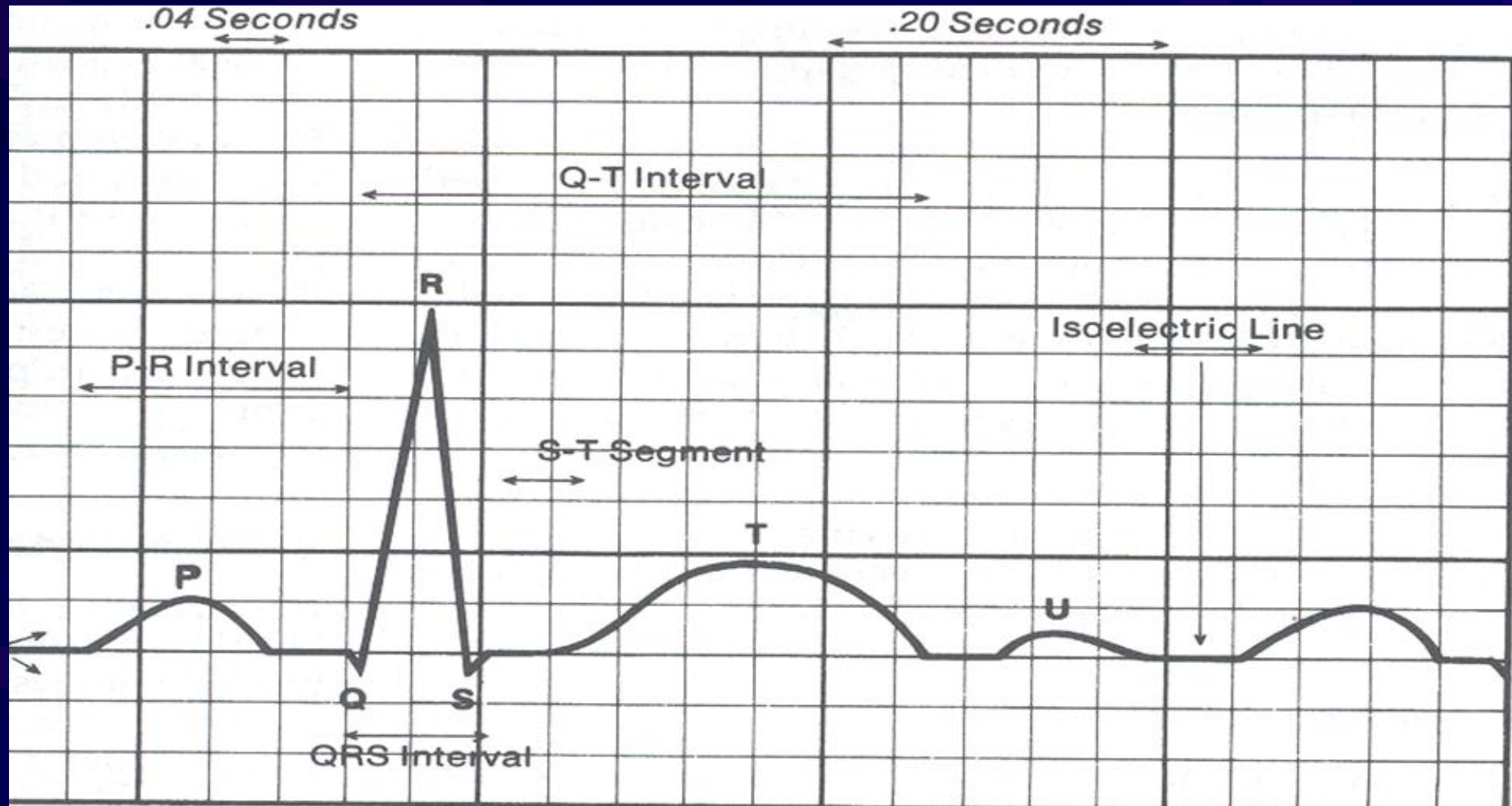
Basic Rhythm Recognition

William Brady, MD
Department of Emergency Medicine

Cardiac Rhythms

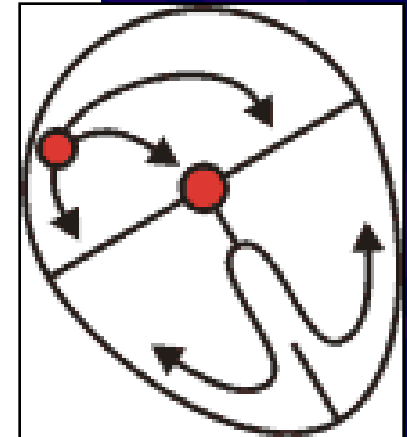
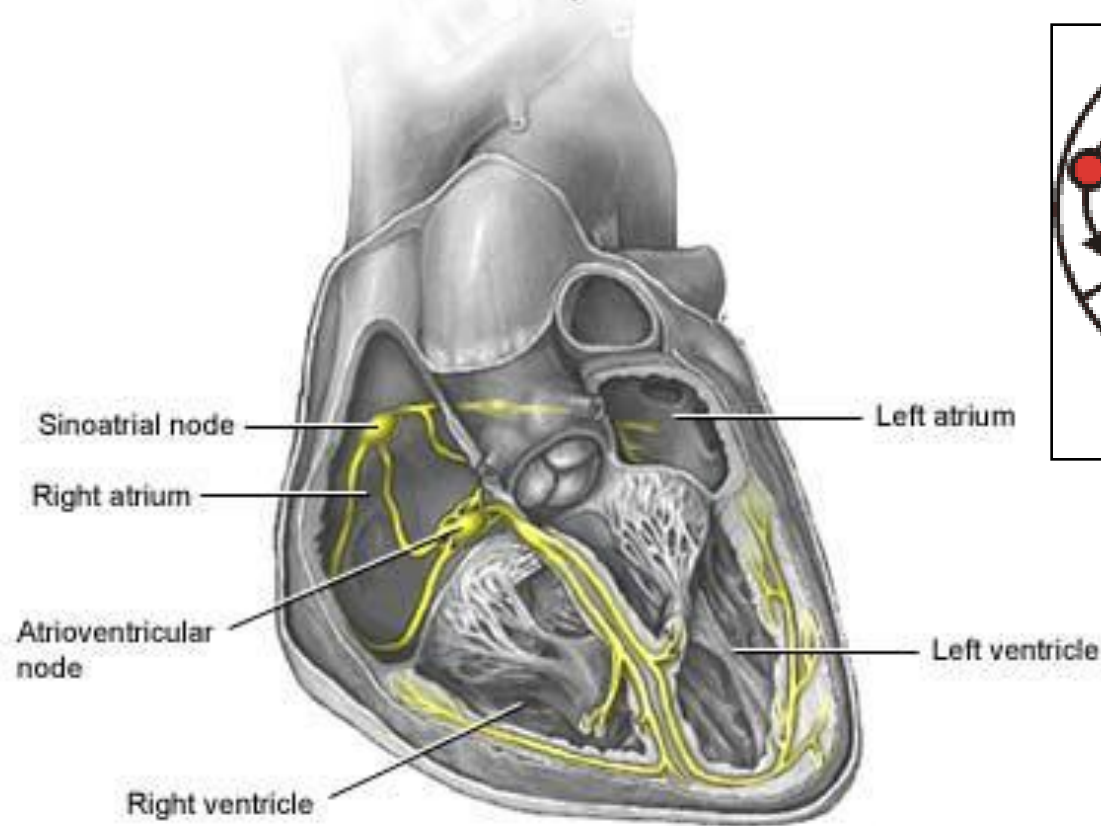


Anatomy of a Rhythm Strip



A Review of the Electrical System

Intrinsic conduction system of the heart



Intrinsic Pacemakers Cells

These cells have property known as “Automaticity”—means they can spontaneously depolarize.

Sinus Node

- Primary pacemaker
- Fires at a rate of 60-100 bpm

AV Junction

- Fires at a rate of 40-60 bpm

Ventricular (Purkinje Fibers)

- Less than 40 bpm

What's Normal

P Wave

Atrial Depolarization

PR Interval (Normal 0.12-0.20)

Beginning of the P to onset of QRS

QRS

Ventricular Depolarization

QRS Interval (Normal <0.10)

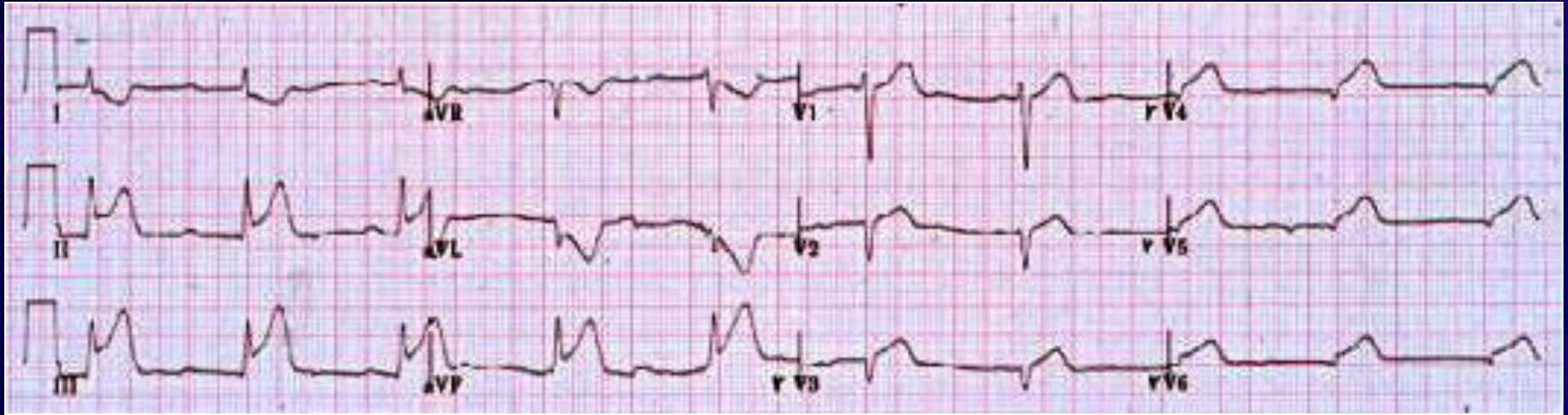
Period (or length of time) it takes for the ventricles to depolarize

The Key to Success...

...A systematic approach!

- Rate
- Rhythm
- P Waves
- PR Interval
- P and QRS Correlation
- QRS Rate
- Pacemaker

A rather ill patient.....



**Very apparent inferolateral
STEMI.....with less apparent
complete heart block**

RATE

Fast vs Slow

QRS Width

**Narrow QRS
Tachycardia**

**Wide QRS
Tachycardia**

**Narrow QRS
Bradycardia**

**Wide QRS
Bradycardia**

Regular

Irregular

Regular

Irregular

Sinus Tach
PSVT
A-Flutter
PAT

A-Fib
A-Flutter
MAT
PAT
ST PAC / PVC

VT
SVT aberrant

PVT
A-Fib

Sinus Brady
A-Fib / Flutter
Junctional
1 AVB
2 AVB / I or II
3 AVB

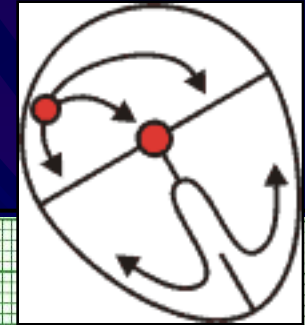
Idioventricular
Bradycardia w/ BBB
2 AVB / II
3 AVB

Stability

- Hypotension / hypoperfusion
- Altered mental status
- Chest pain
 - Coronary ischemic
- Dyspnea
 - Pulmonary edema

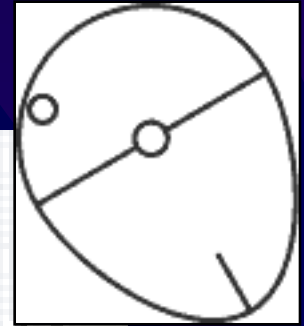
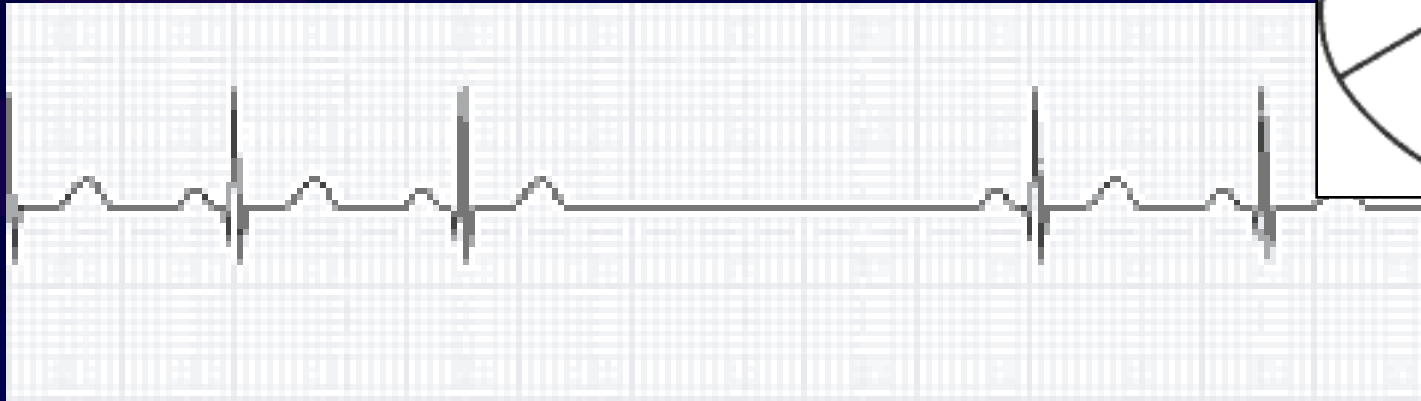
Sinus Rhythm

Sinus Rhythm



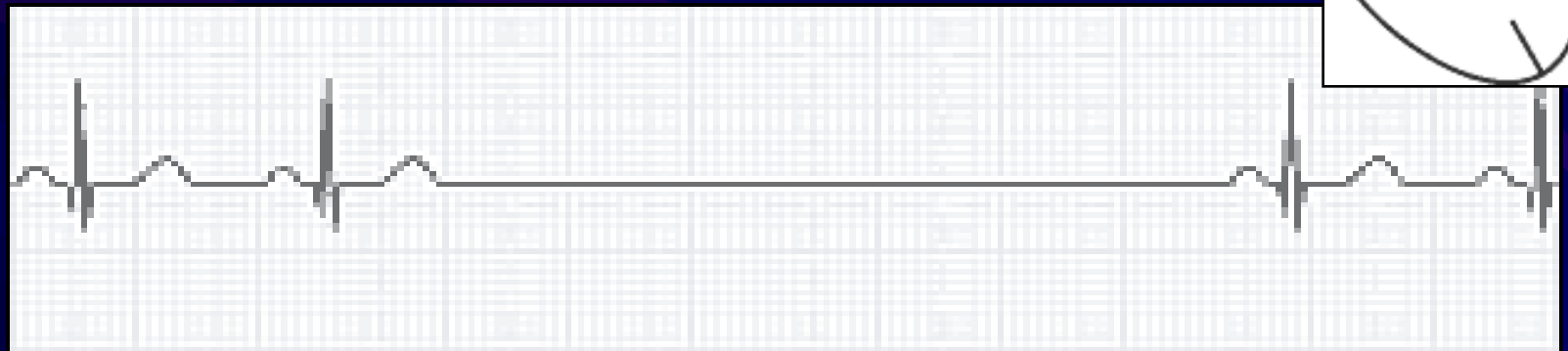
P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> Before each QRS Look alike 	<ul style="list-style-type: none"> Constant, regular Interval .12-.20 	<ul style="list-style-type: none"> Rate 60-100 Interval =/ < .10 	<ul style="list-style-type: none"> Regular 	<ul style="list-style-type: none"> SA Node 	Upright in leads I, II, & III

Sinus Pause



- A delay of activation within the atria for a period between 1.7 and 3 seconds
- A palpitation is likely to be felt by the patient as the sinus beat following the pause may be a heavy beat. Syncope is also possible.

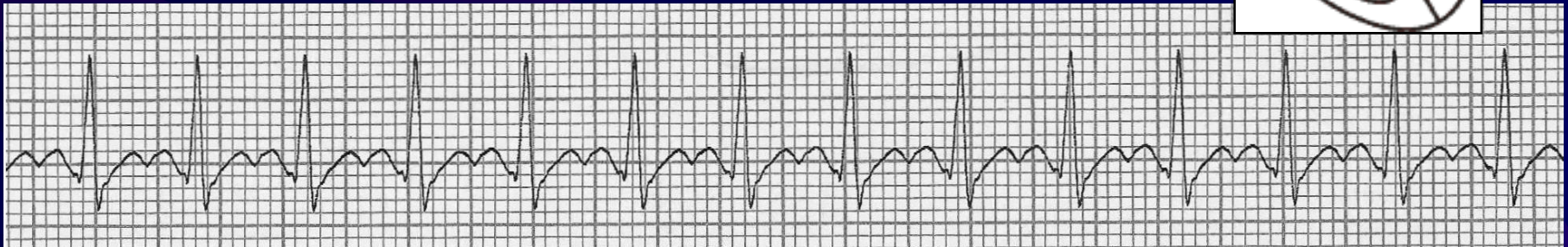
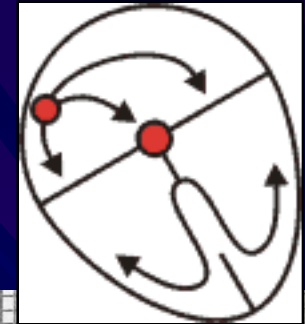
Sinus Arrest



- a delay of activation in the Atria = or > 3 seconds
- Patient is likely to have a syncopal event

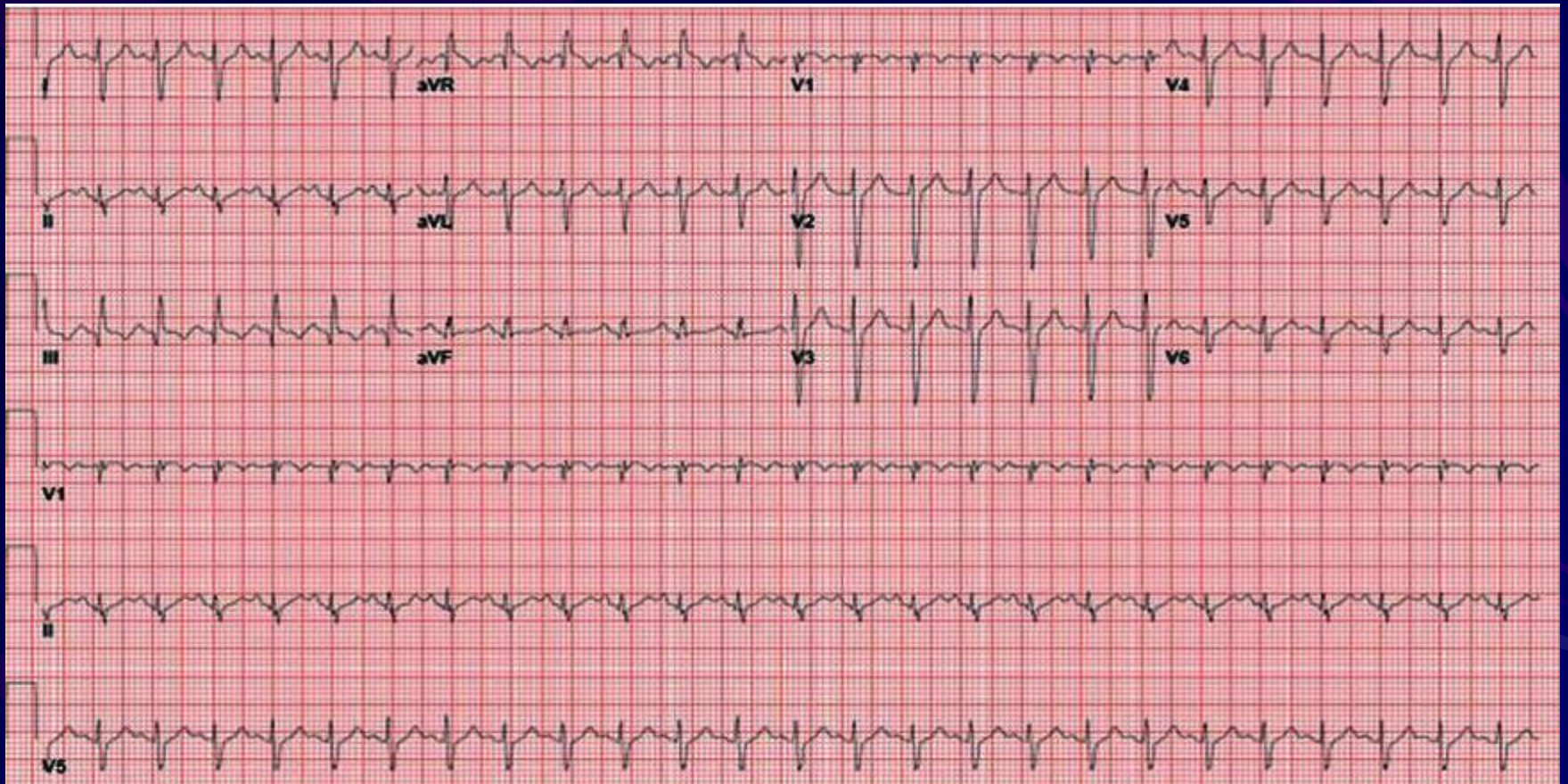
Tachycardia

Sinus Tachycardia

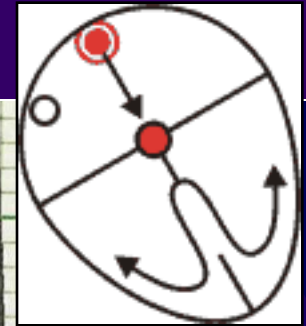


P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none">▪ Before each QRS▪ Look alike	<ul style="list-style-type: none">▪ Constant, regular▪ Interval .12-.20	<ul style="list-style-type: none">▪ Rate > 100▪ Interval = / < .10	<ul style="list-style-type: none">▪ Regular	<ul style="list-style-type: none">▪ SA Node	Consider causes

Sinus Tachycardia

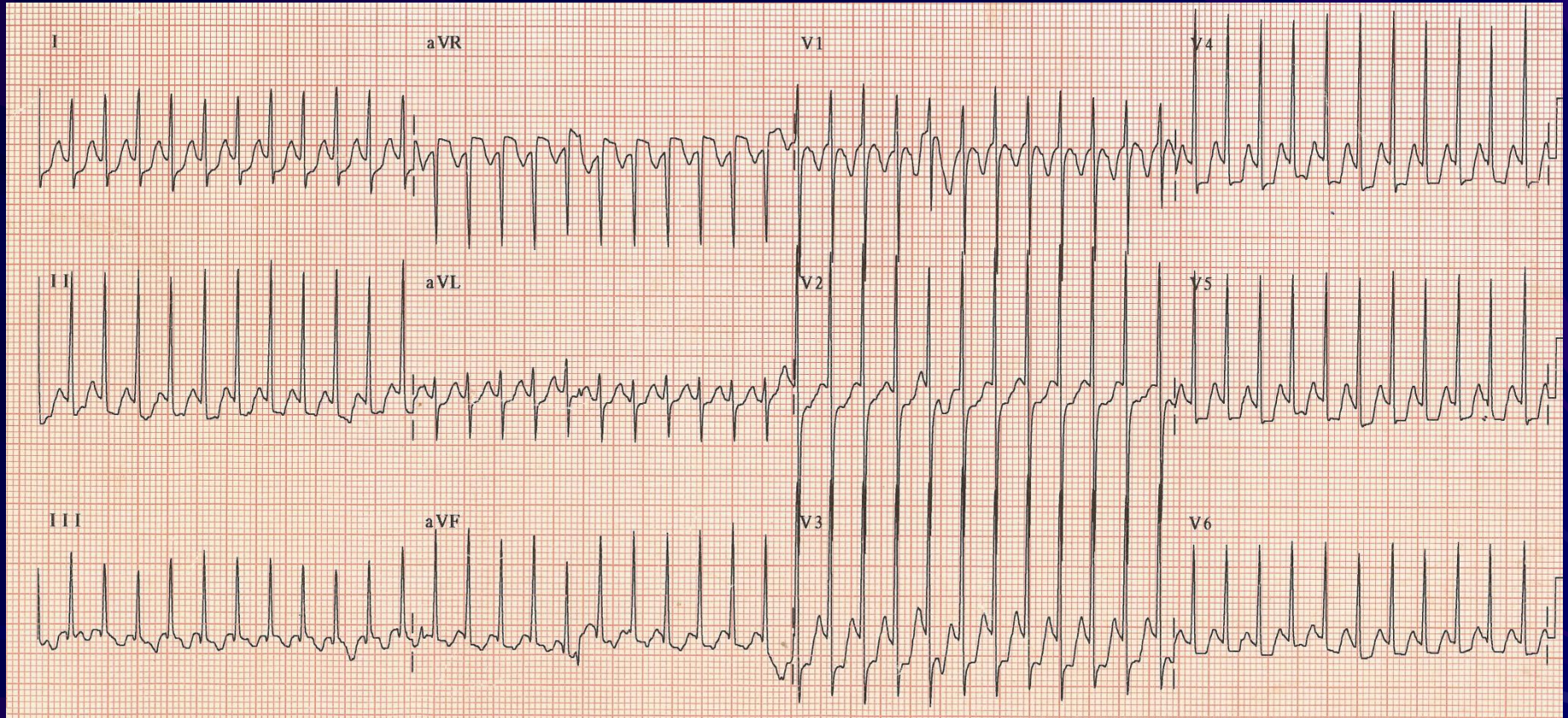


Paroxysmal Supraventricular Tachycardia (PSVT)

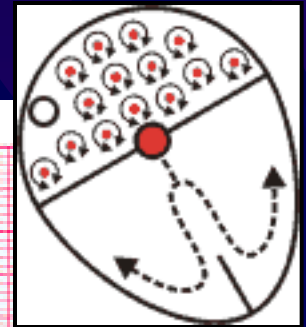
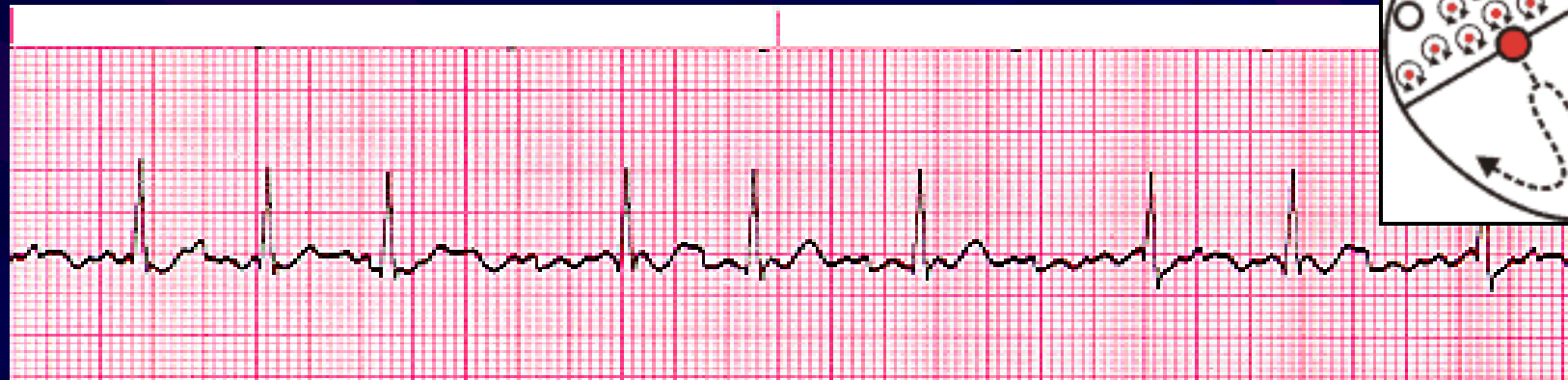


P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
Are not easily seen, because they are buried in the T waves	Difficult to determine due to the rapid rate and poorly distinguished P waves	>150; up to 250	Regular	Originates above the ventricles; typically not driven by the SA Node.	<ul style="list-style-type: none"> ■ May be due to increased automaticity or re-entry ■ Common provocatuers are : Caffeine, hypoxia, cigarettes, stress, anxiety, sleep deprivation, medications

PSVT

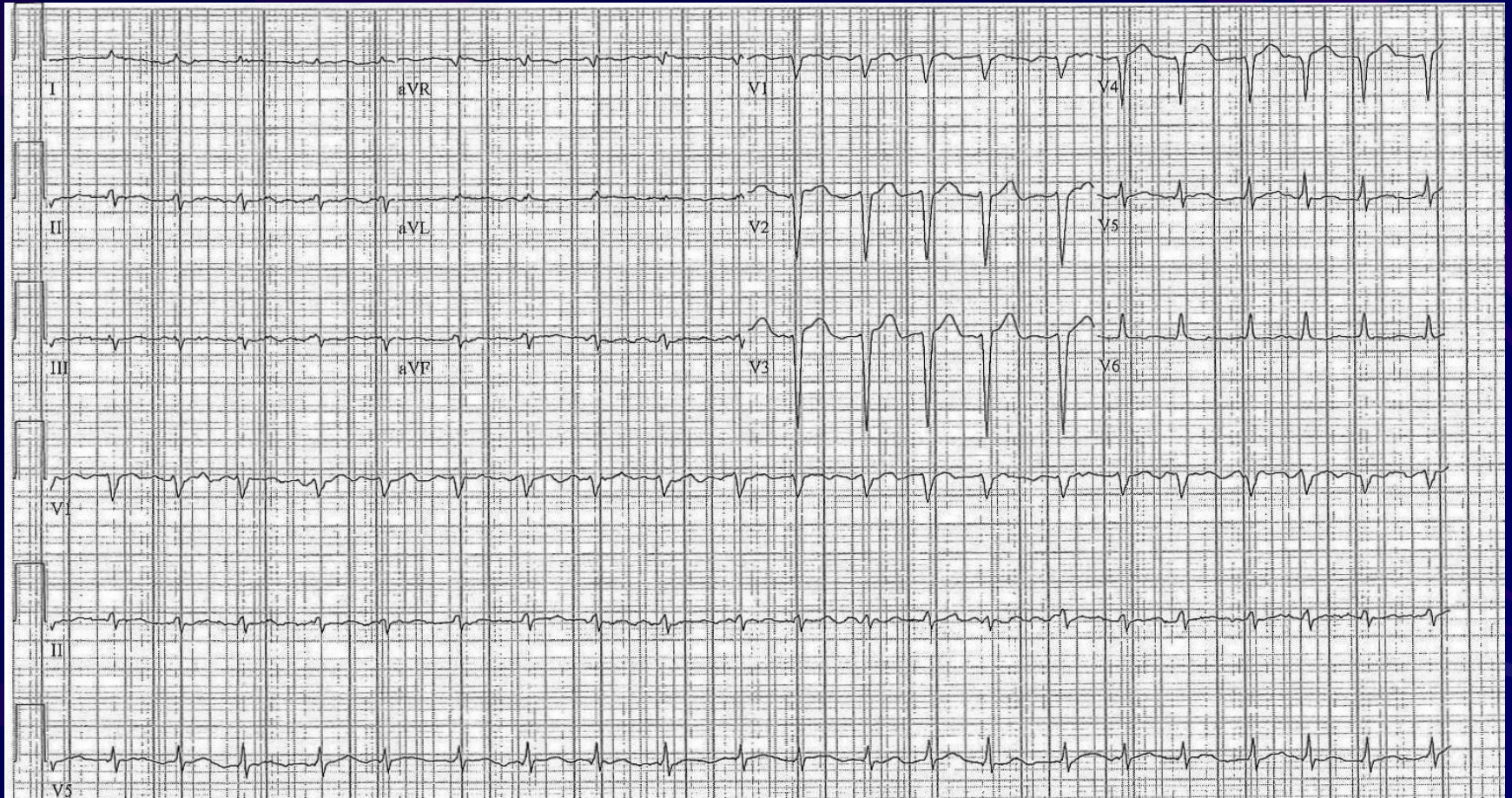


Atrial Fibrillation



P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> No distinct P waves—chaotic, undulating fibrillation waves 	<ul style="list-style-type: none"> Absent or indiscernible 	<ul style="list-style-type: none"> Varies; may be a slow or rapid ventricular response <.10 	<ul style="list-style-type: none"> Both atrial and ventricular complexes are irregularly irregular 	<ul style="list-style-type: none"> Occurs from multiple reentry sites; resulting in a very rapid atrial rate >300 	<ul style="list-style-type: none"> Lose the “atrial kick” Potential for thrombi

Atrial Fibrillation

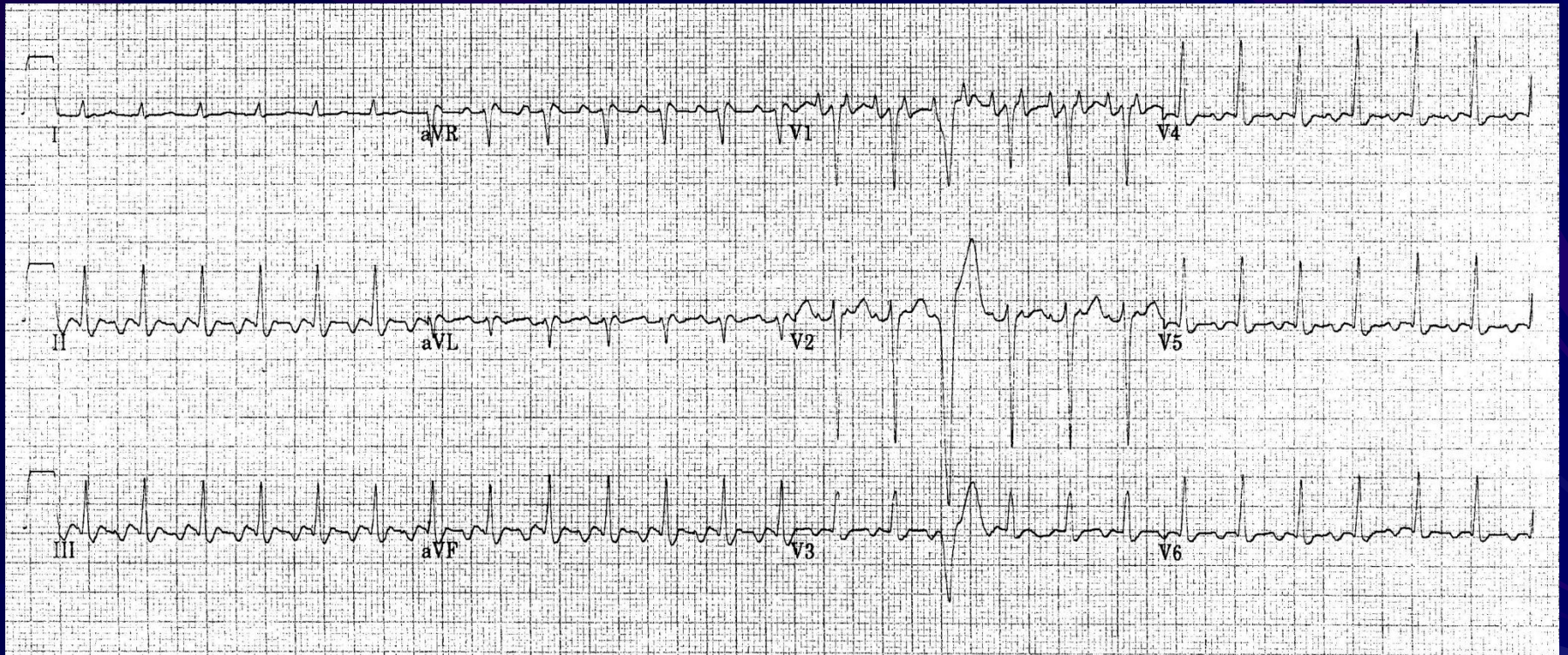


Atrial Flutter

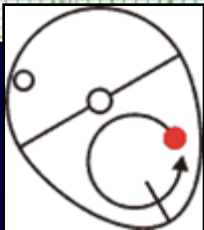


P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> ▪ Saw tooth ▪ Atrial rate can range from 200-300 	<ul style="list-style-type: none"> ▪ Typically immeasurable; also, may be variable 	<ul style="list-style-type: none"> ▪ Varies; may be a slow or rapid ventricular response ▪ $<.10$ 	<ul style="list-style-type: none"> ▪ Both atrial and ventricular complexes are regular unless there is a variable block ▪ Ratio 2:1, 3:1 or variable 	<ul style="list-style-type: none"> ▪ Single reentry circuit; impulse takes a circular course around the atria 	<ul style="list-style-type: none"> ▪ Similar to A Fib in symptomology and treatment ▪ Lose the "atrial kick" ▪ Potential for thrombi

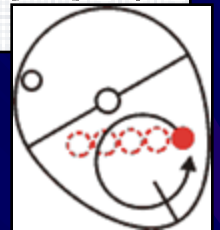
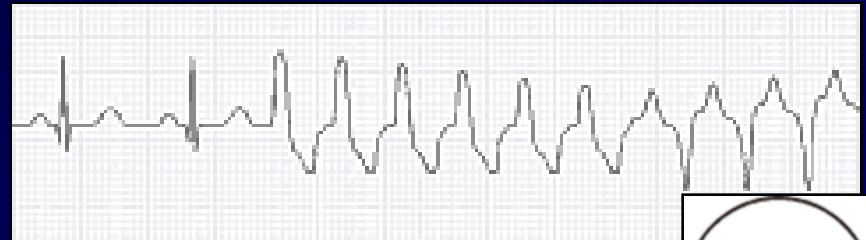
Atrial Flutter



Ventricular Tachycardia



Monomorphic VT



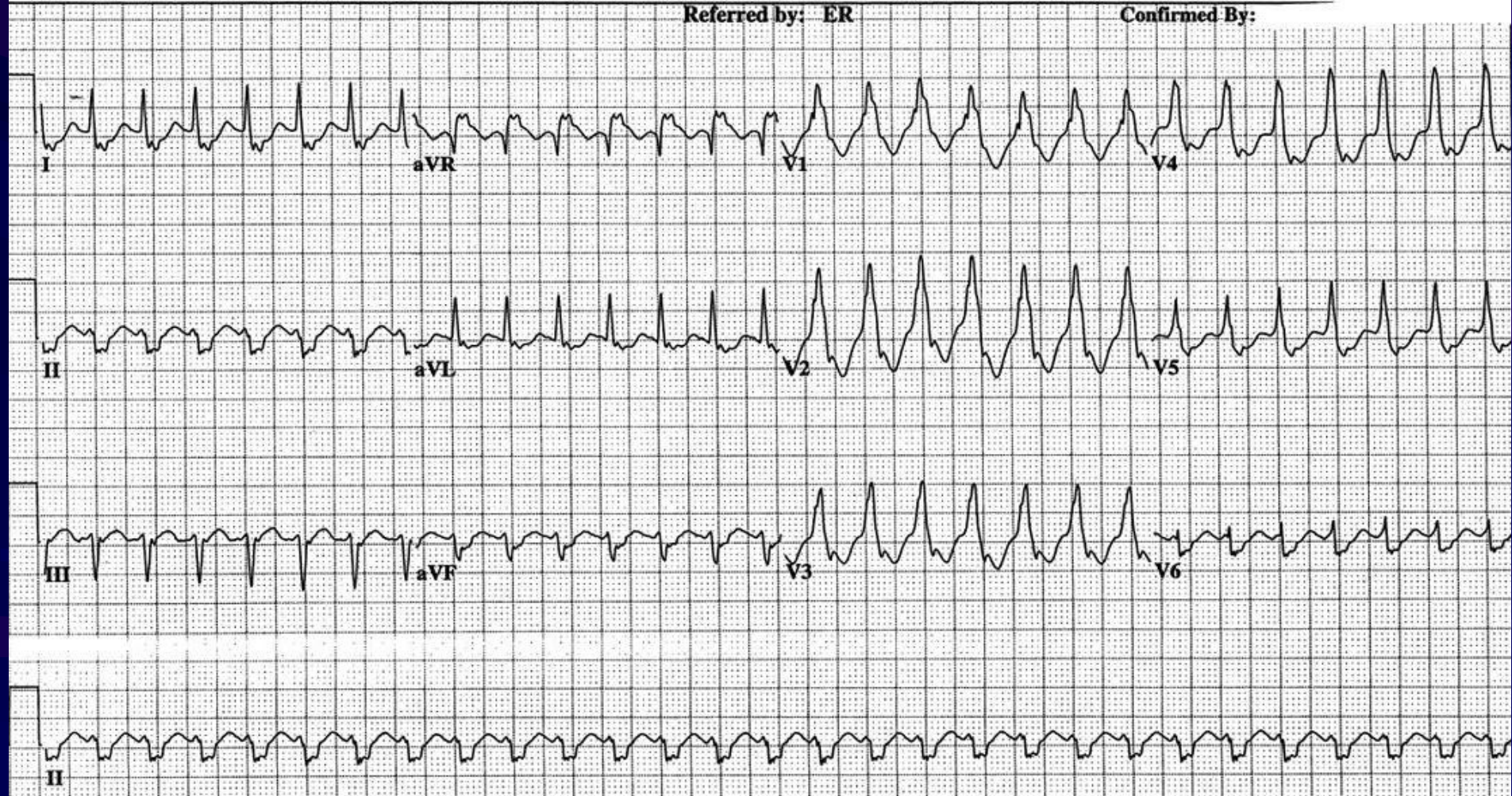
Polymorphic VT

P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> Rare If present, dissociated from the QRS 	<ul style="list-style-type: none"> Absent 	<ul style="list-style-type: none"> Wide (>.12) and bizarre >120 	<ul style="list-style-type: none"> Normally similar (monomorphic) Varied appearance termed "polymorphic" 	<ul style="list-style-type: none"> Originates in the ventricles 	<ul style="list-style-type: none"> Typically pulseless; Slower rhythms may have a pulse—typically not tolerated well for long periods.

Ventricular Tachycardia

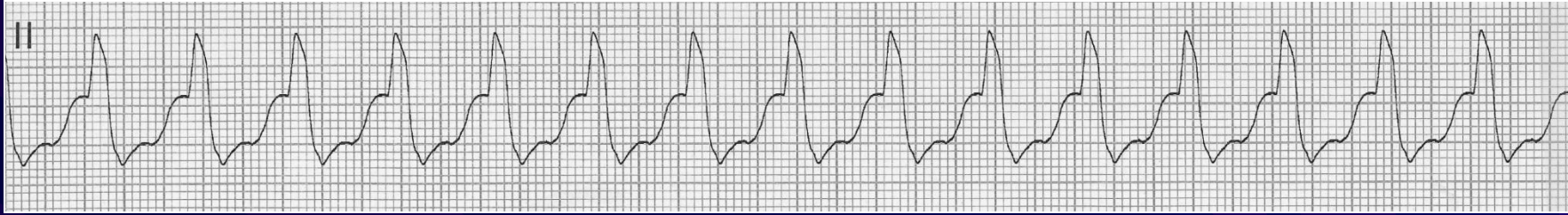
Referred by: ER

Confirmed By:



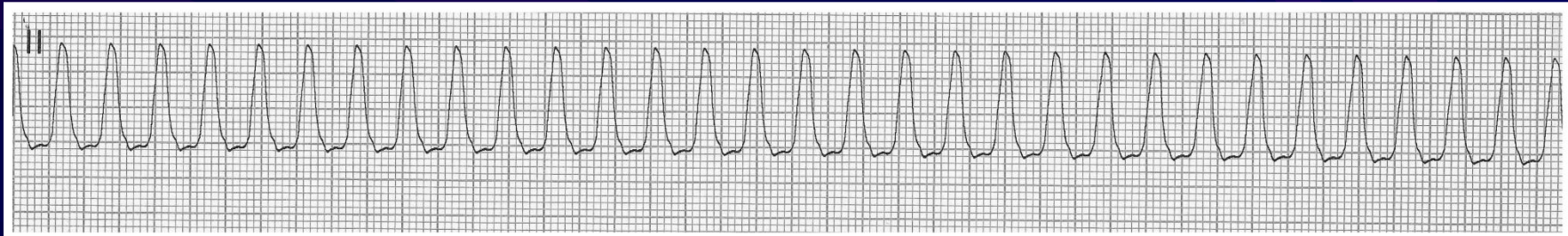
Monomorphic VT

A



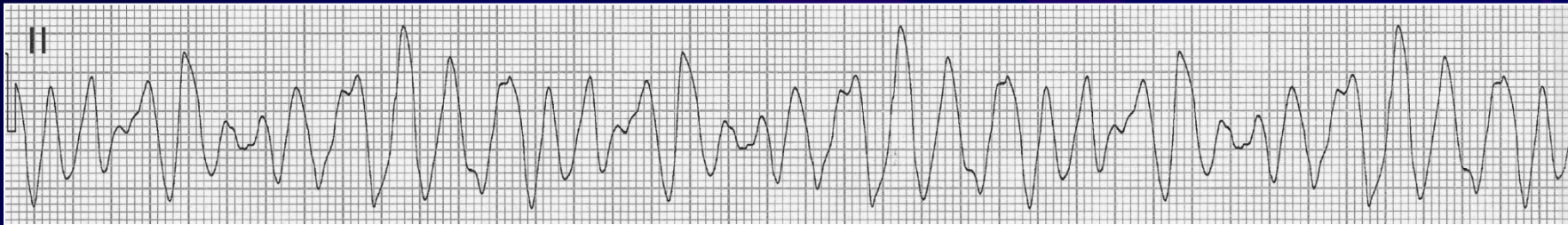
Monomorphic VT

B



Polymorphic VT

C

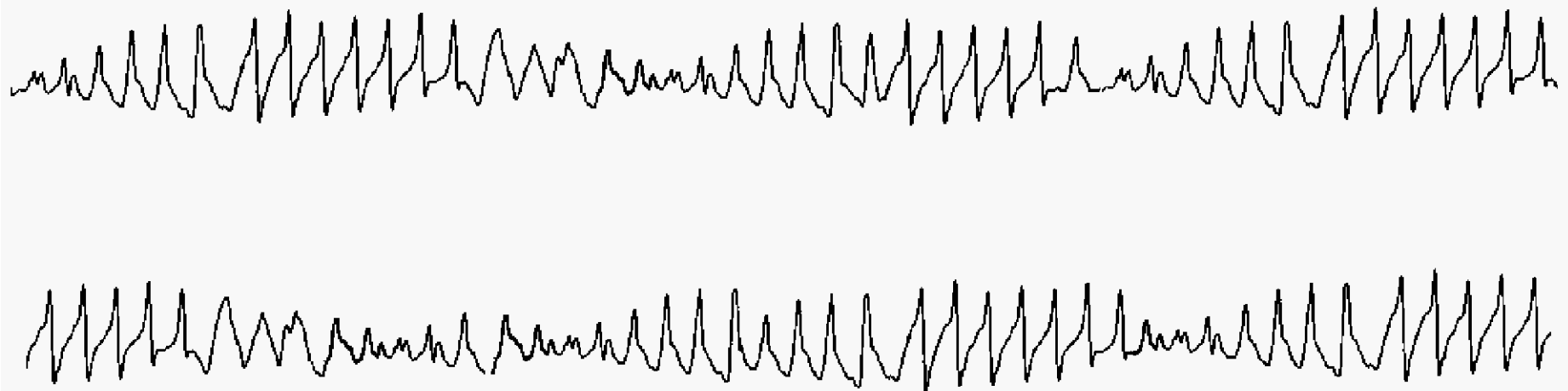


Polymorphic VT – Torsade des Pointes

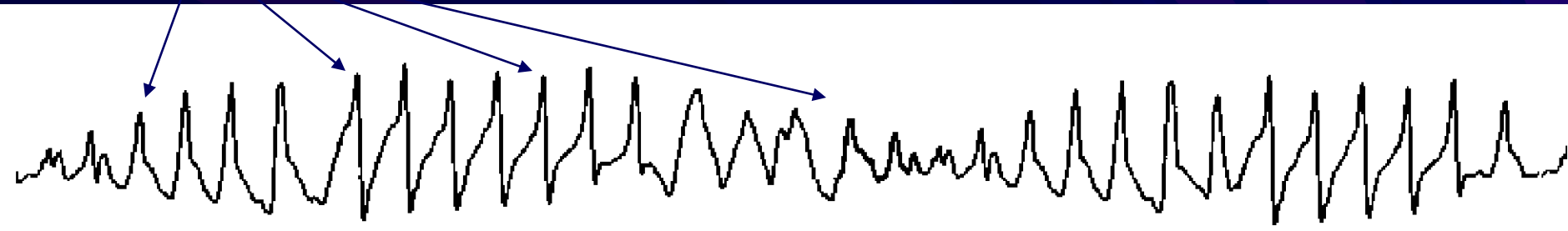
D



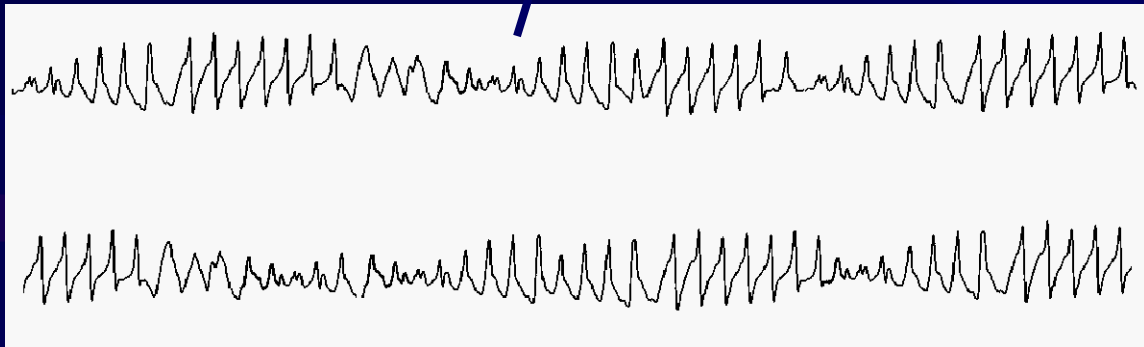
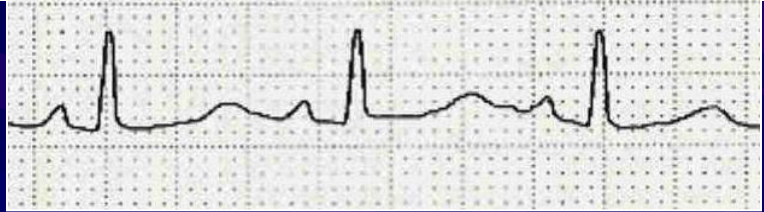
Polymorphic Ventricular Tachycardia Torsade des Pointes



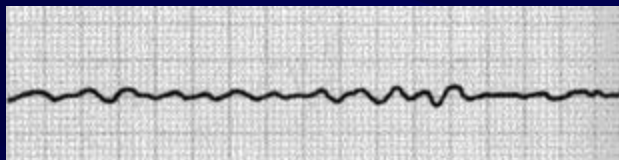
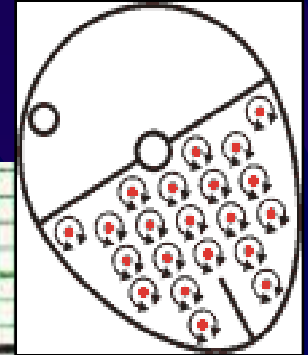
Continuously Changing QRS Complex Morphology in a Crescendo-Decrescendo Pattern



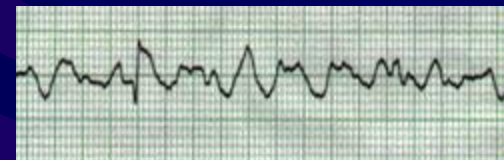
Prolonged QT interval noted prior to sudden cardiac death.



Ventricular Fibrillation



Fine V Fib



Course V Fib

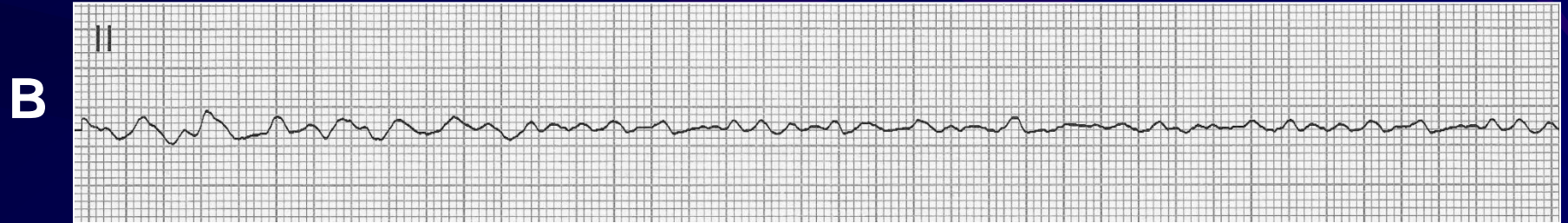
P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> Absent 	<ul style="list-style-type: none"> Absent 	<ul style="list-style-type: none"> Chaotic, unable to quantify, poorly defined 	<ul style="list-style-type: none"> Chaotic 	<ul style="list-style-type: none"> Multiple ectopic foci throughout the ventricles 	<ul style="list-style-type: none"> Cardiac arrest! Very poor prognosis!

Ventricular Fibrillation

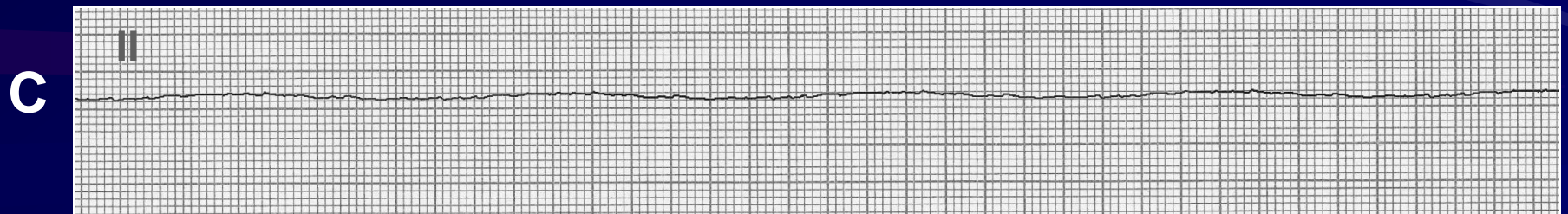
Coarse



Intermediate

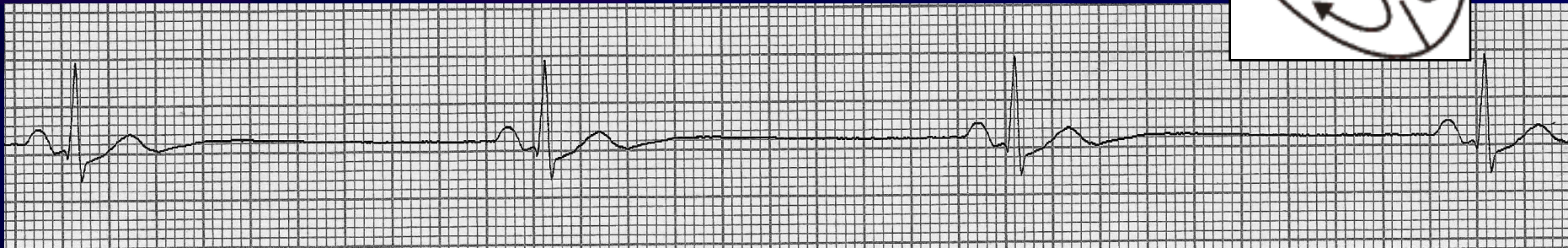
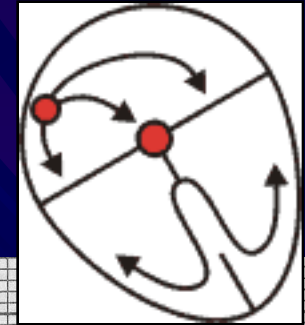


Fine



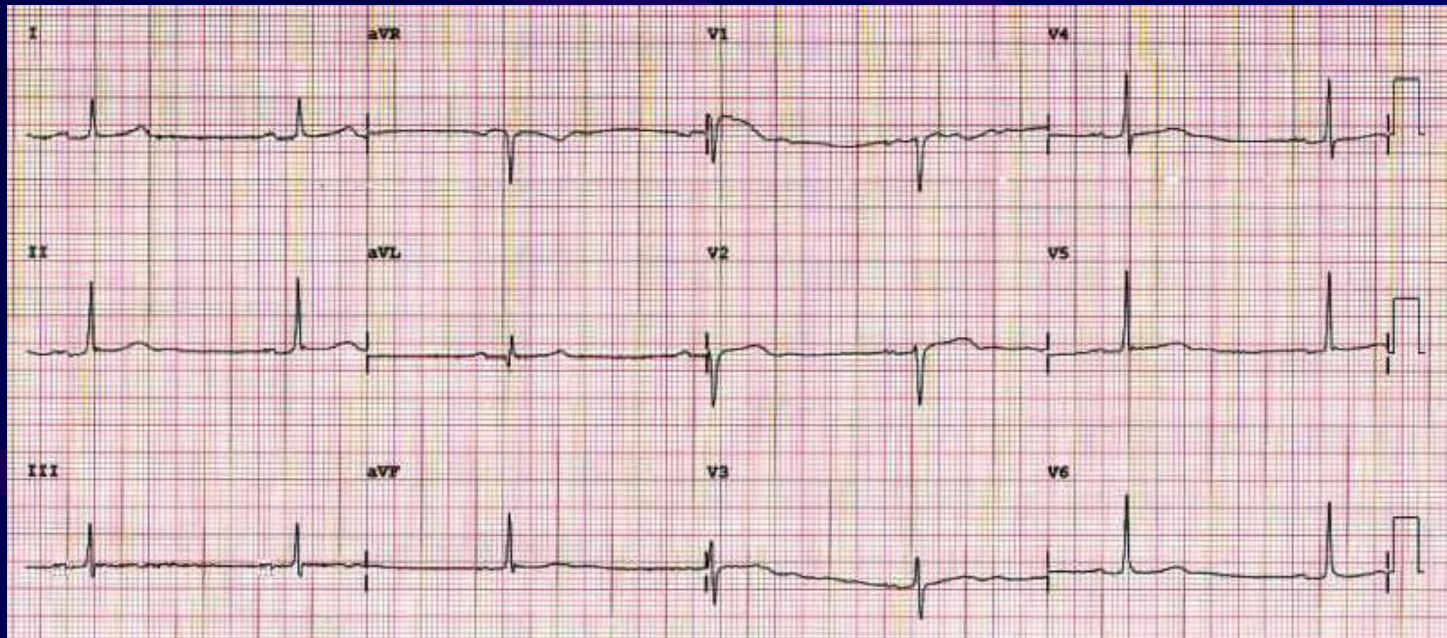
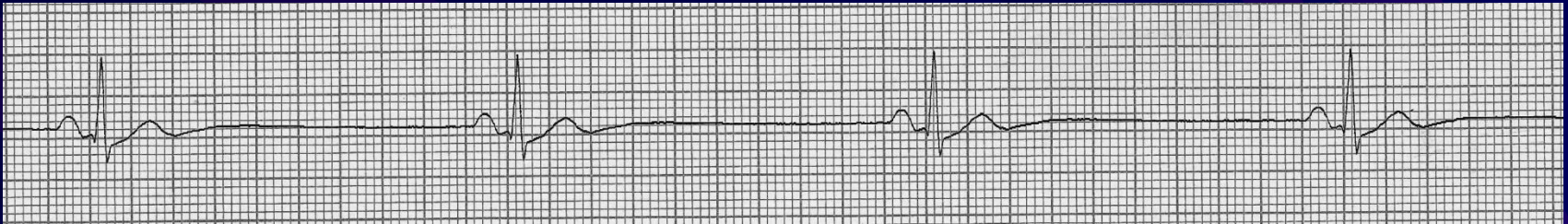
Bradycardia

Sinus Bradycardia

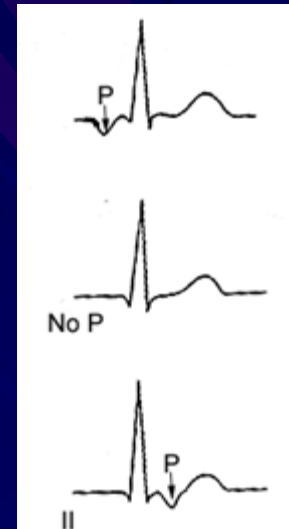



P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none">▪ Before each QRS▪ Look alike	<ul style="list-style-type: none">▪ Constant, regular▪ Interval .12-.20	<ul style="list-style-type: none">▪ Rate < 60▪ Interval = / < .10	<ul style="list-style-type: none">▪ Regular	<ul style="list-style-type: none">▪ SA Node	

Sinus Bradycardia

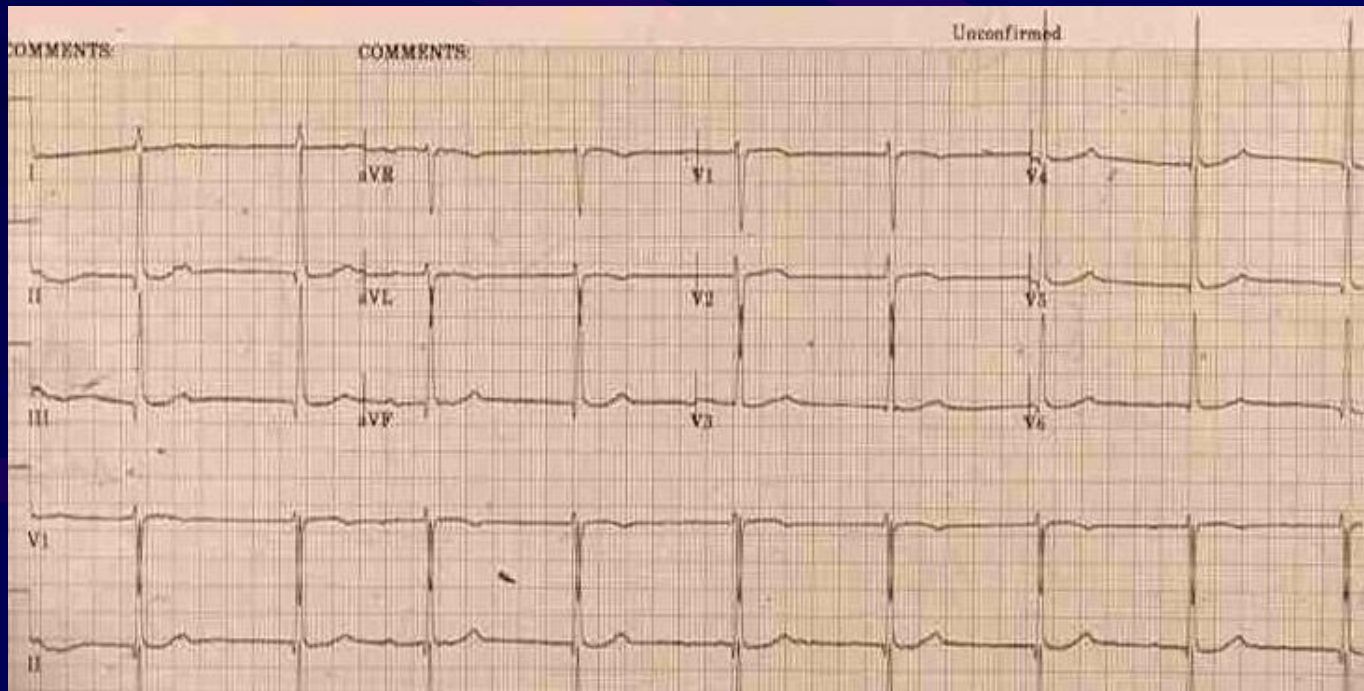


Junctional Rhythms



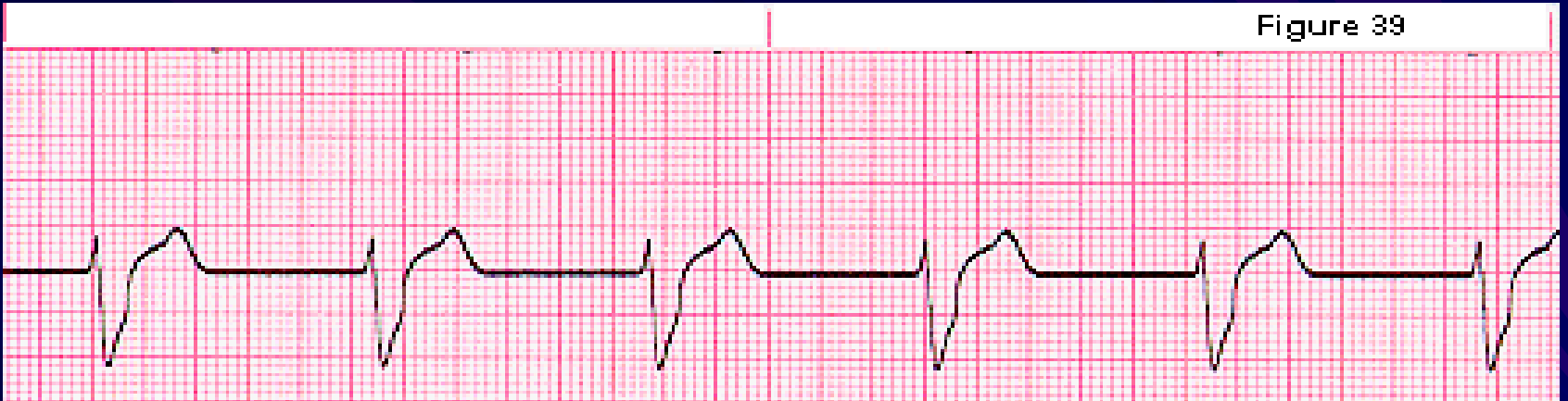
P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<p>May be before, during or after the QRS</p> <p>May be abnormal in size and shape</p>	Normal or prolonged	40-60	Regular	<p>At the level of the AV node</p>  <p>The diagram shows a cross-section of the heart with the conduction system. A red dot represents the AV node, with arrows pointing outwards to indicate its role as the pacemaker. The SA node is shown as a small circle to the left.</p>	<p>■ The SA node malfunctions and the AV node initiates escape beats. Normally, the SA node overrides the AV.</p>

Junctional Rhythm



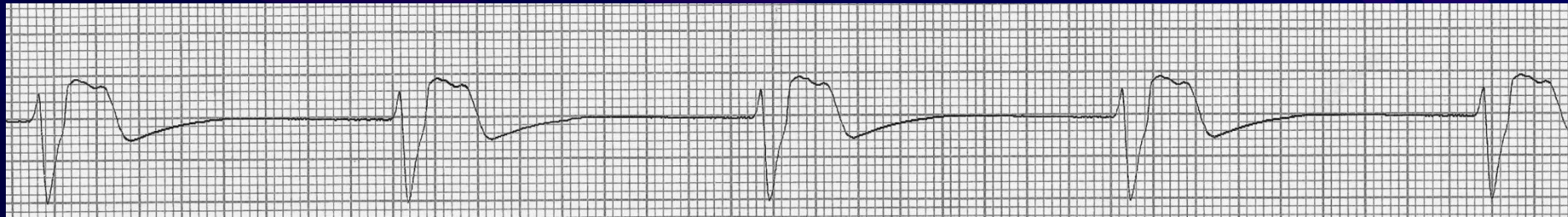
Idioventricular

Figure 39



P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
Absent	Absent	<ul style="list-style-type: none">■ Typically 20-40■ May accelerate to 40-100	Regular	Ventricles	<ul style="list-style-type: none">■ Normal SA and AV node fail to generate an impulse; ventricles kick in with a rate of 20-40

Idioventricular Rhythm



AV Block

First Degree Block



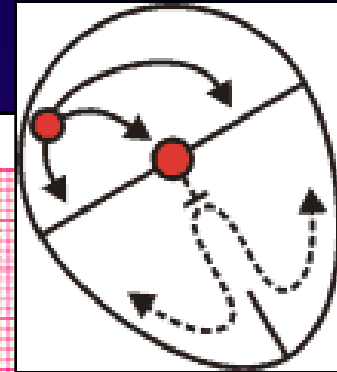
P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none">▪ Before each QRS▪ Actually a delay rather than a block	<ul style="list-style-type: none">▪ $>.20$	<ul style="list-style-type: none">▪ Brady to tachy	<ul style="list-style-type: none">▪ Regular	<ul style="list-style-type: none">▪ SA...with a delay	<ul style="list-style-type: none">▪ Typically Asymptomatic

First-degree AV Block



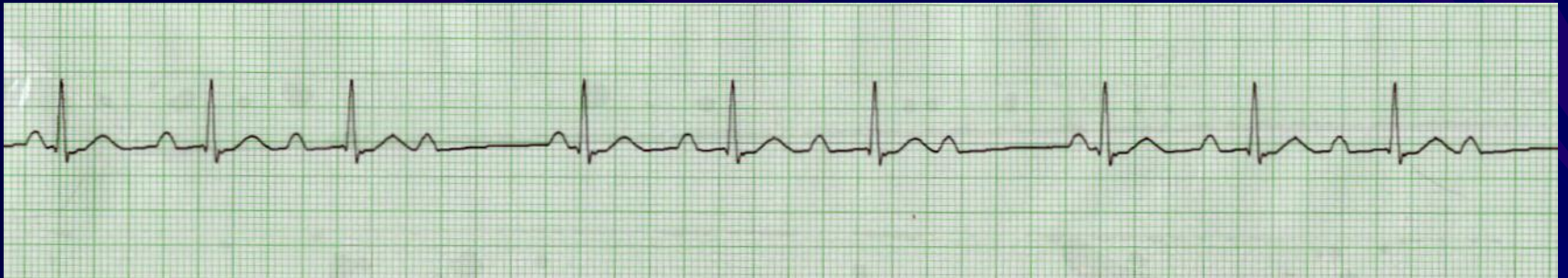
Second Degree Block: Type I (aka Wenckebach)

Figure 31



P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> Size and shape normal; occasional P wave not followed by a QRS 	<ul style="list-style-type: none"> Progressive lengthening of the PR until a QRS is dropped 	<ul style="list-style-type: none"> <.10 interval approximate 50-80 	<ul style="list-style-type: none"> Atrial rate usually faster than ventricular due to the dropped beat 	<ul style="list-style-type: none"> Problem at the AV Node level with increasing slowing 	<ul style="list-style-type: none"> Causes may include drugs, ischemia, increased parasympathetic tone

Second-degree AV Block / Type I



Second Degree Block: Type II

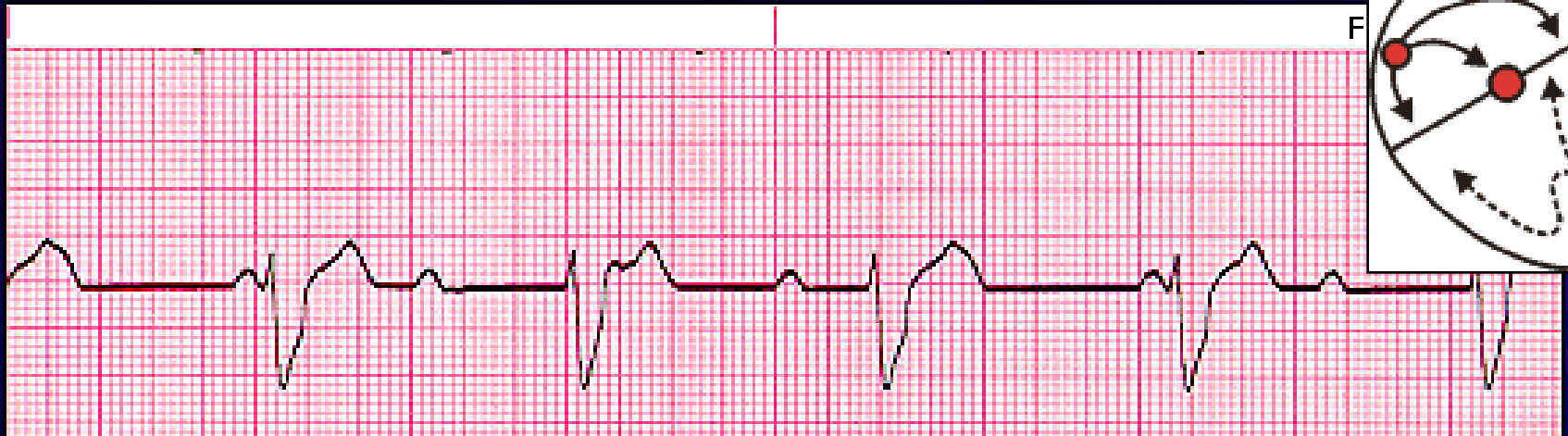


P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
<ul style="list-style-type: none"> Normal configuration May not have corresponding QRS May be a varied block 	Intervals will remain constant	Slowed	<ul style="list-style-type: none"> Atrial rate unaffected; ventricular rate slowed Ventricular irregular due to blocked beats 	<ul style="list-style-type: none"> Interval—in relation to AV Node <.10 implies high level block; >.12 implies low level block 	<ul style="list-style-type: none"> Cause organic lesions May progress to 3rd degree! Prepare to pace!

Second-degree AV Block / Type II

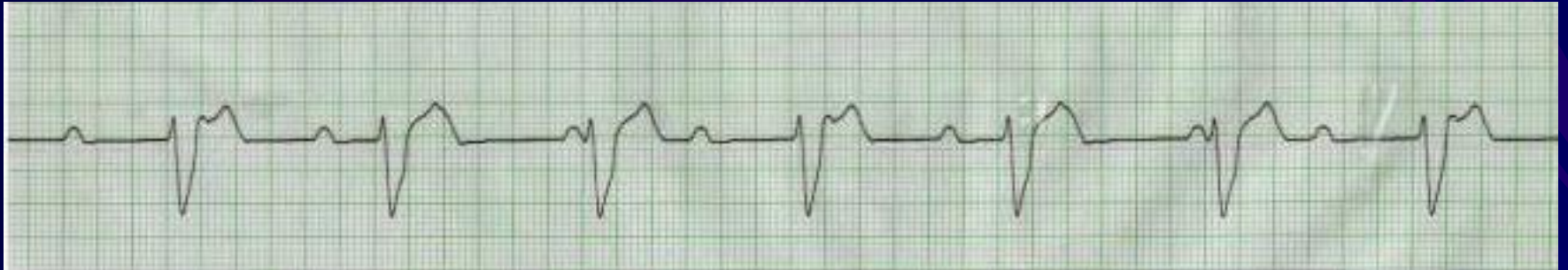


Third Degree Block (complete)



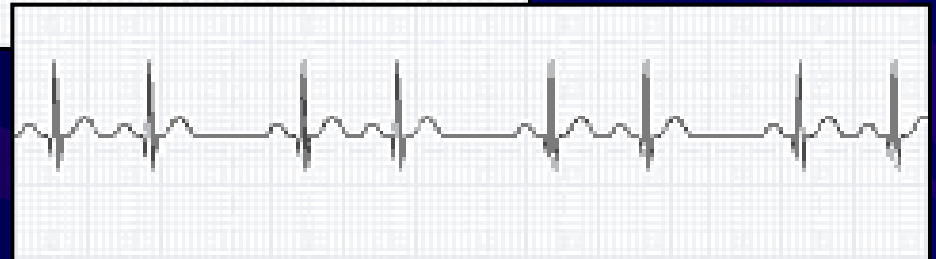
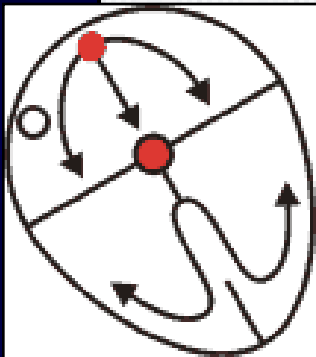
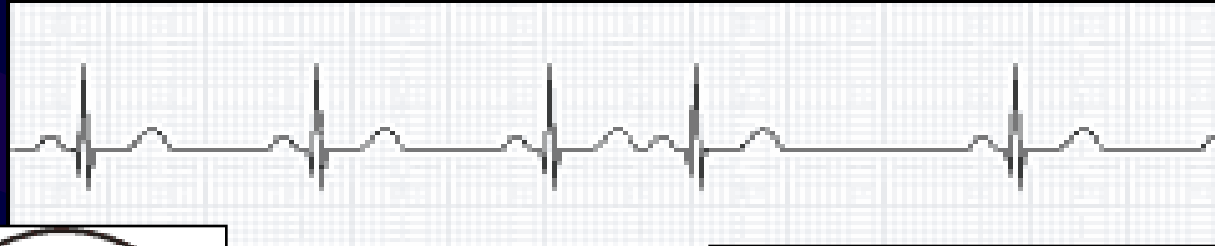
P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
Normal configuration	No relationship between the P and R	<ul style="list-style-type: none"> ■ Atrial rate 60-100 ■ Ventricular rate 20-40 	<ul style="list-style-type: none"> ■ Atrial and ventricular complexes are regular...but dissociated 	<ul style="list-style-type: none"> ■ Damage to the conduction system results in NO passage of impulse; therefore, ventricle escape beats arise 	<ul style="list-style-type: none"> ■ Prepare to pace!!

Third-degree AV Block



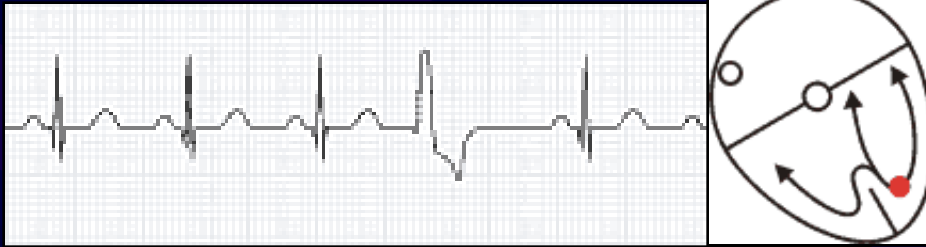
Premature Beats

PAC (Premature Atrial Contraction)

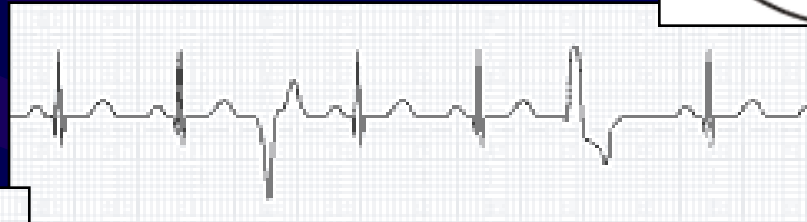
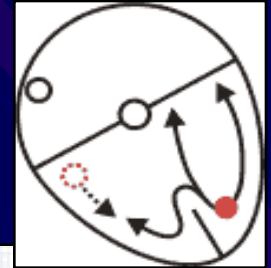


- Caused by a premature contraction
- Patient may or may not sense a “skipped” beat

PVC (Premature Ventricular Contraction)



PVC



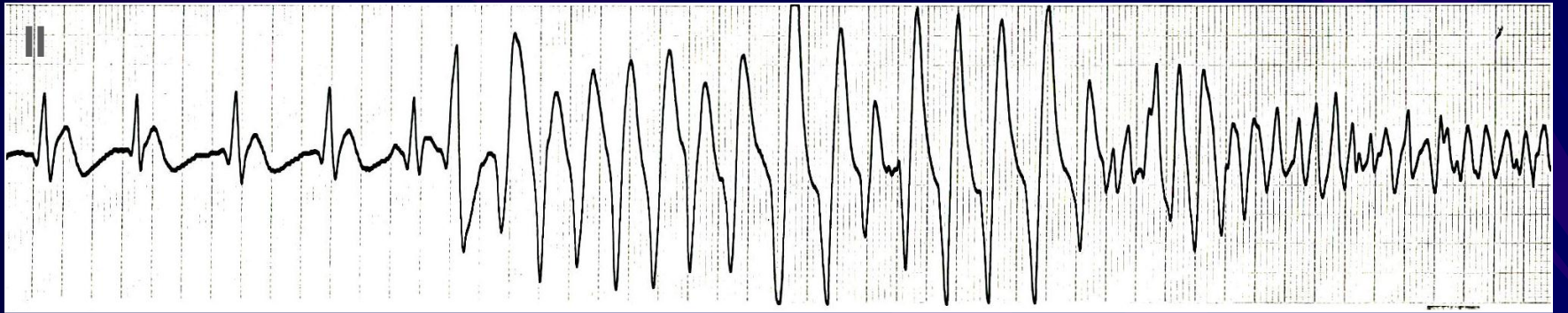
**Multi-focal or Polymorphic
PVC's**

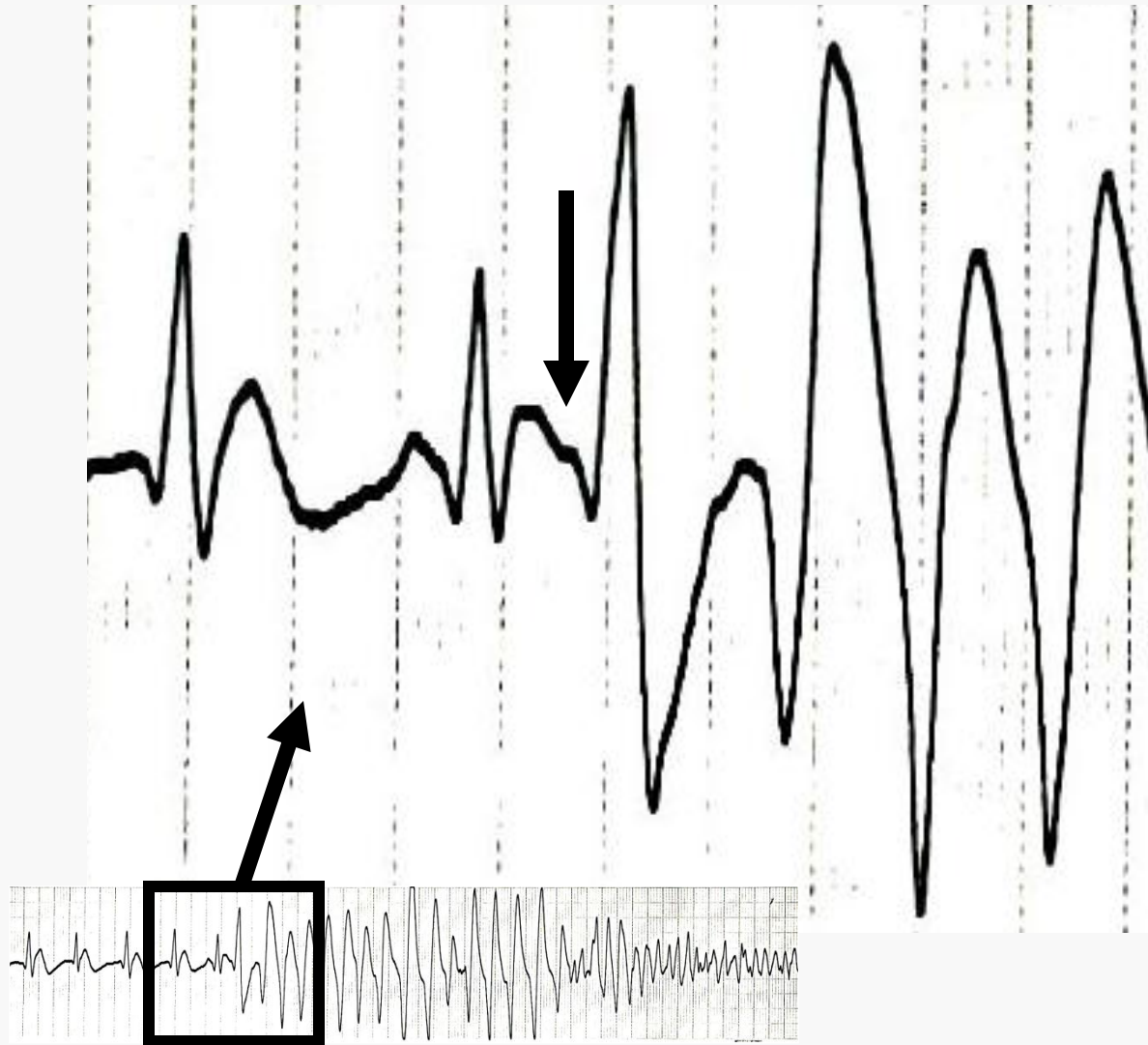


Bigeminy



Trigeminy





Pulseless Electrical Activity

What is PEA?

Definition:

“PEA is a rhythmic display of some type of electrical activity other than VT/VF, but without an accompanying pulse that can be palpated by any artery.”

PEA is a Survivable Rhythm

Key to Survival: Rapidly determining underlying causes

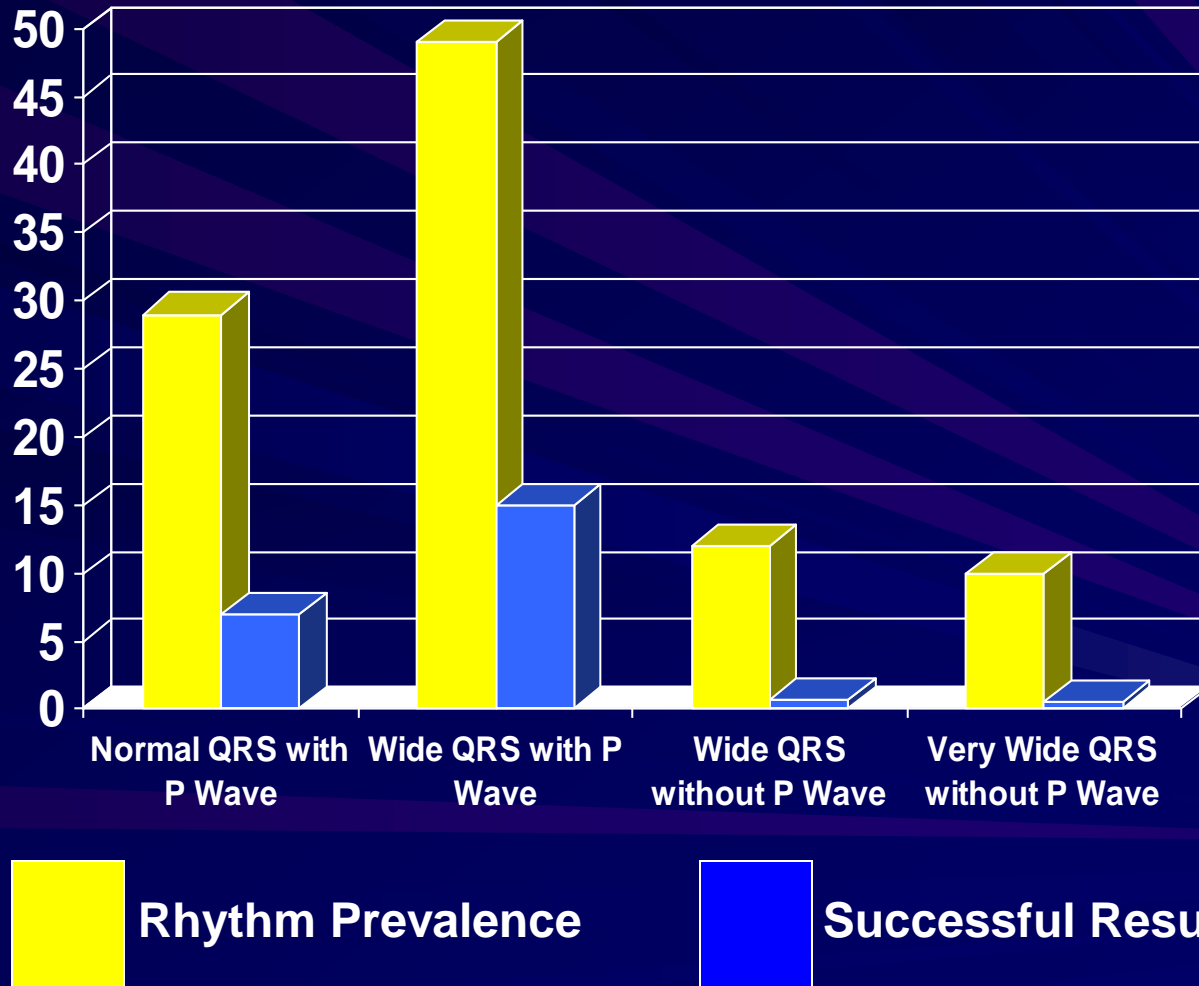
6 H's

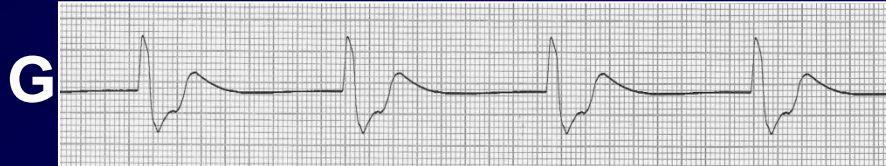
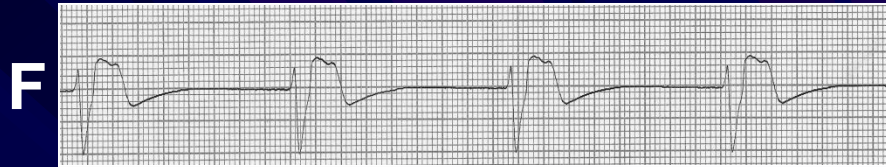
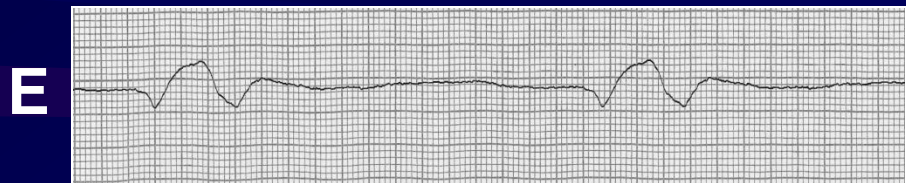
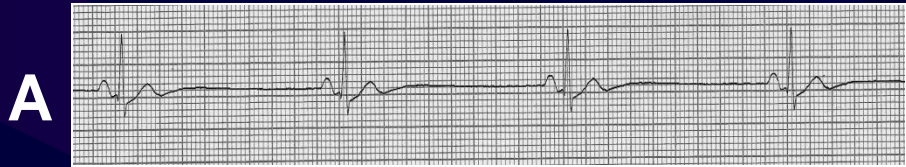
- Hypovolemia
- Hypoxia
- Hydrogen Ion (acidosis)
- Hyper/hypo-kalemia
- Hypothermia
- **Hypoglycemia**

6 T's

- Tablets, toxins
- Tamponade, Cardiac
- Tension Pneumothorax
- Thrombosis, Cardiac
- Thrombosis, Pulmonary
- Trauma

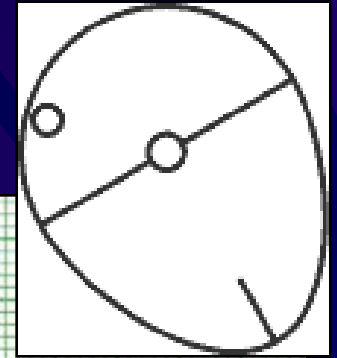
Rhythm Characteristics in PEA Relative to Resuscitation Outcome





Asystole

Asystole



P Wave	PR Interval	QRS Rate	Rhythm	Pacemaker	Comment
▪Absent	▪Absent	▪None	▪None	▪No electrical activity!	▪Cardiac arrest! ▪Very poor prognosis!

Asystole

Present in 3 leads

