Interpretation of EKGs Session 1

William Camm, MD

FLMI, FALU, CLU, ACS, ARA

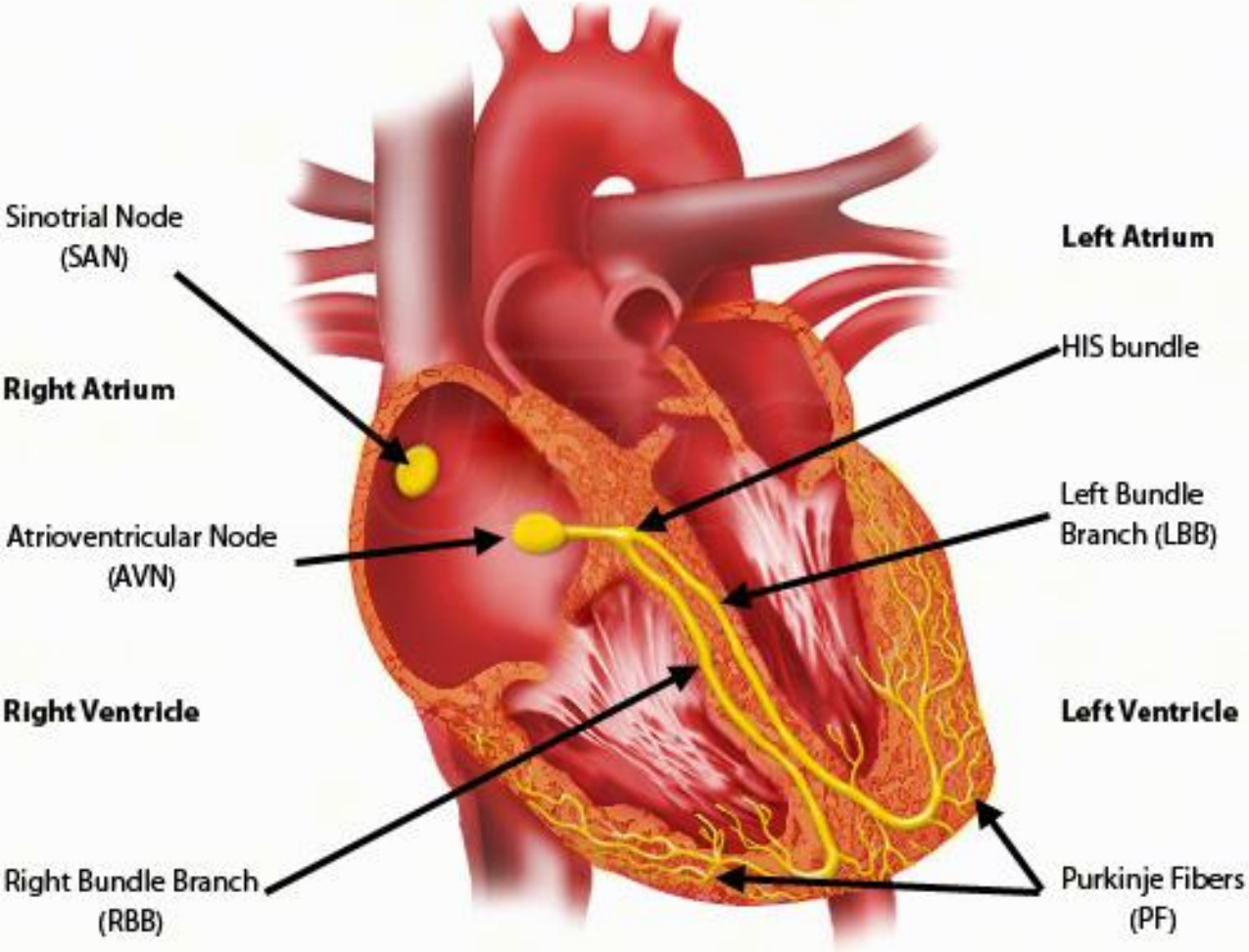
What we will learn

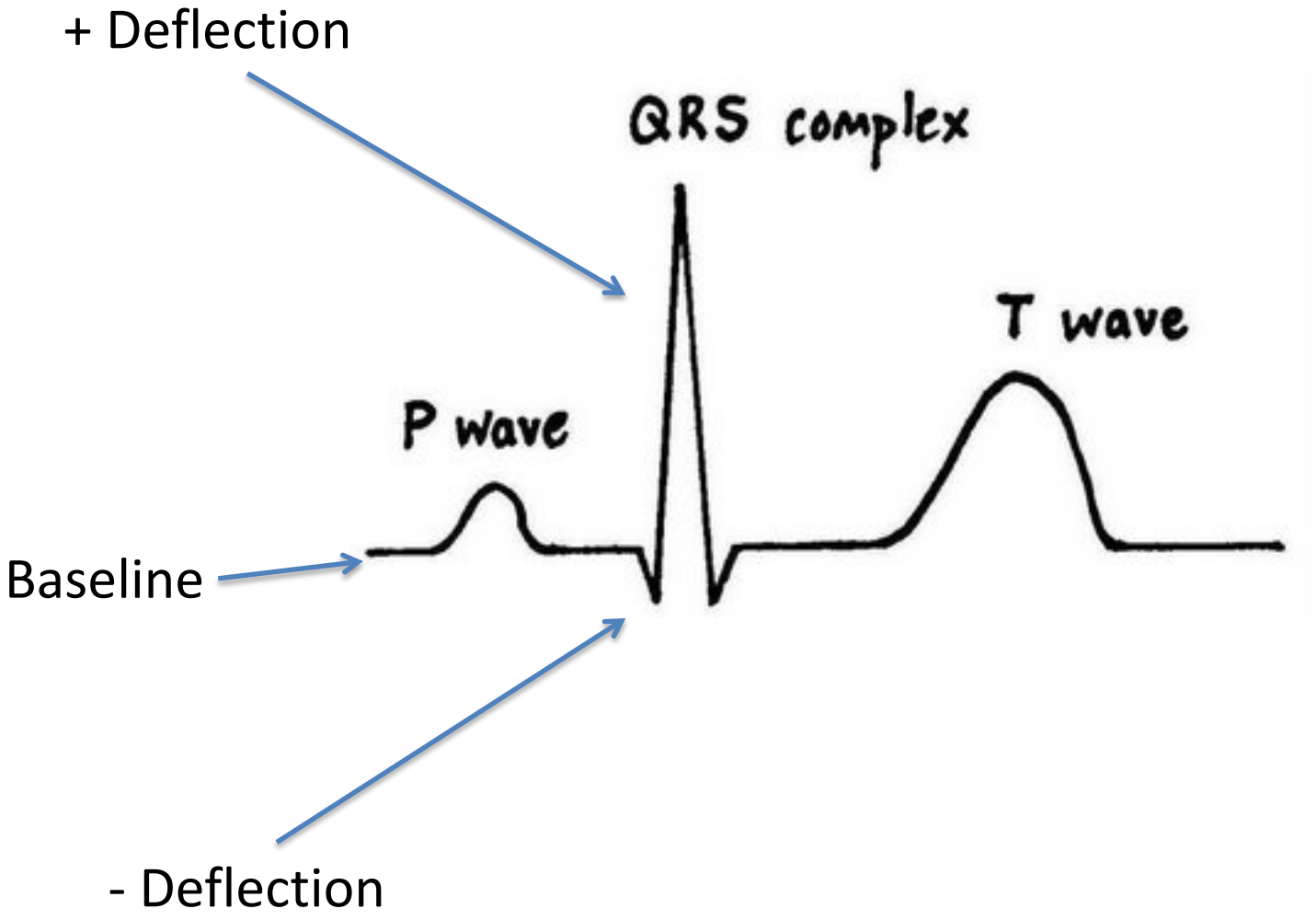
- Basics of EKG Interpretation
  - Normal vs abnormal
  - What to refer
- Leads
- Rate, Rhythm, Intervals, Conduction, Heart blocks, Hypertrophy, Infarctions (old and new), Ischemia and misc abnormalities (WPW, pacemakers etc)
- Our course based on Dubin's book "Rapid Interpretation of EKG's"
- EKG calipers very helpful

Basics

- Invented by Einthoven in 1901
- Basic anatomy of the heart
  - 2 atria, 2 ventricles
- EKG records electrical activity in the heart
- Depolarization/repolarization
- Electrodes record positive and negative activity
  - Positive: needle goes above baseline
  - Negative: needle goes below baseline

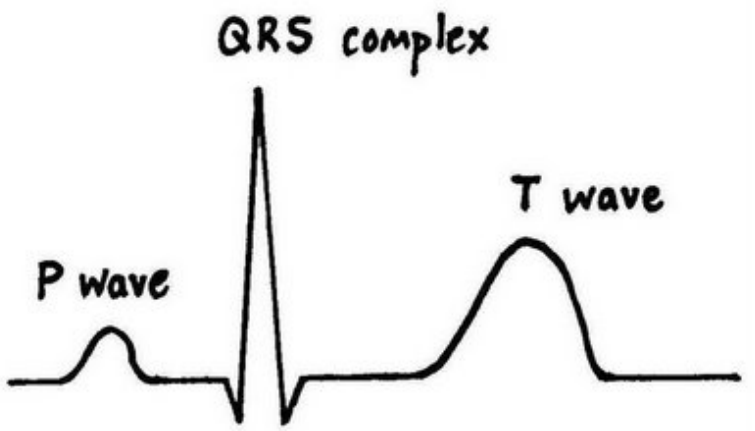
Cardiac Conduction system

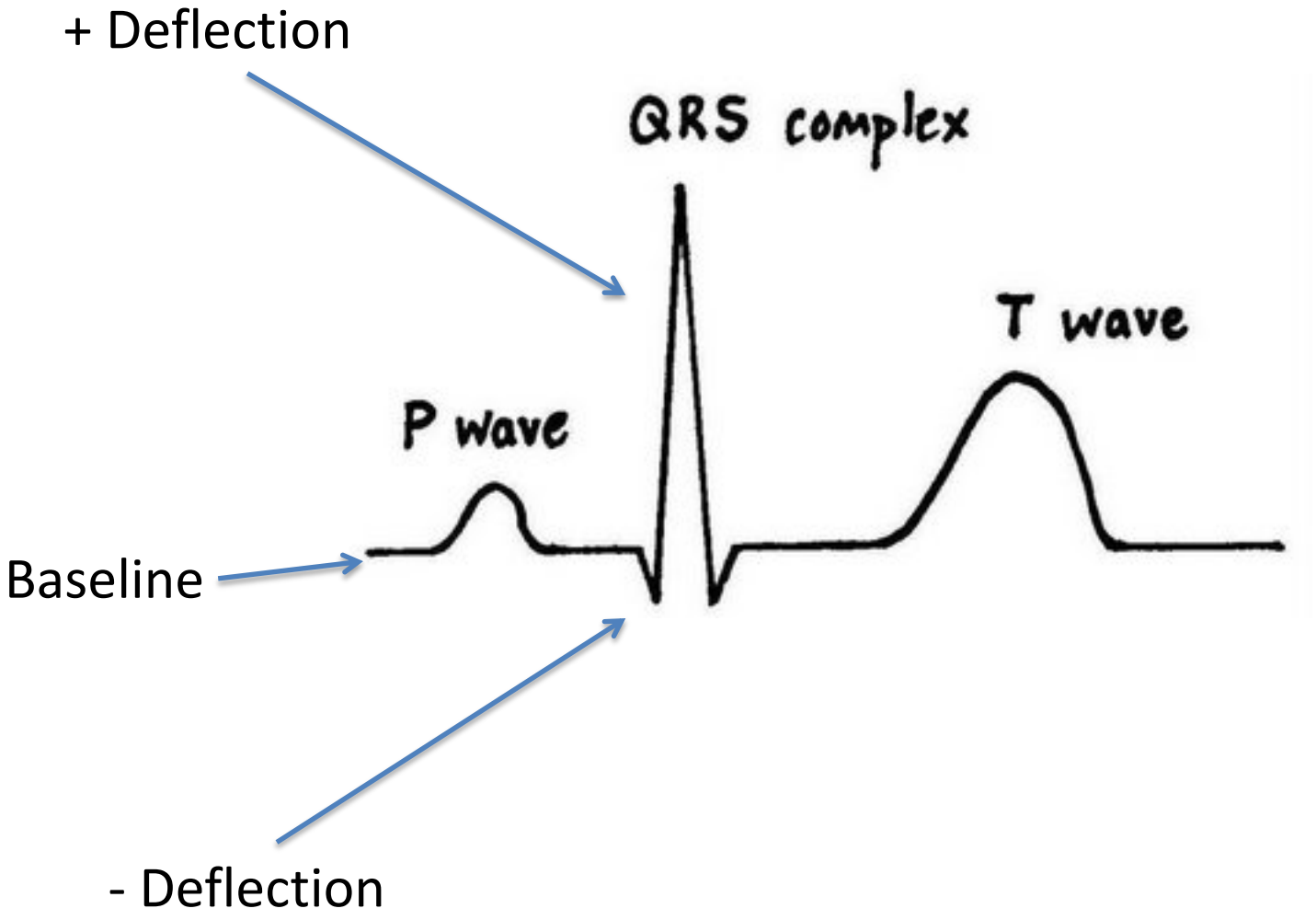



+ Deflection
QRS complex
T wave
P wave
Baseline
- Deflection

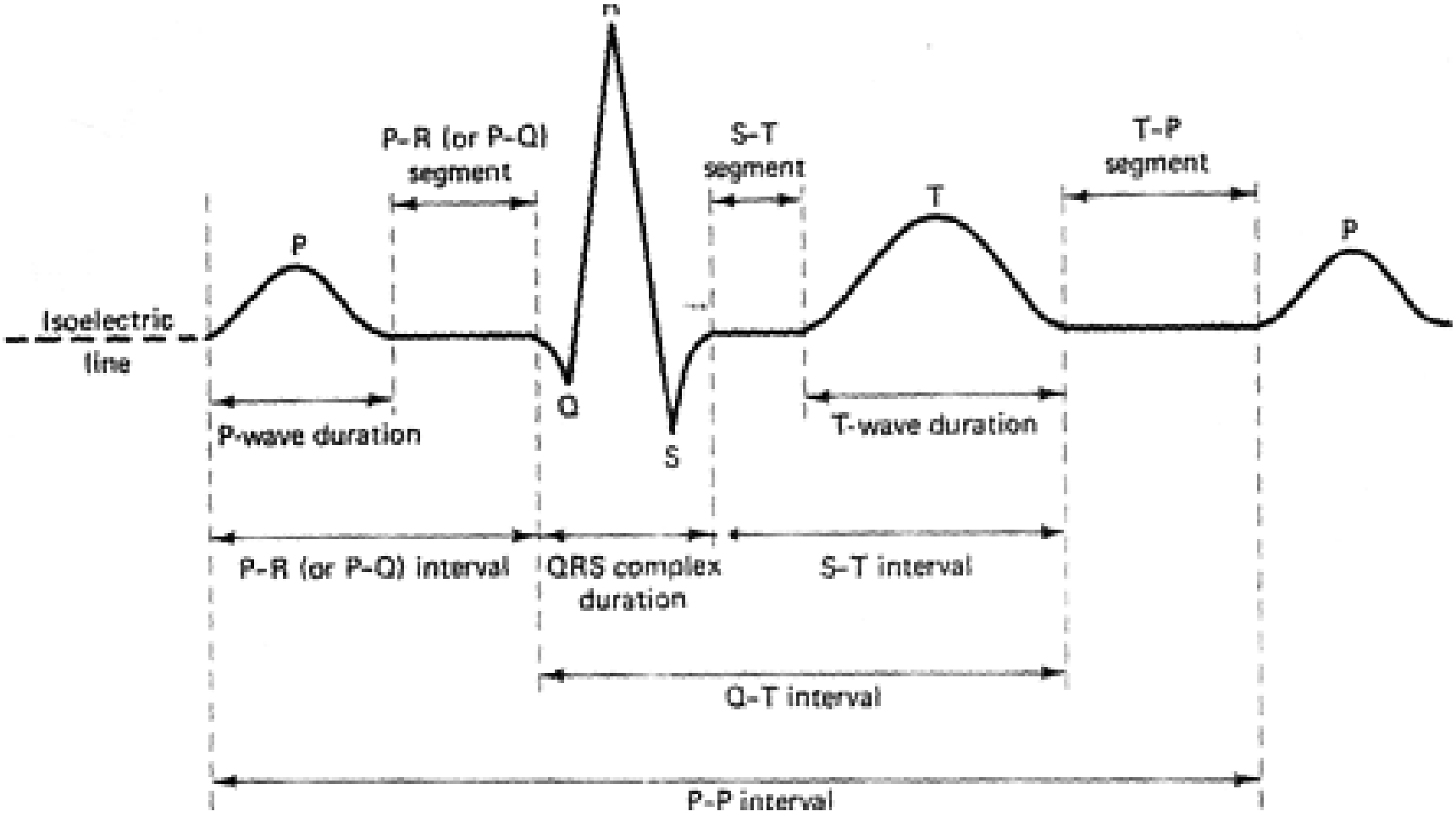
Waves

- PQRST
- P wave: atrial depolarization
- QRS: ventricular depolarization
- T: ventricular repolarization




+ Deflection
QRS complex
T wave
P wave
Baseline
- Deflection

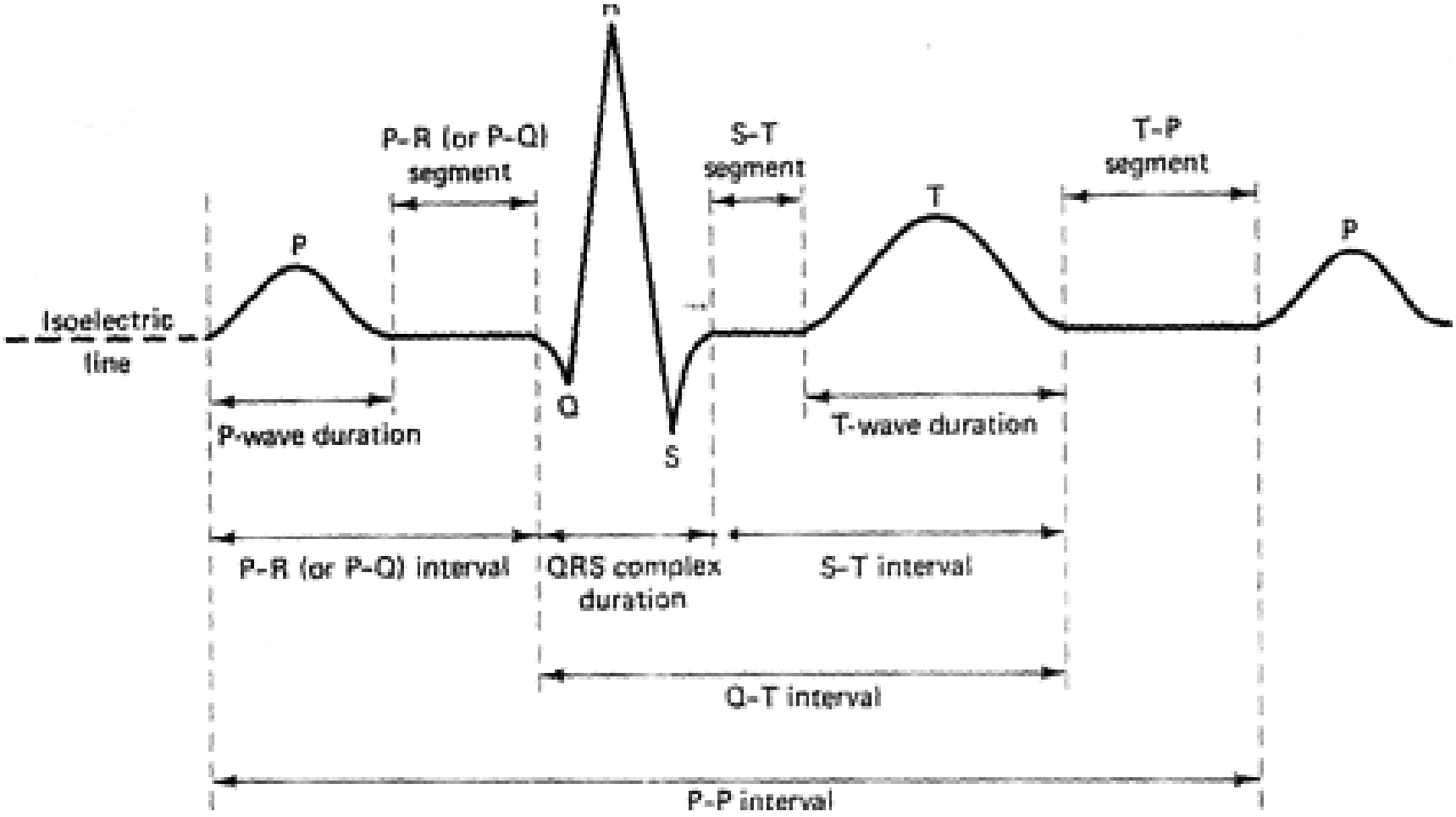
EKG Waves


R
P-R (or P-Q) segment
S-T segment
T-P segment
T
P
P
Isoelectric line
Q
S
P-wave duration
T-wave duration
P-R (or P-Q) interval
QRS complex duration
S-T interval
Q-T interval
P-P interval

QRS

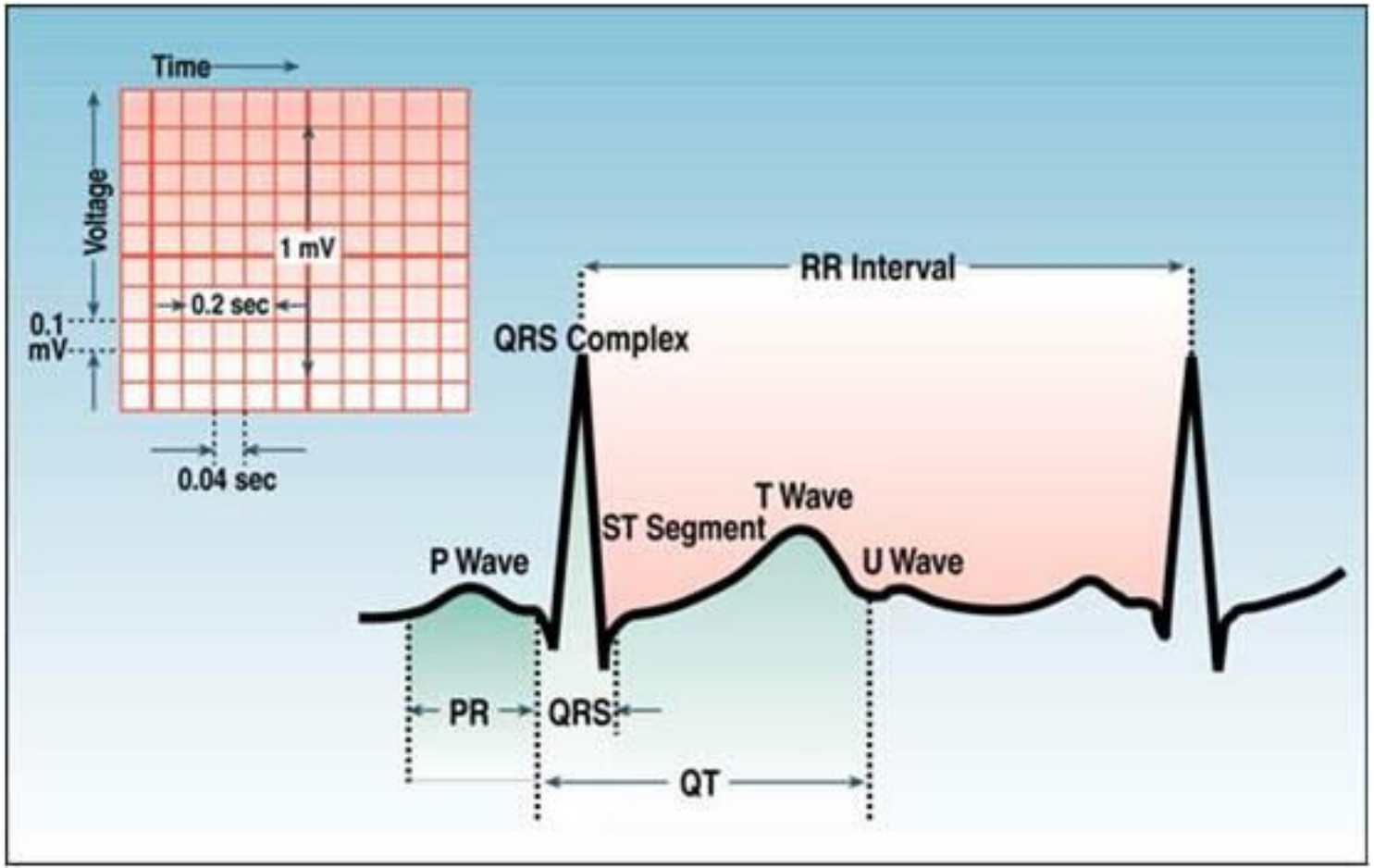
- Q: 1st downward deflection
- R: 1st upward deflection
- S: 2nd downward deflection
- R’: second upward deflection

EKG


R
P-R (or P-Q) segment
S-T segment
T-P segment
T
P
P
Isoelectric line
Q
S
P-wave duration
T-wave duration
P-R (or P-Q) interval
QRS complex duration
S-T interval
Q-T interval
P-P interval

U waves

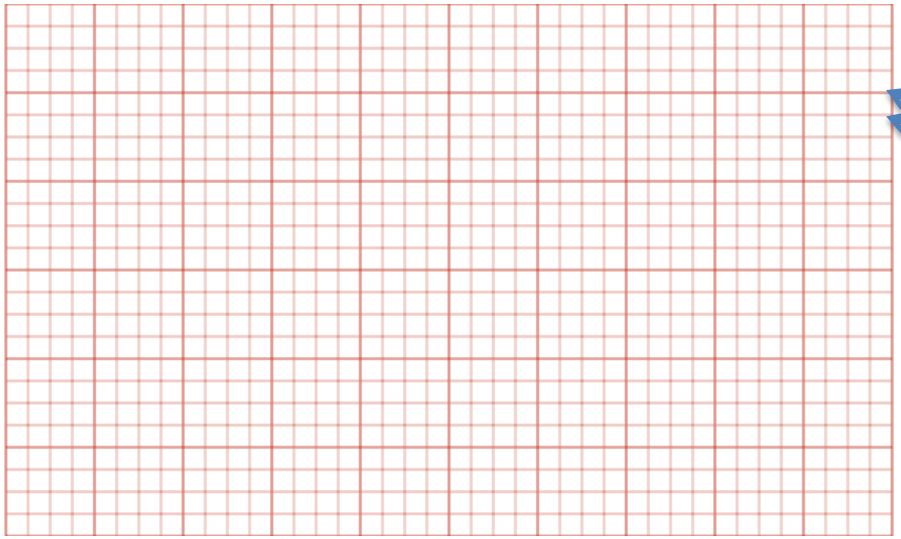
- Associated with low K+



EKG Recording

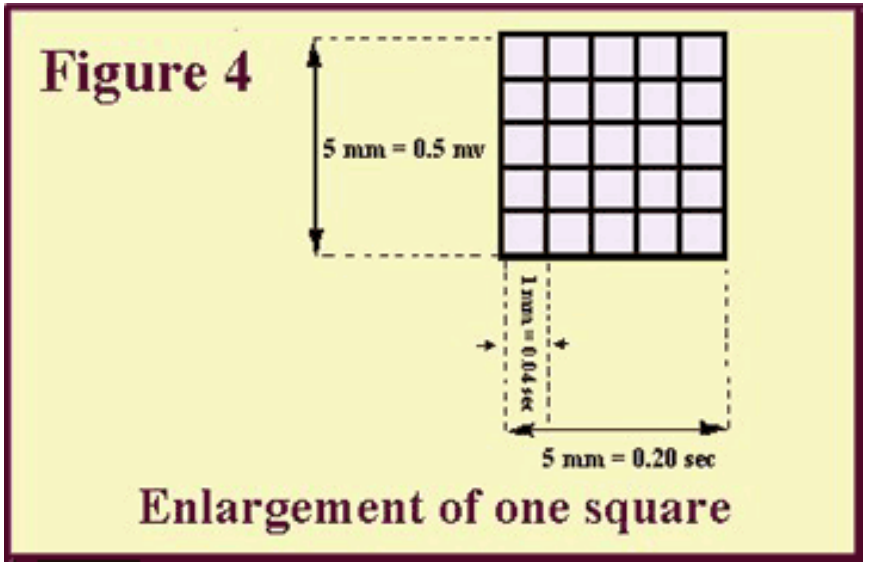
- Horizontal is time in seconds
  - 1mm = 0.04 seconds: 1 small box
  - 5mm= 0.2 seconds: 1 large box (5 small boxes)
- Vertical is voltage in millivolts
  - Baseline: up is positive, down is negative
  - 1mv = 2 large boxes
- Paper speed: 25mm/second
  - Look for paper speed; some run at 50mm/sec
  - Makes heart rate look very slow

EKG Recording

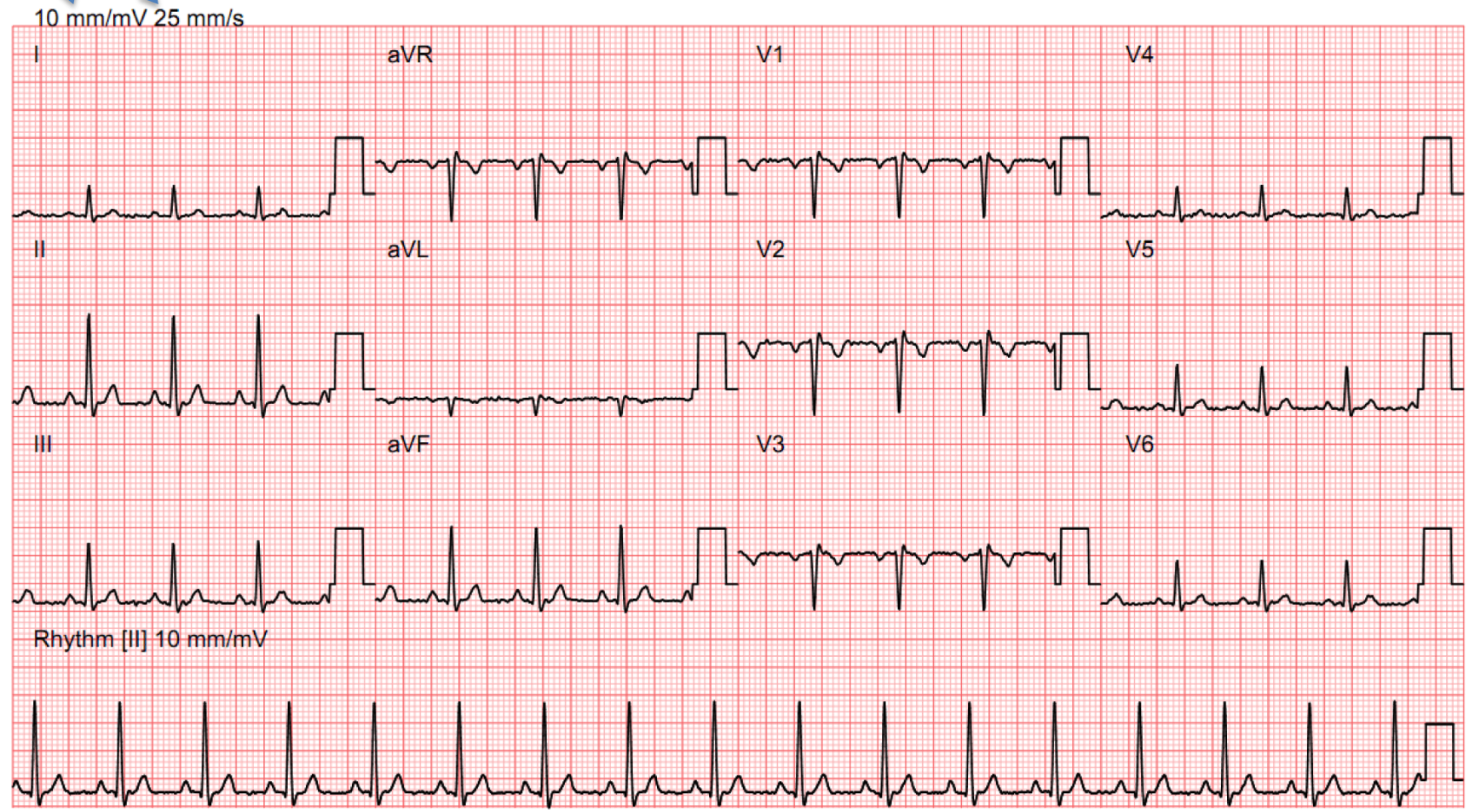


Little Box

Big Box



Paper Speed and Voltage

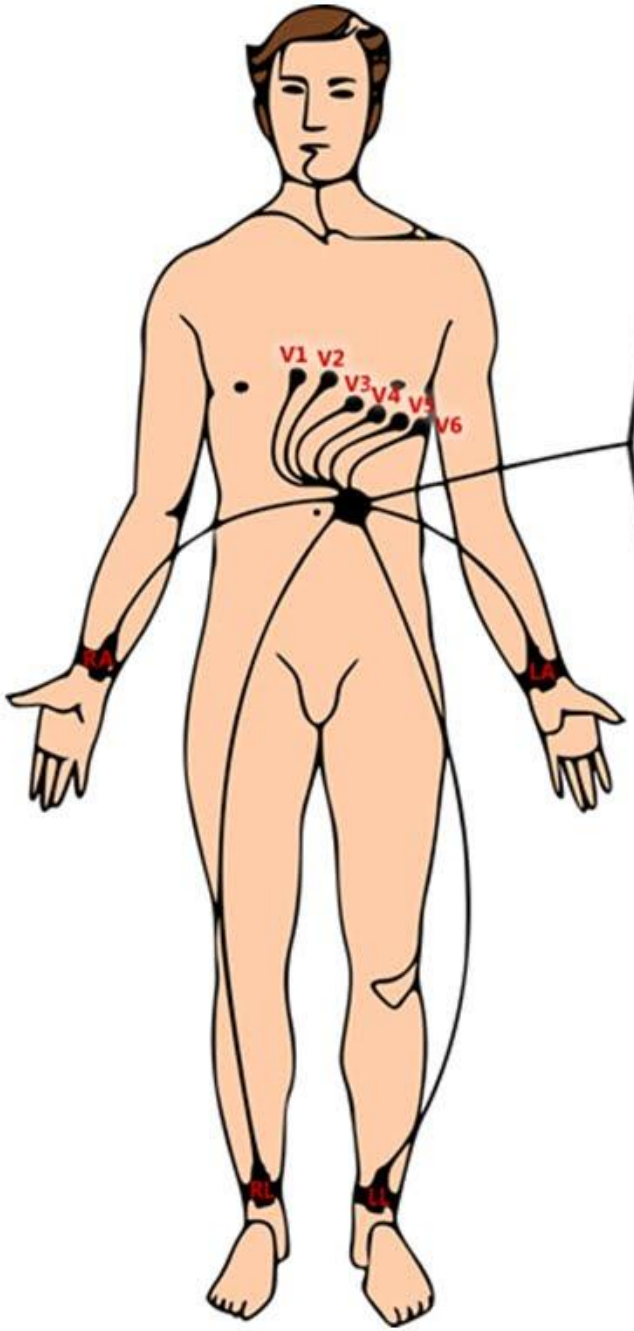


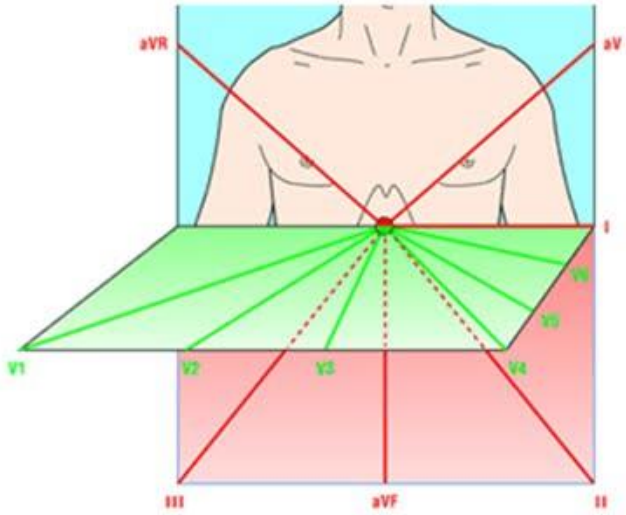
Standard EKG

- 12 leads
- 25mm/sec paper speed
- 1 mv = 2 large boxes or 10mm high

EKG Leads

- 12 leads
  - 3 limb leads: I, II, III
  - 3 augmented limb leads: AVR, AVL, AVF
    - The term “augmented” is not important
    - Therefore, 6 limb leads
  - 6 chests leads: V1-6
- Allows us to look at the heart from many different angles





V1 - 4th intercostal space
R sternal border

V2 - 4th intercostal space
L sternal border

V3 - Between leads V2 and V4.

V4 - 5th L intercostal space in midclavicular line

V5 - Horizontally even with V4, but in the anterior axillary line.

V6 - Horizontally even with V4 and V5 in the midaxillary line. (The midaxillary line is the imaginary line that extends down from the middle of the patient's armpit.)

What do the Leads look at? Very Important!

- I and L: lateral side of LV (LCA)
- 2, 3 and F: Inferior side of LV (RCA)
- V1-2: anterior, septum, and right ventricle
- V2-4: anterior wall of LV
- V4-6: anterior and lateral wall of LV
  - LV supplied by the LAD and LCA

Lead Placement

- A big issue with insurance EKG's
- Leads often reversed
  - Leg lead placed on arm and vice versa
  - Chest leads not properly placed
- Will review later hints suggesting improper lead placement

Autonomic NS control

- Not important to us learning to read EKG's
- Sympathetic NS speeds up heart
- Parasympathetic system slows it down

Heart Rate

- Normal heart rate: 60-100
- <60: sinus bradycardia
- >100: sinus tachycardia
  - Note that MIB codes differently
    - ST: no code until >110
    - SB: no code until <45

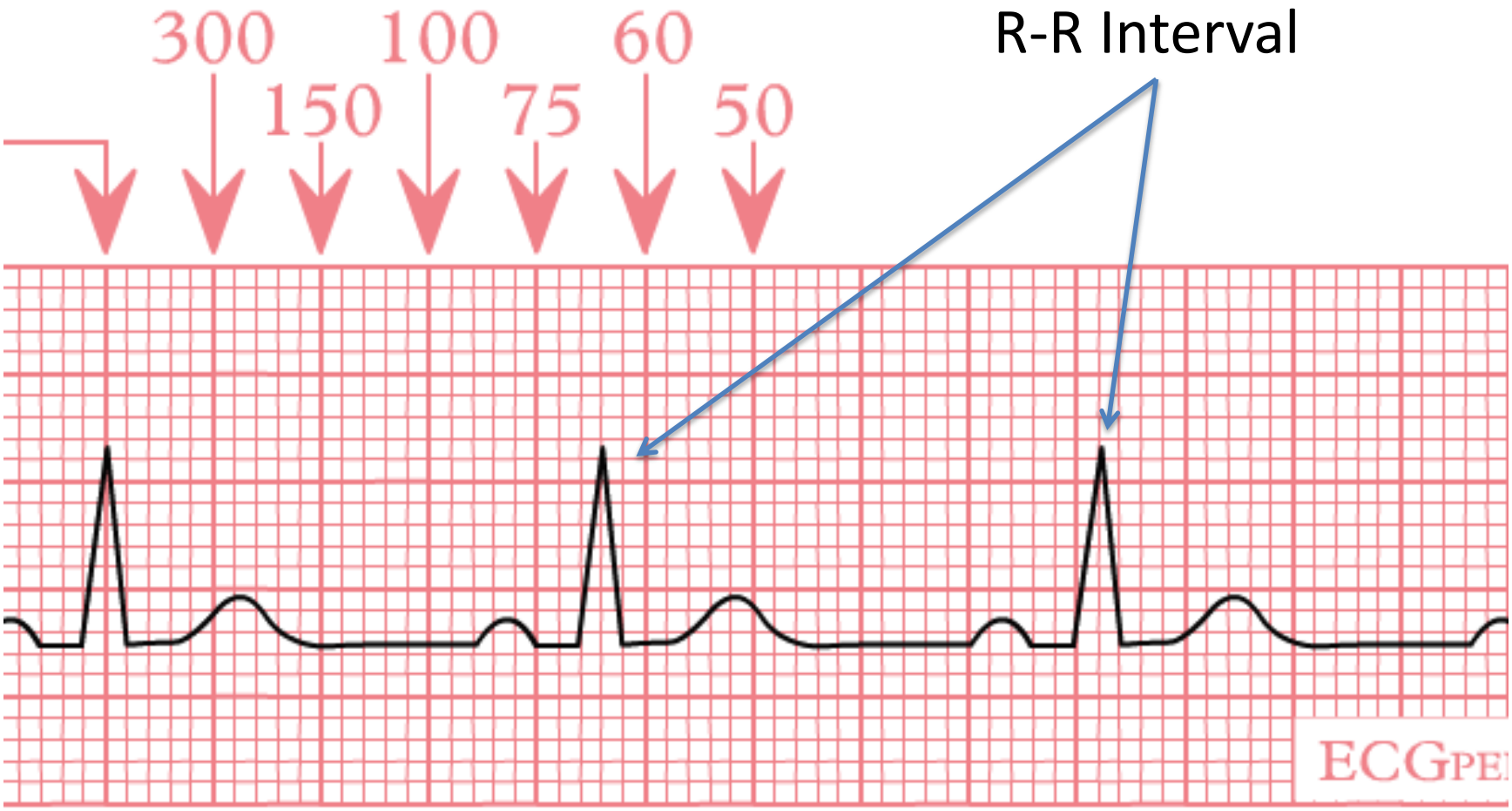
Rate Disorders

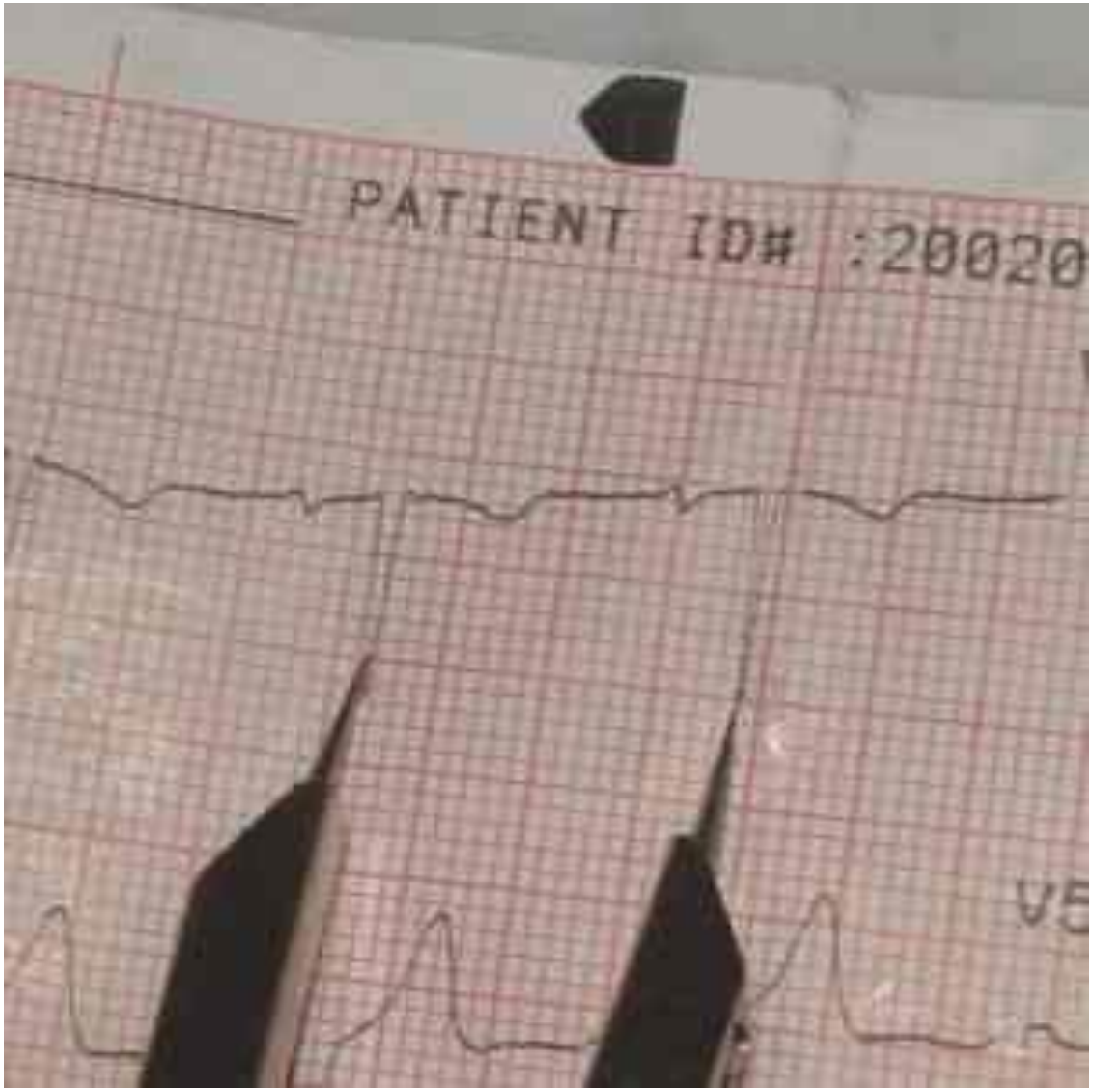
- Tachycardia or bradycardia
- Different types
  - Where does it arise from?
    - Atrium, ventricle, His Bundle
  - Paroxysmal (occasional)
  - Constant or regular

Heart Rate

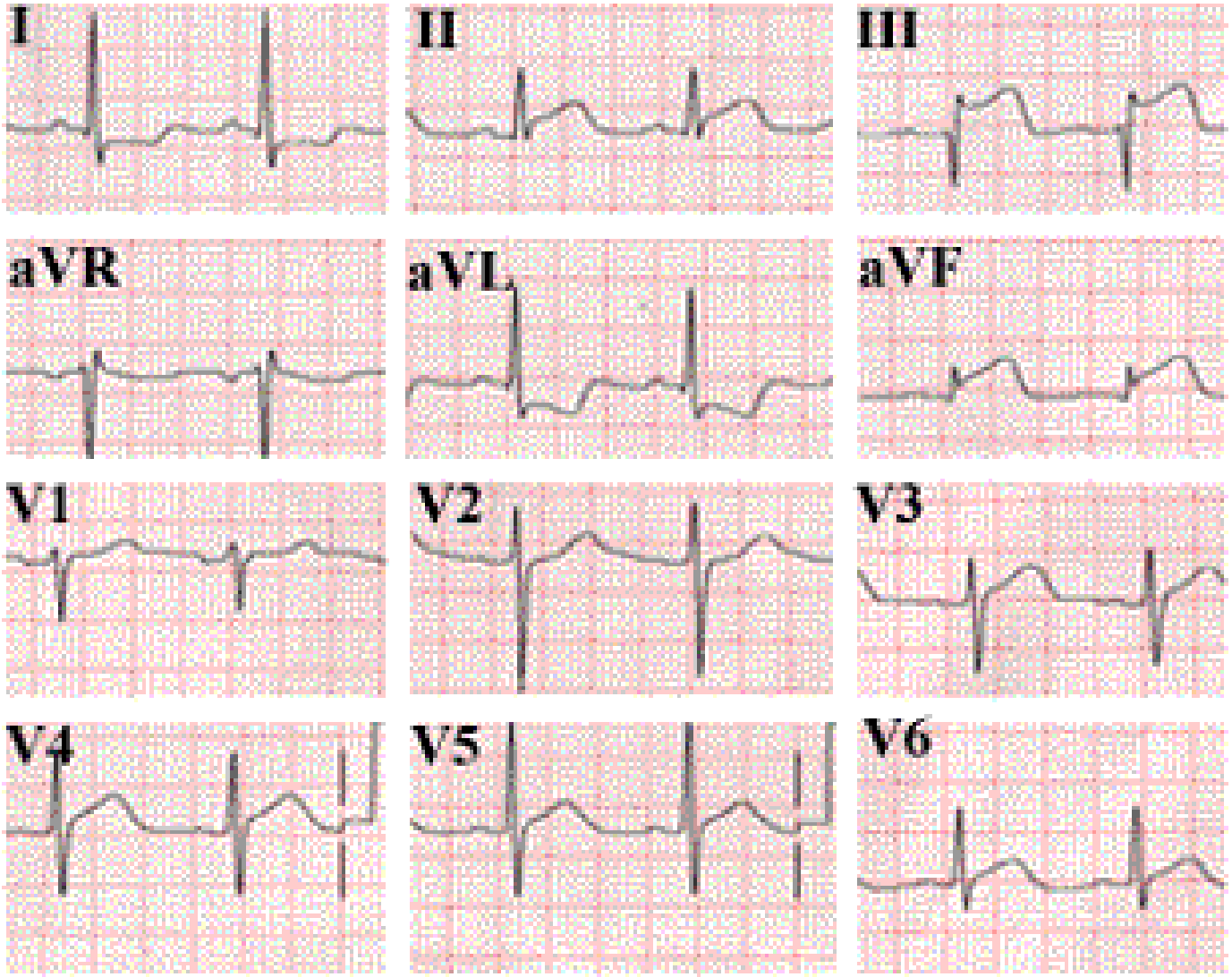
- Need to memorize: 300, 150, 100, 75, 60, 50
- Use your calipers
- Place on 2 consecutive R waves then use boxes to determine rate
- Make sure paper speed at 25mm/sec
- Best to use a rhythm strip if available
  - Tracing should have a 6 second rhythm
  - Usually lead II

Heart Rate

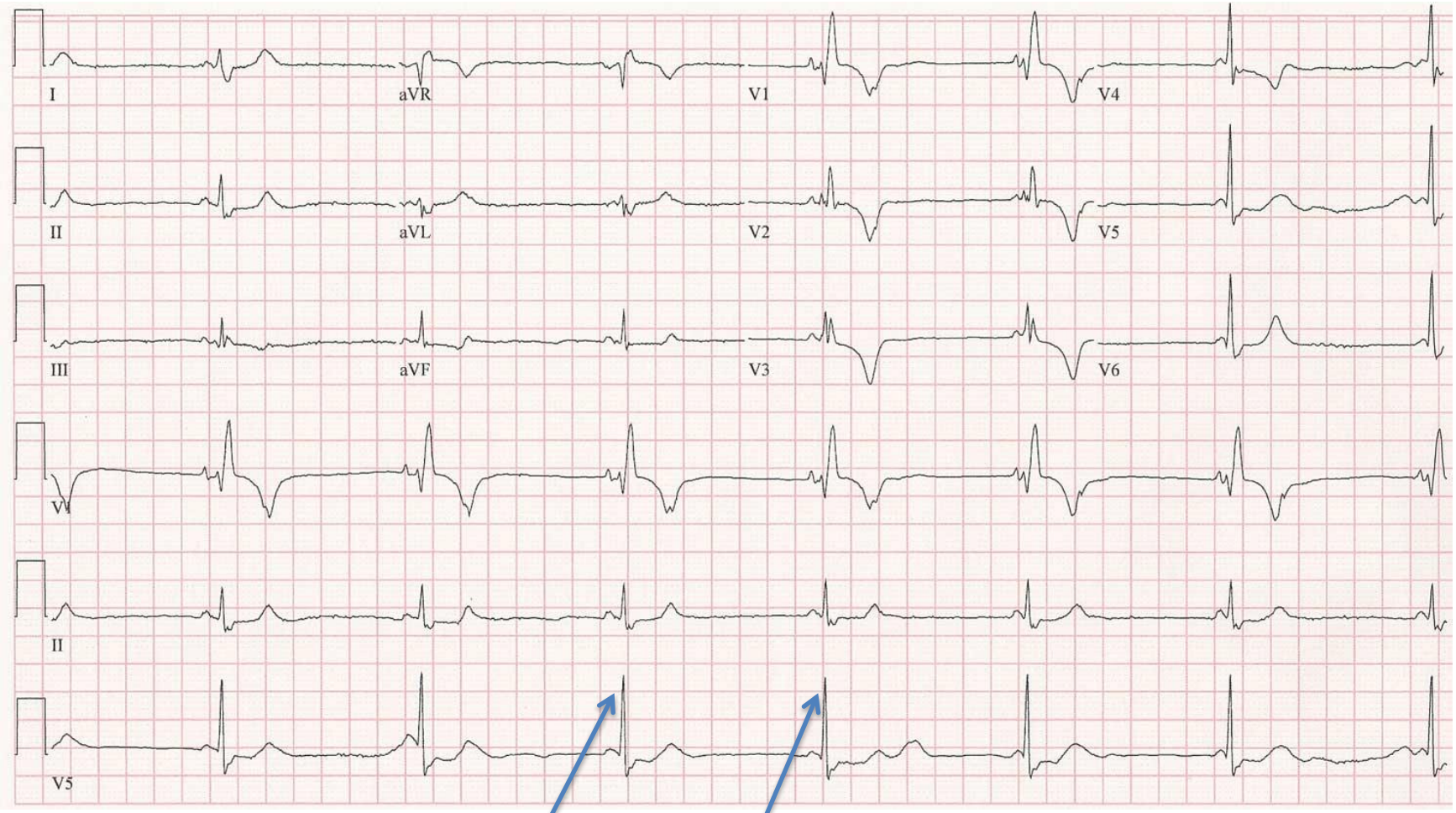



PATIENT ID# :20020
V5

Heart rate?



Heart Rate?

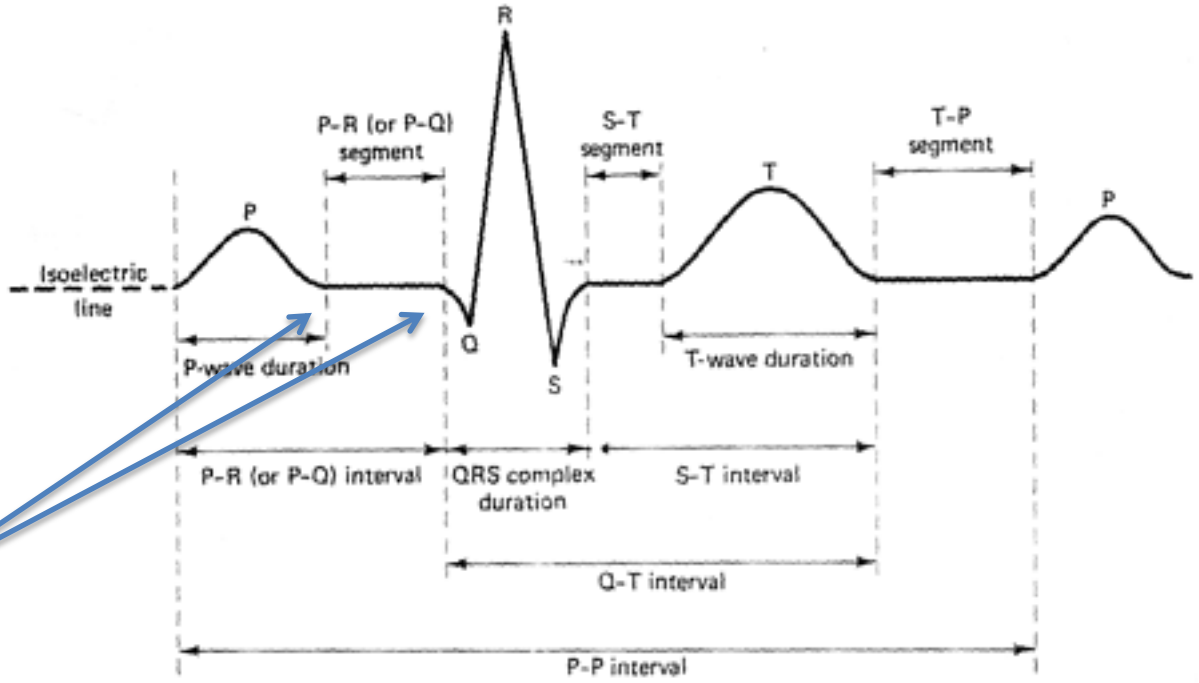


Rate
43

Rhythm Strip

Intervals
3 Important Ones

- PR interval
- QRS interval
- QT interval



Use calipers to measure: PR interval

Important Intervals

- PR: normal between 0.12 and 0.2 (3-5 small boxes)
  - Will discuss when outside this range
    - Long: 1st degree AV block
    - Short: WPW
- QRS: normally < 0.12 (3 small boxes)
- QT: rate dependent
  - Normally 0.36 to 0.40 (<1/2 RR interval)
  - Will discuss when outside this range
  - QTc: corrected QT based on rate

Rhythm Disorders

- Normal Sinus Rhythm
- Sinus arrhythmia: not impt to insurance
- Irregular rhythms
  - Atrial
    - PAC's, PAT, AF
  - Ventricular
    - PVC's. VT, VF
- Pacemakers

Rhythm Disorders

- Hard to be sure of the disorder without a rhythm strip which we may not get
- We may only get a 12 lead tracing
- When in doubt refer
  - If irregular refer

Normal Sinus Rhythm

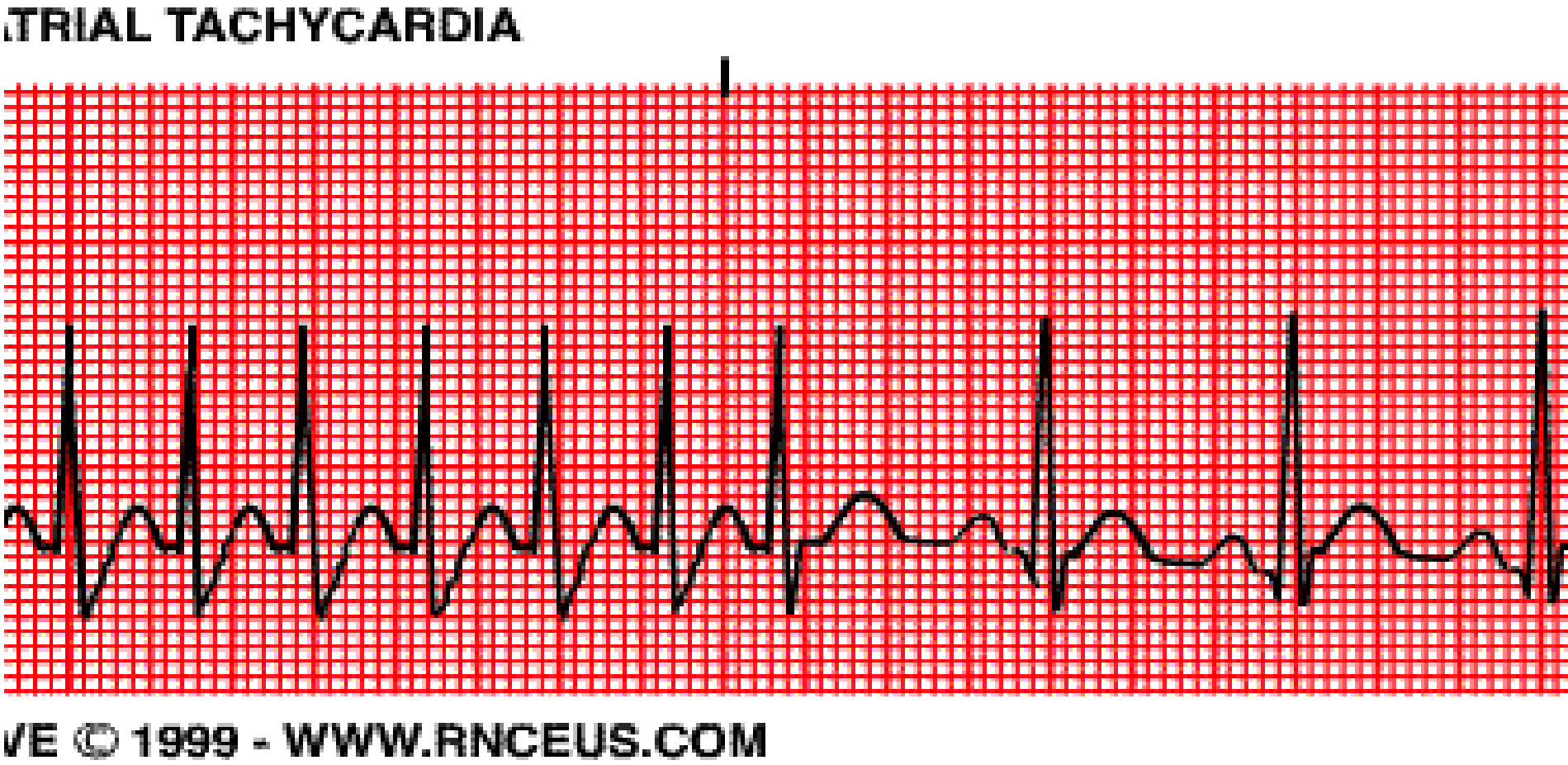
Sinus arrhythmia

Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
Usually 60-100	Irregular	Before each QRS, identical	.12 to .20	<.12

Premature Atrial Contraction
PAC

Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
N/A	Irregular	Premature & abnormal or hidden	<.20	<.12

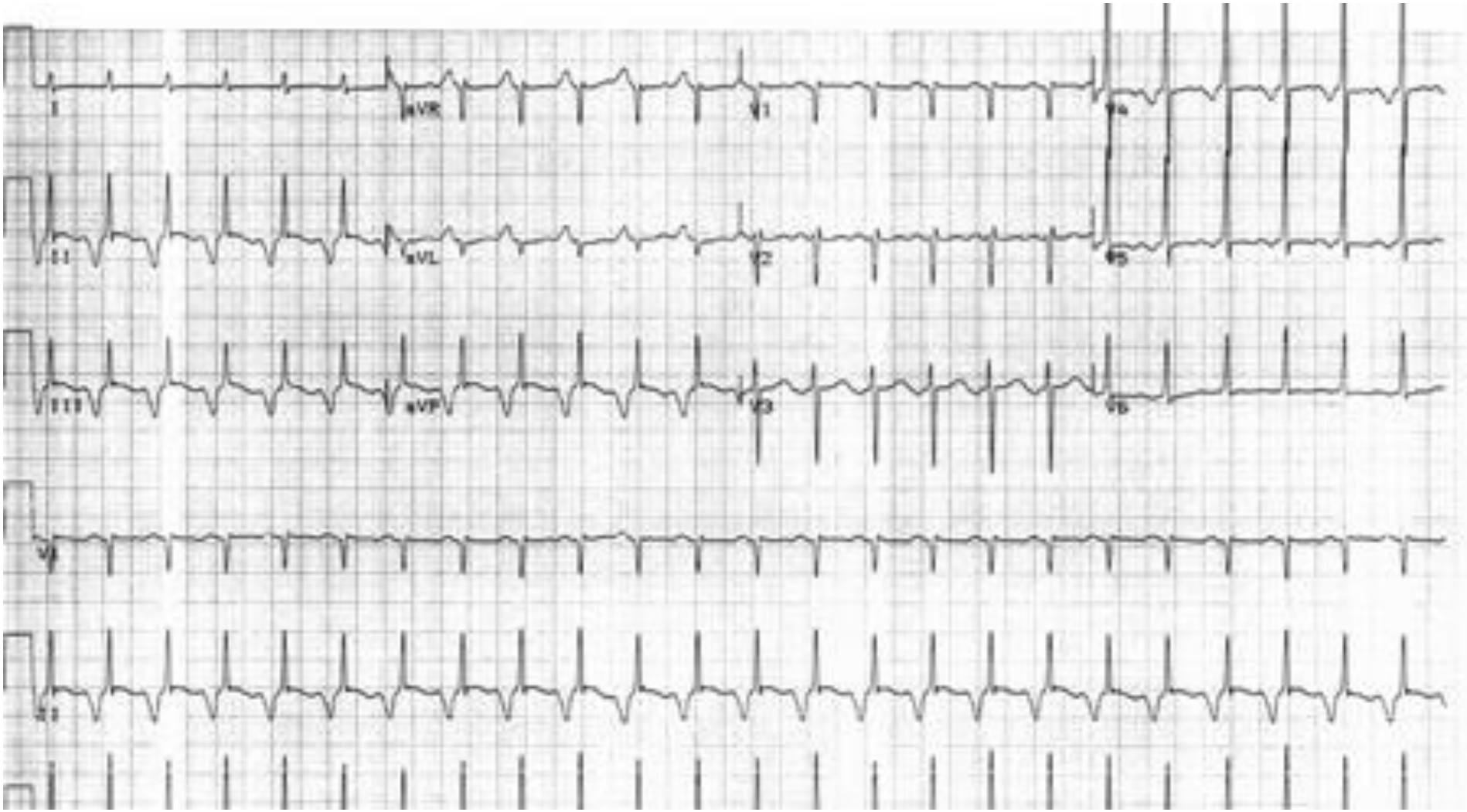
PAT



PAT v PSVT

- Sometimes cannot tell
  - If P waves are present can call PAT
  - If not PSVT
- Need a long rhythm strip
- If the heart rate is over 100 refer

PAT

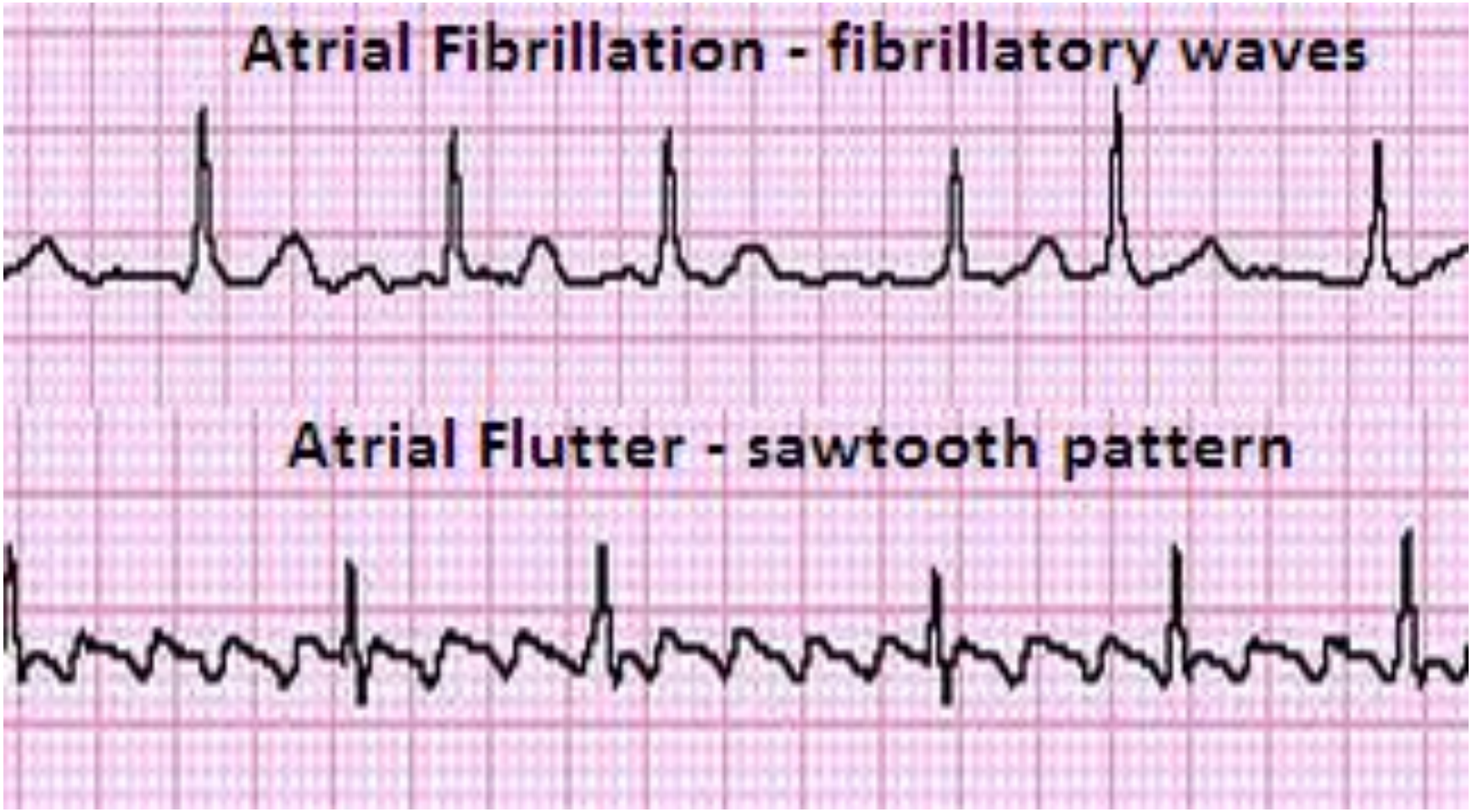


PAT

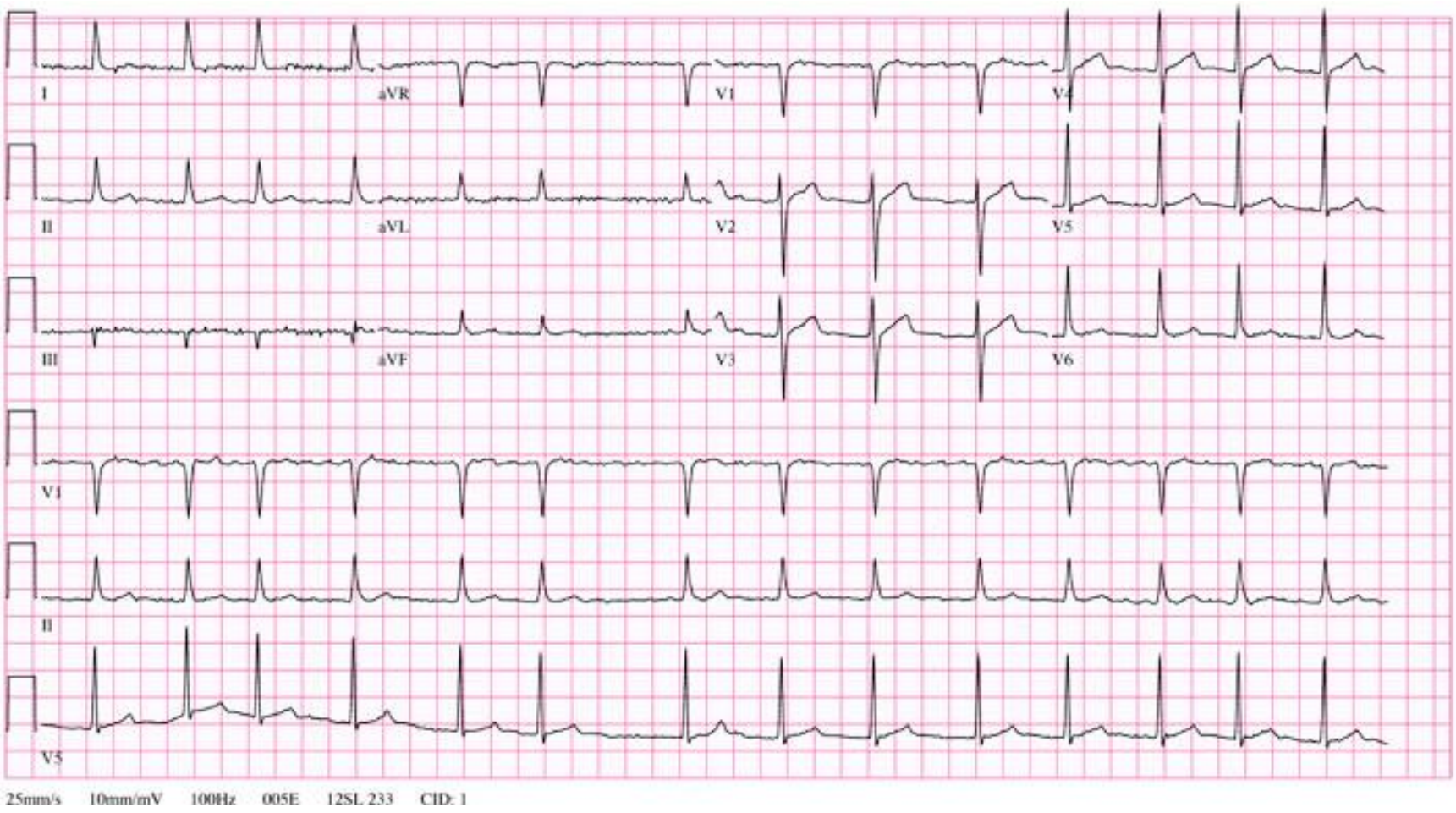
Atrial Flutter/Fibrillation

- Need to identify
- Cannot miss
- Extra mortality due to stroke risk
- Afib: irregularly irregular
- Aflutter: may be somewhat regular
- When in doubt refer

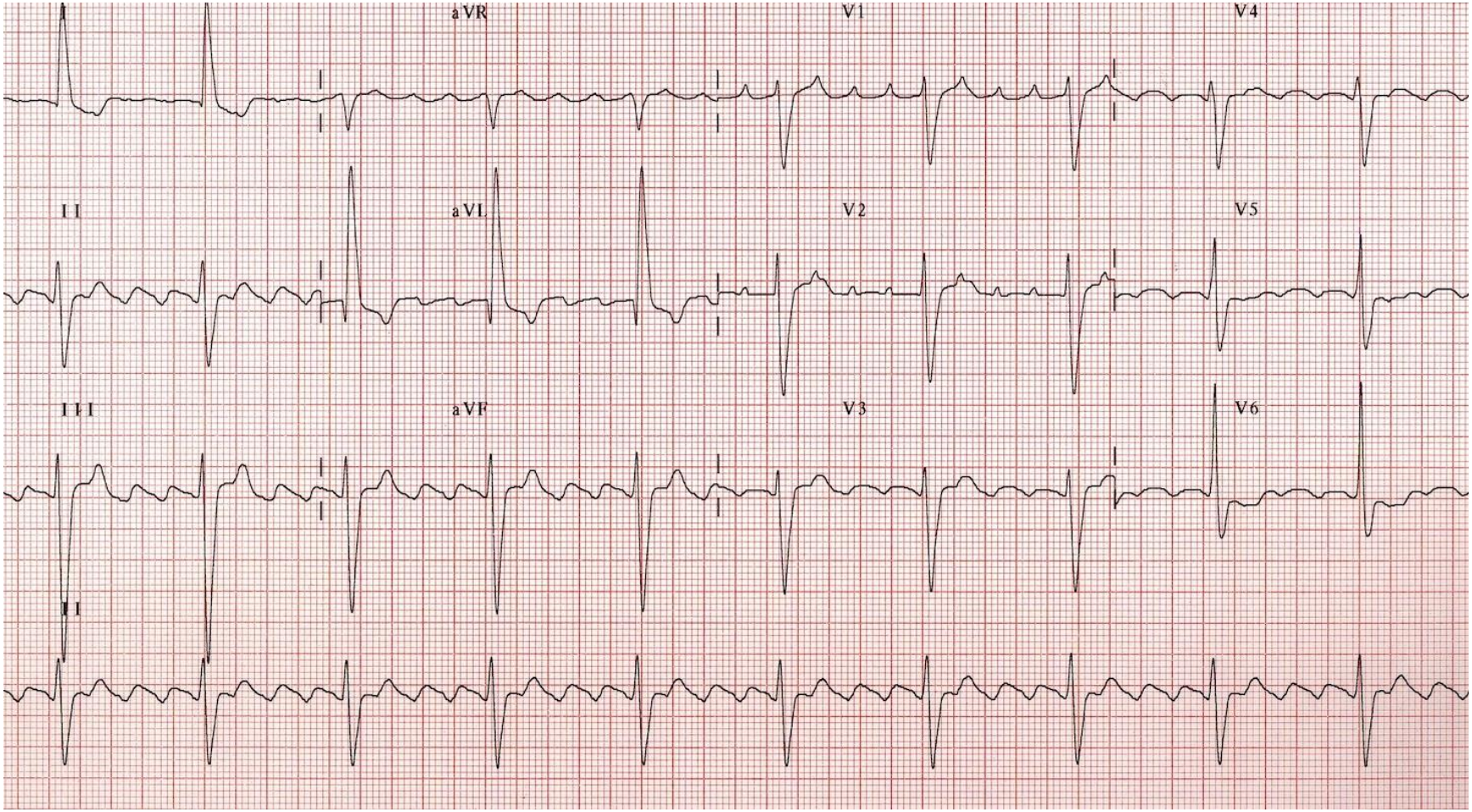
Aflutter/Afib



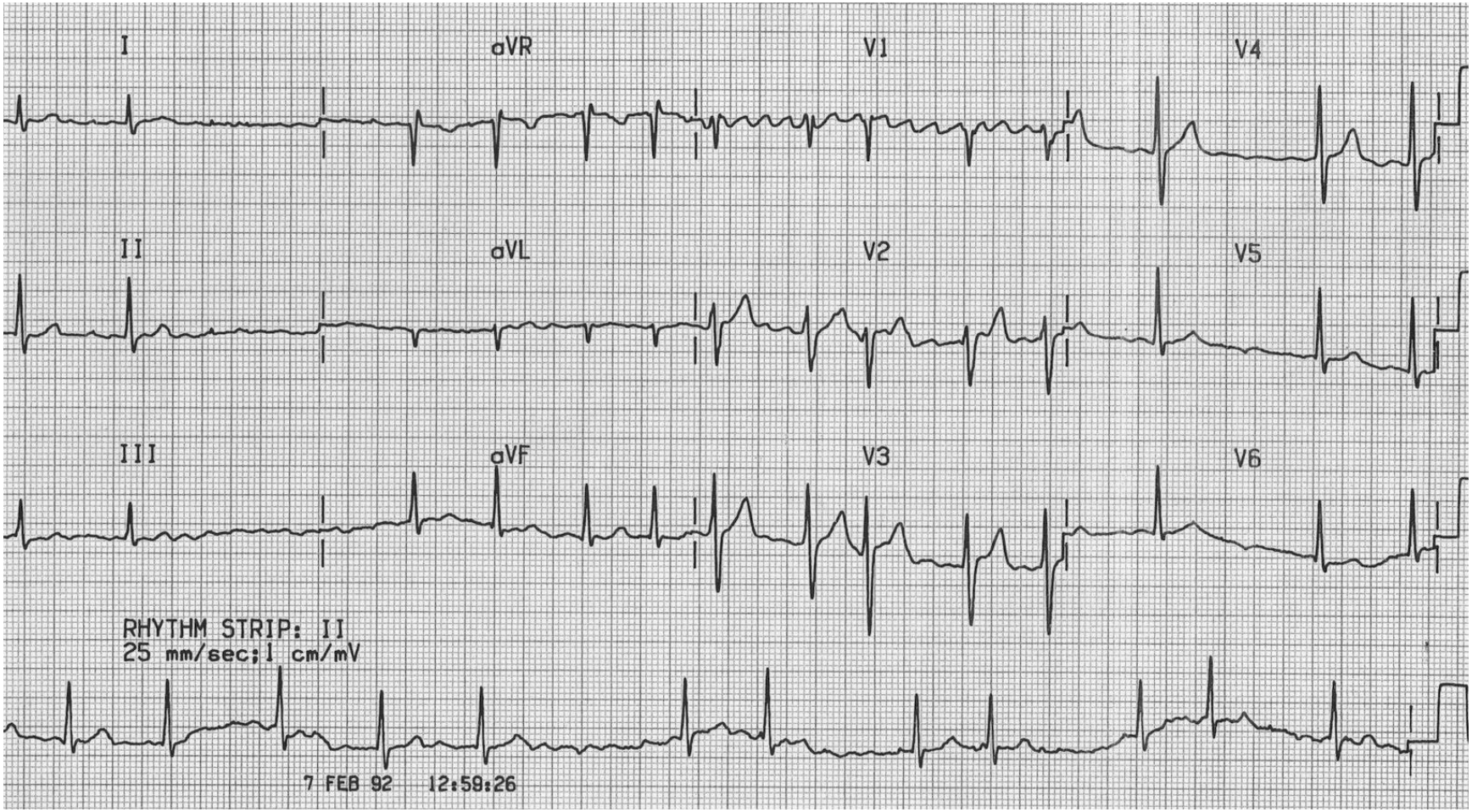
Afib


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5
25mm/s 10mm/mV 100Hz 005E 12SL 233 CID: 1

A Flutter



AFib


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV
7 FEB 92 12:59:26

Irregular Rhythms

- If the rhythm is in any way irregular refer the tracing
- **We cannot miss Afib/flutter**
- If you see the saw tooth waves suggesting flutter refer
- PAC’s and PVC’s

Ventricular Arrhythmias

- PVC's: common
- VT: less common but seen
  - Can be slow or fast
  - Is it a LBBB or VT?
- VF: only seen if there is a hx
  - Untreated VF=death

Premature Ventricular Contraction PVC

- Unifocal: arises from 1 place
- Multifocal
- Every other beat: bigeminy
- Every third beat: trigeminy
- 2 PVC’s in a row called a couplet
- 3 PVC’s in a row= VT
- VT can degenerate to VF

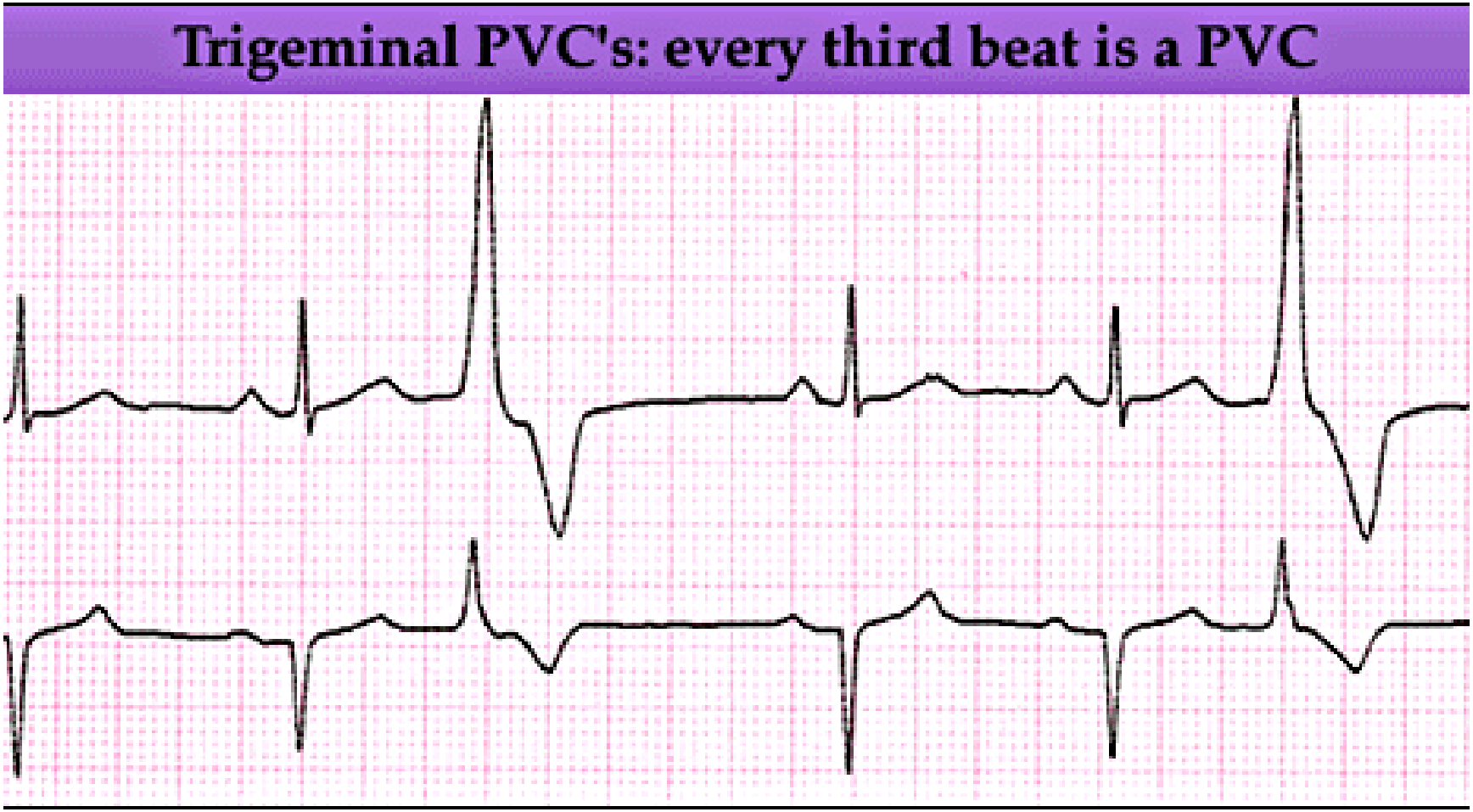
PVC's

- Wide complex
- Causes
  - Low blood oxygen
  - Low EF
  - Ischemia, injury, infarction
  - Low K+
  - MVP
- Mortality depends on cause
  - Can be benign

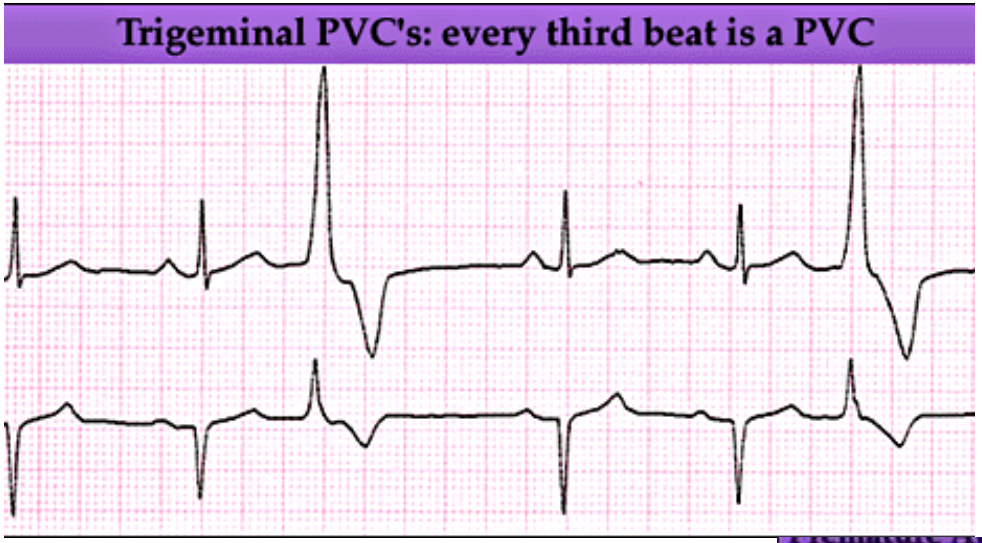
PVC's

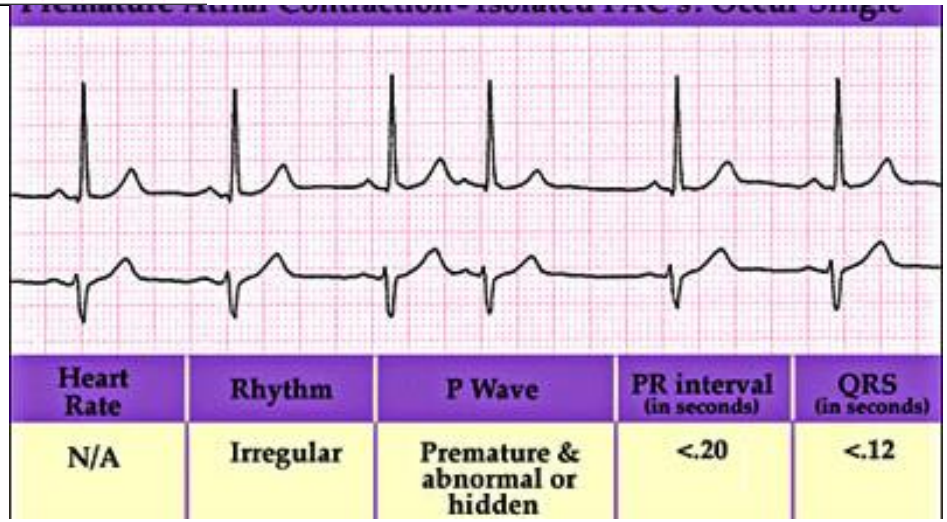
- Isolated: unifocal
  - Common, could be benign
  - Can be due to coffee, caffeine
- Multifocal: more worrisome
  - Worry about ischemia
- PVC's starting on a T wave more worrisome

PVC’s



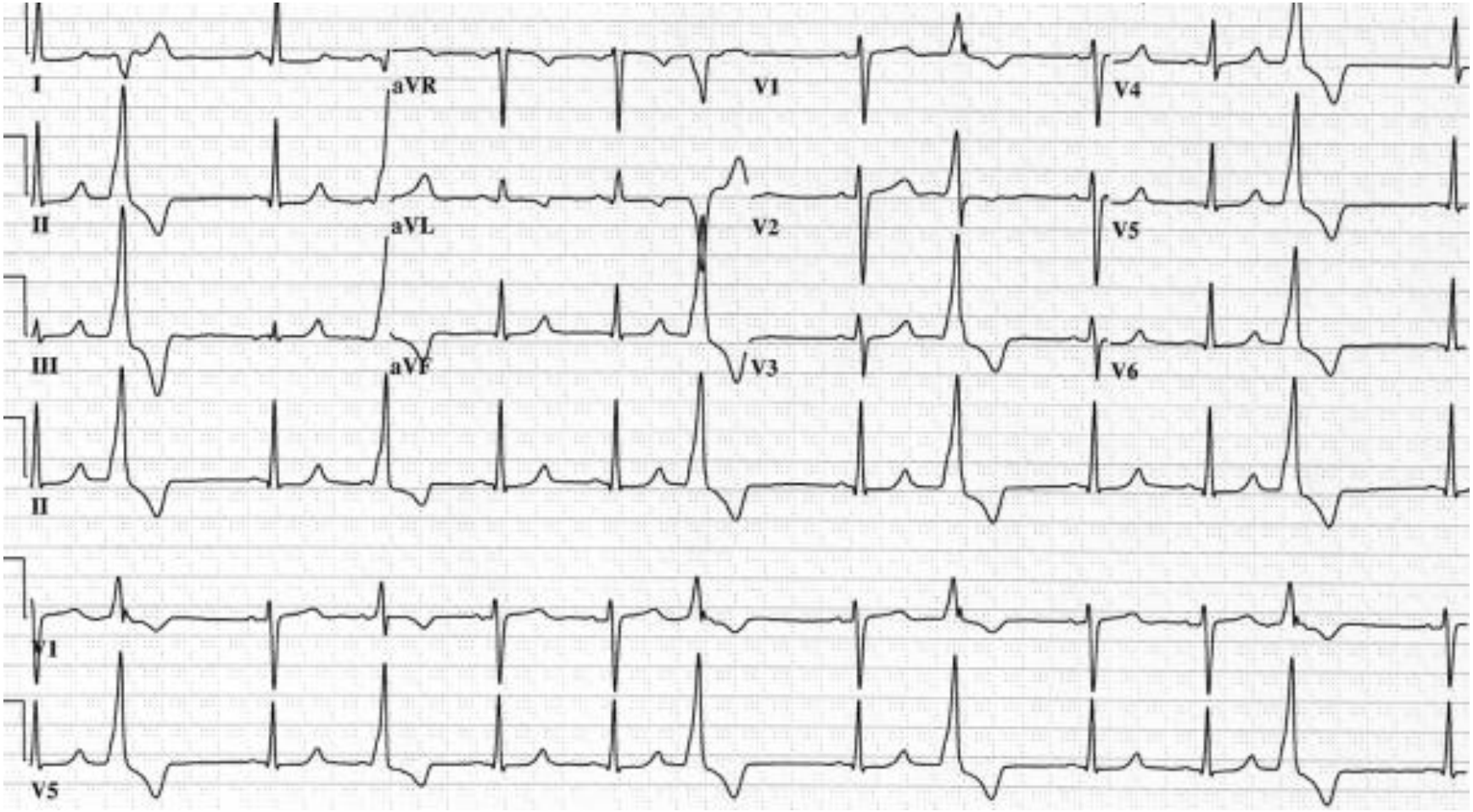
PVC vs PAC



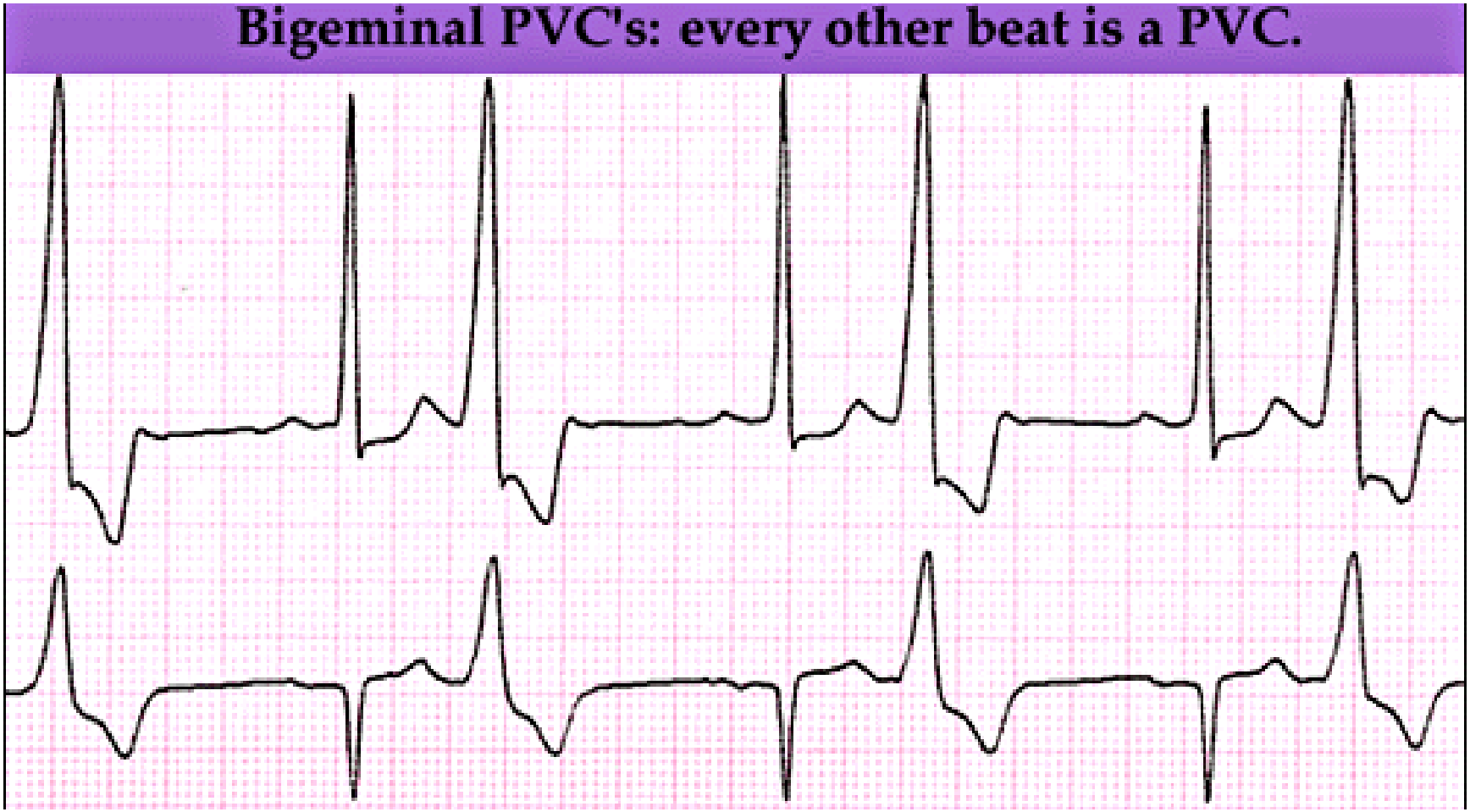


Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
N/A	Irregular	Premature & abnormal or hidden	<.20	<.12

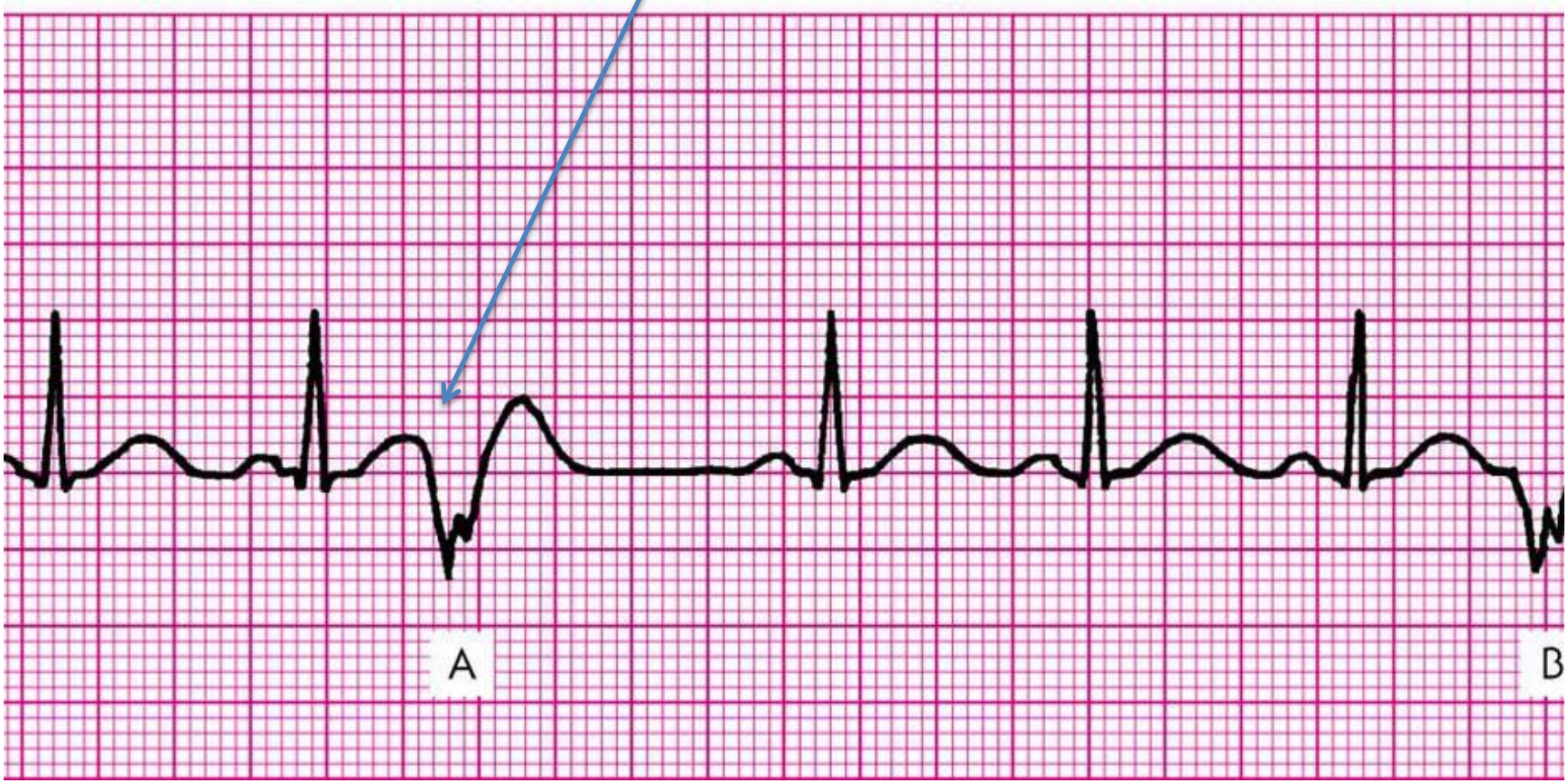
PVC's



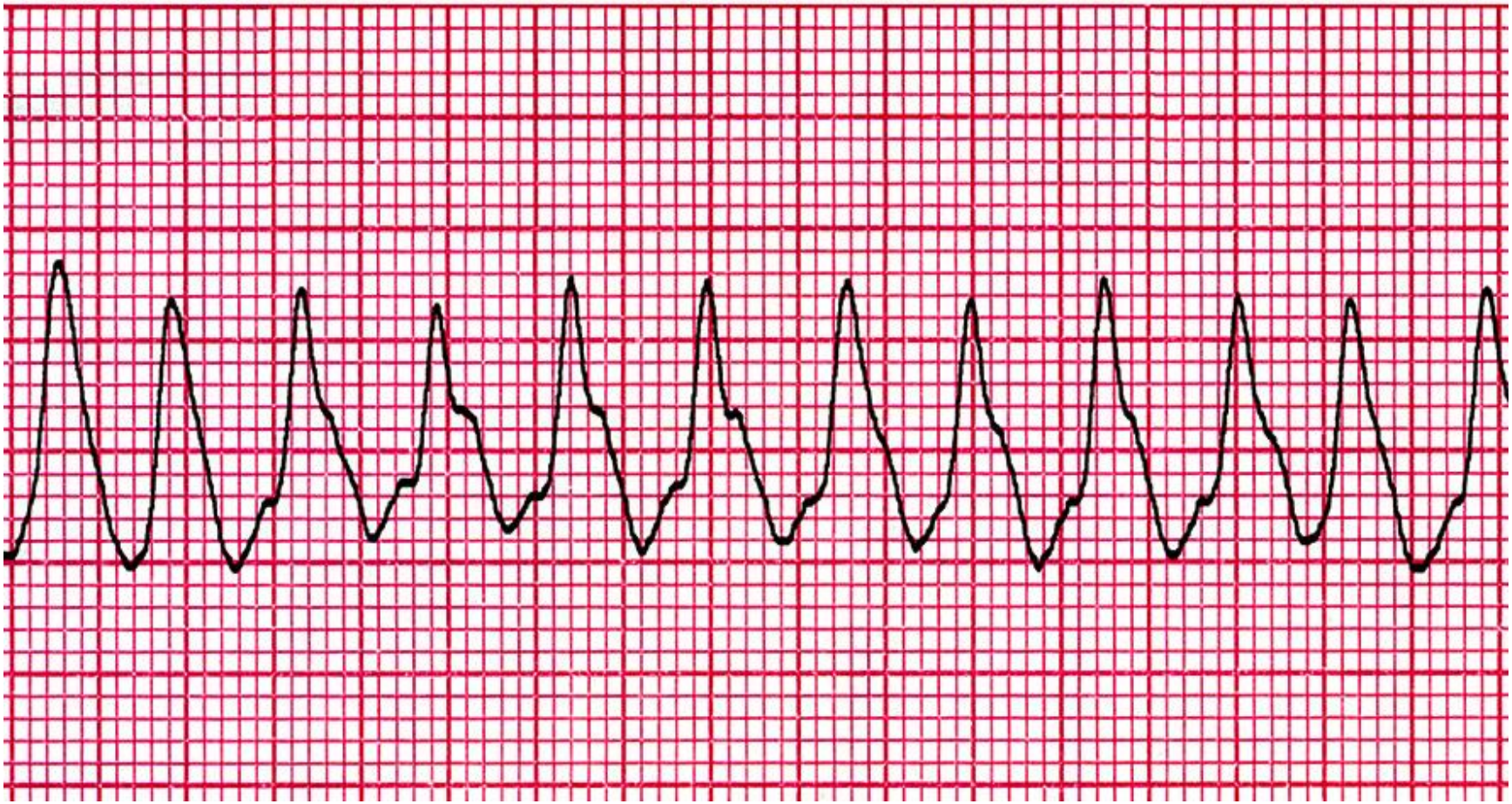
Bigeminy



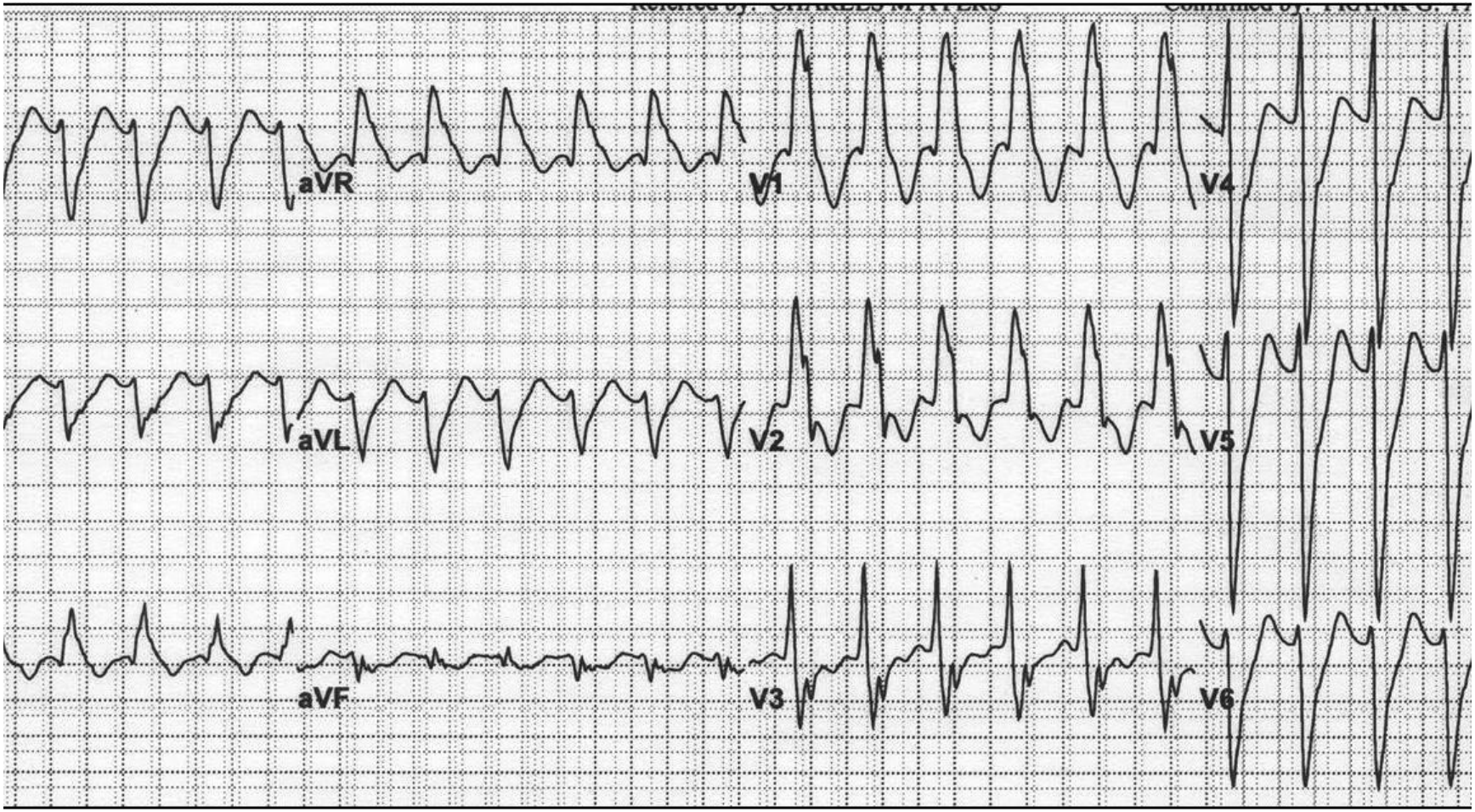
R on T
PVC beginning on a T wave



VT



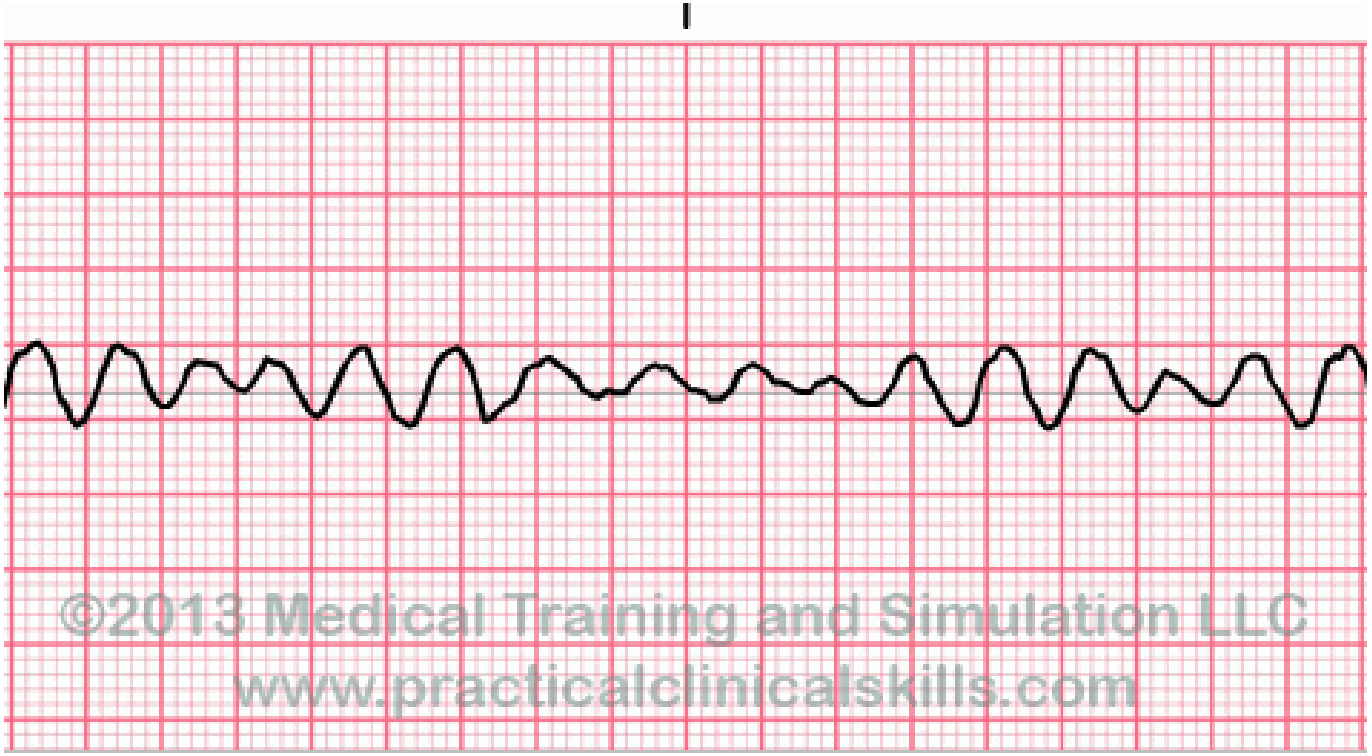
VT: 12 lead



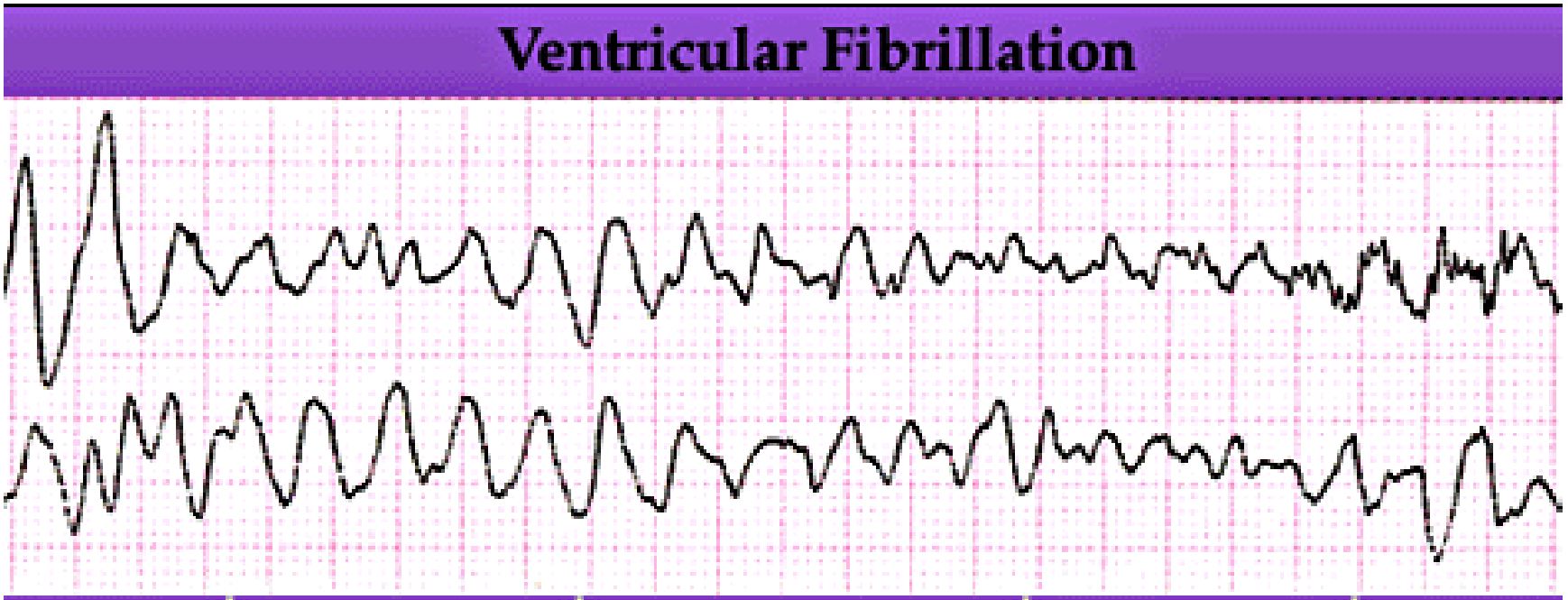
VT

- Sometimes hard to differentiate VT from Tachycardia with a LBBB
  - Tracing will look bizarre so refer

VF


©2013 Medical Training and Simulation LLC
www.practicalclinicalskills.com

VF

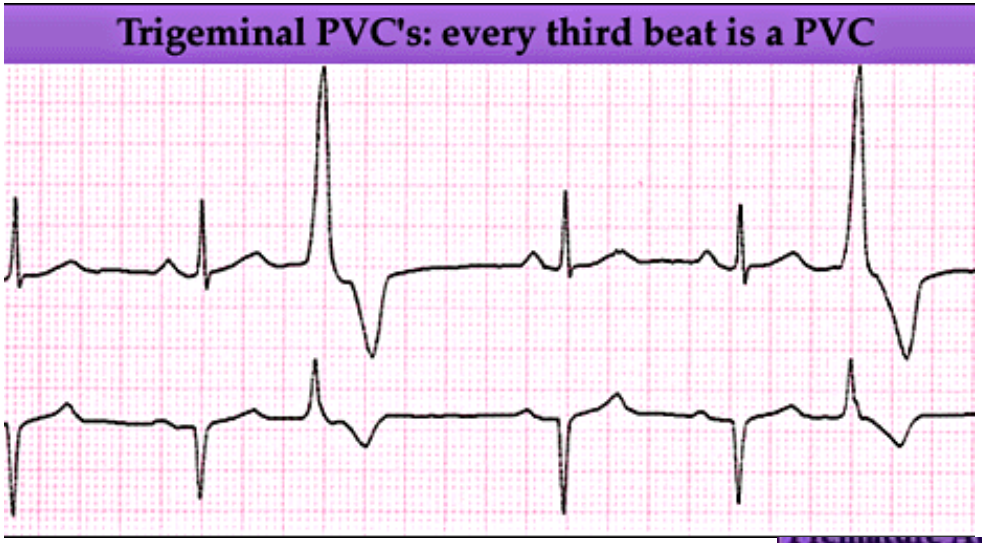


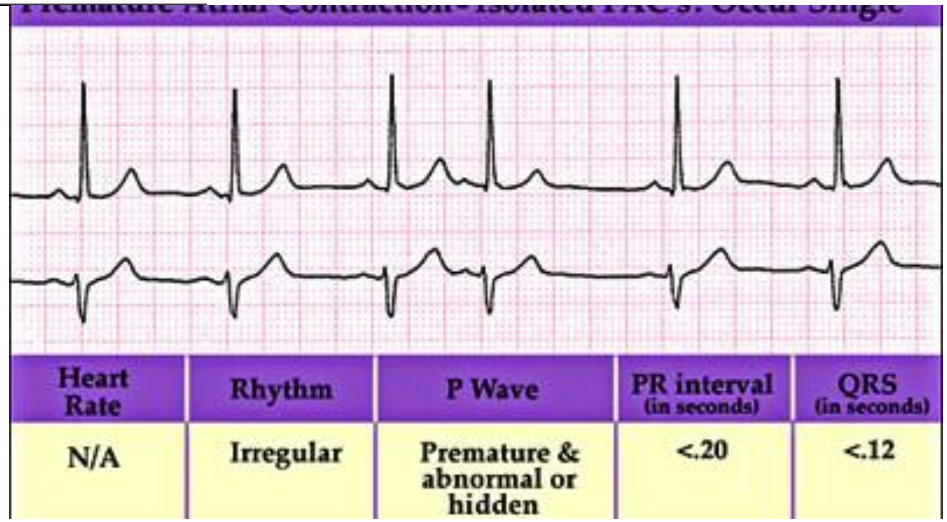
Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in second
300-600	Extremely irregular	Absent	N/A	Fibrillato baselin

PAC vs PVC

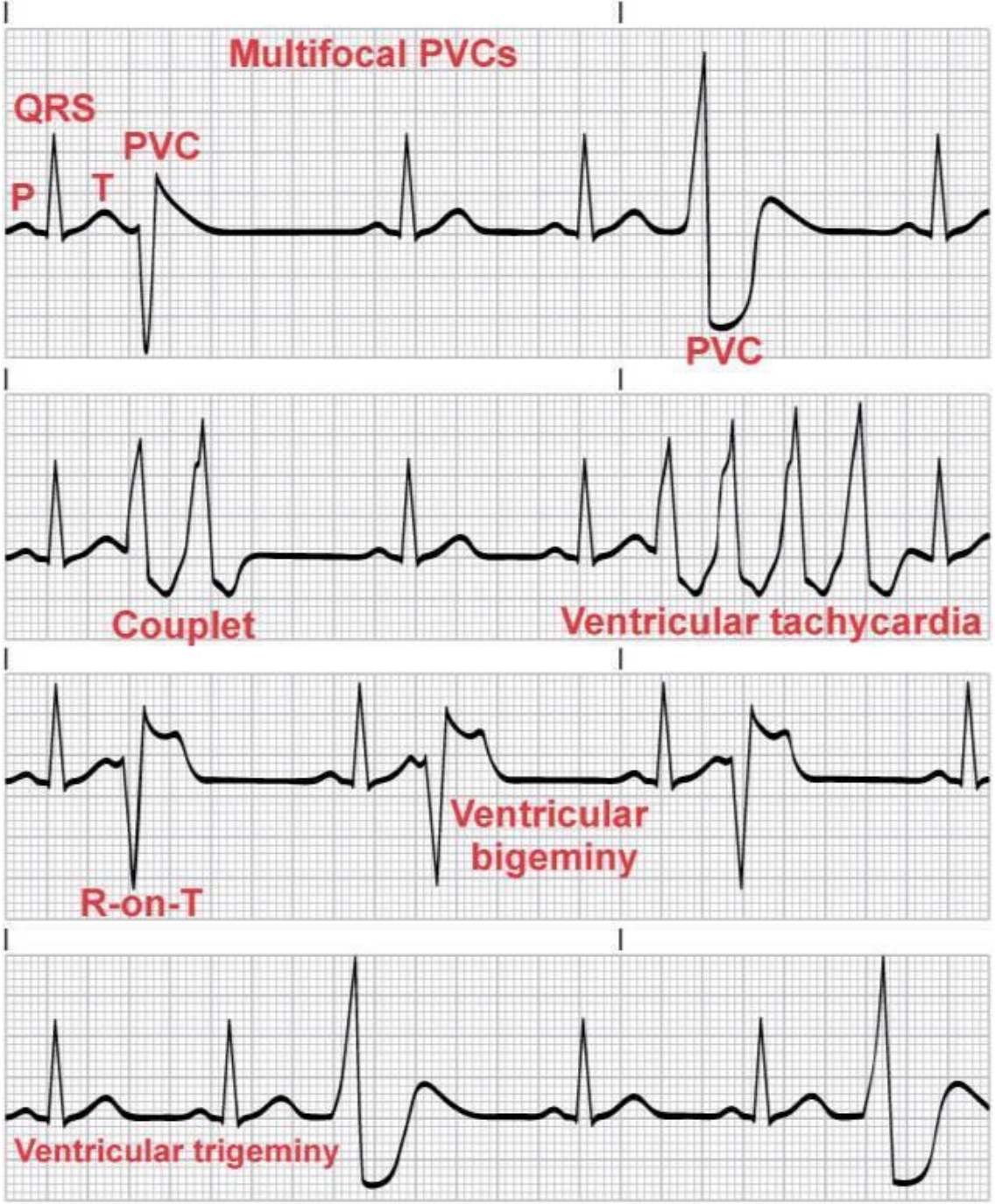
- PAC:
  - Similar appearance to normal beat
    - QRS < 0.12 (3 small boxes)
  - Comes early so rhythm irregular
- PVC
  - Bizarre looking
  - QRS > 0.12
- When in doubt refer

PVC vs PAC





Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
N/A	Irregular	Premature & abnormal or hidden	<.20	<.12



From Huszar RJ: *Basic dysrhythmias: interpretation and management,* revised ed 3, St Louis, 2007, Mosby.

Fig. 36-17. Various forms of premature ventricular contractions (PVCs). Note: Recorded from lead II.

Heart Blocks

- AV Blocks
  - 1st, 2nd and 3rd Degree
- Bundle Branch Blocks
  - RBBB, LBBB, IVCD, Complete HB
  - Hemiblocks
    - LAHB
    - LPHB
  - Bifascicular blocks: RBBB + LAHB or RBBB + LPHB