EKG Interpretation… a few case studies

David Neubert, MD

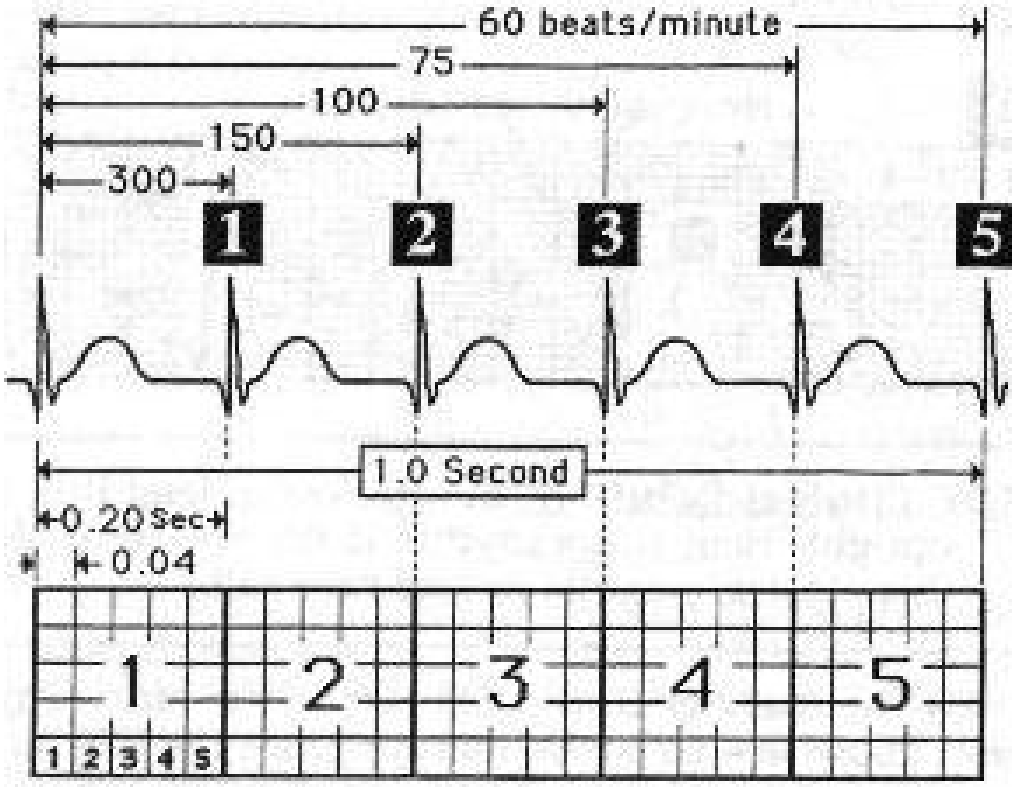
TAC-MED LLC

Goals

- Case presentation
- EKG
  - Rate
  - Rhythm – Ventricular vs. Supraventric.
  - Axis – Normal, Left, Right
  - Conduction/blocks
  - ST changes – Ischemia, infarct, hyper.
- Treatment

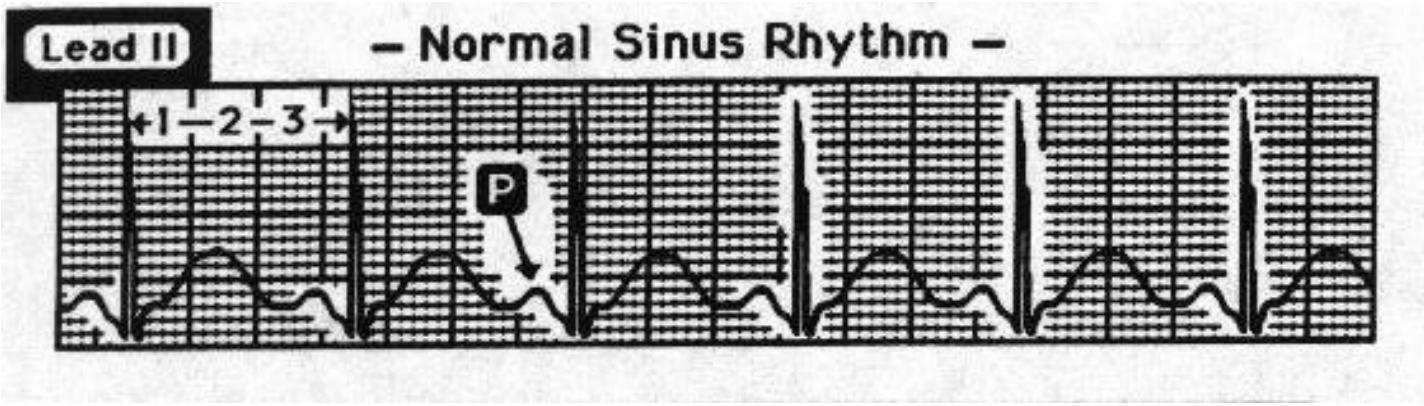
Quick review – Rate

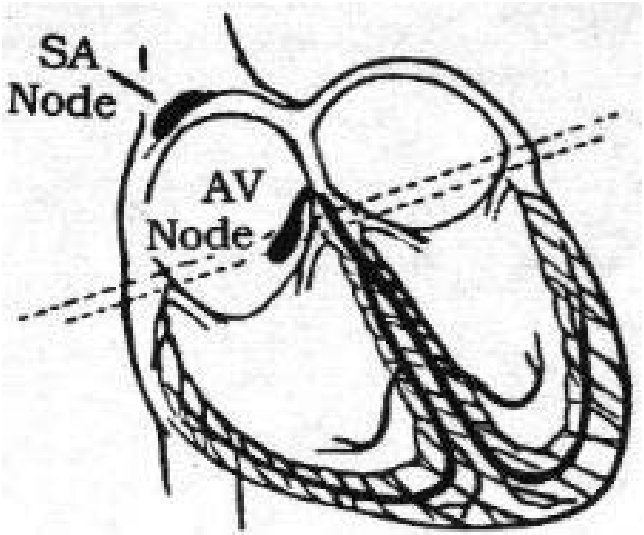
- 300
- 150
- 100
- 75
- 60



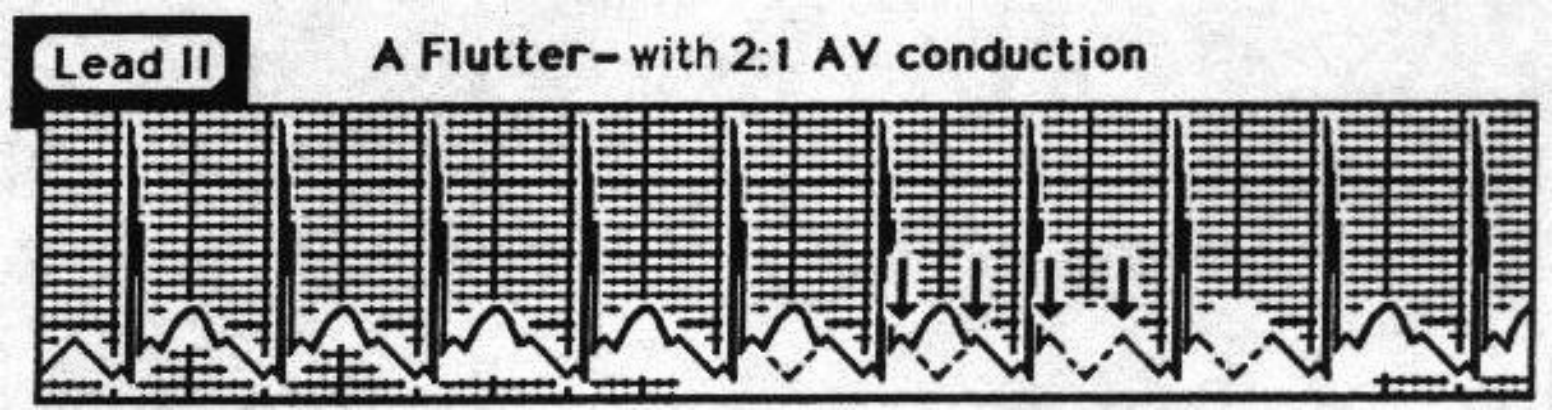
*Unless otherwise noted, all ECG tracings next few slides from “EKG web brain” at…
http://medinfo.ufl.edu/~ekg/TOC.htm

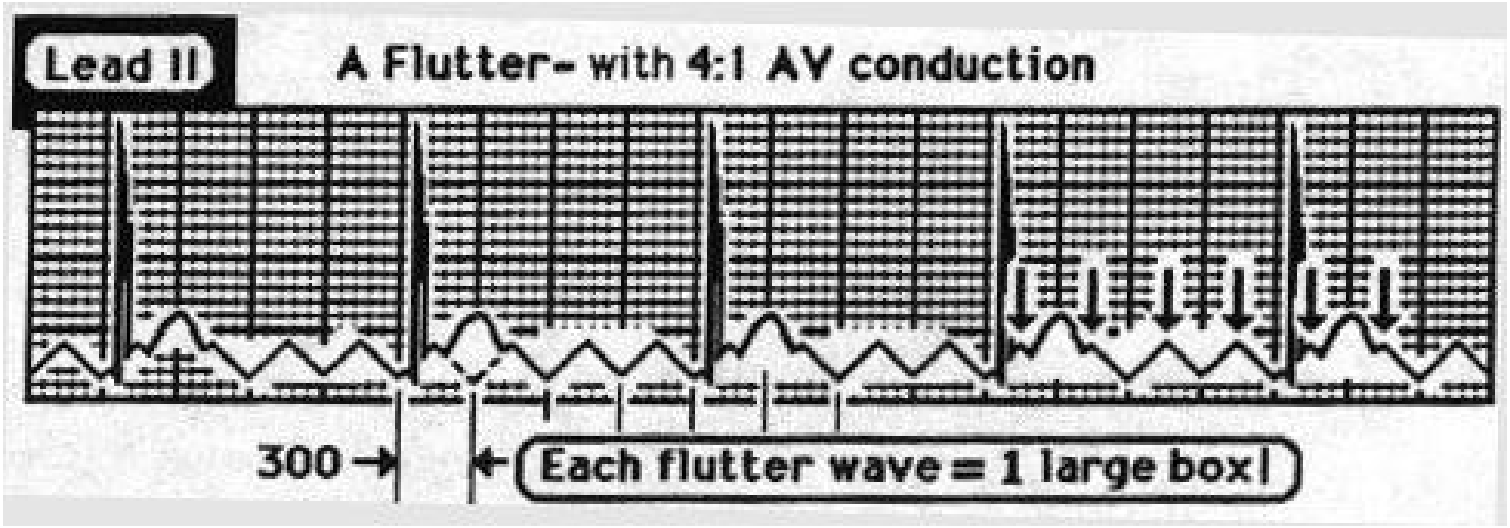
Quick review – Rhythm



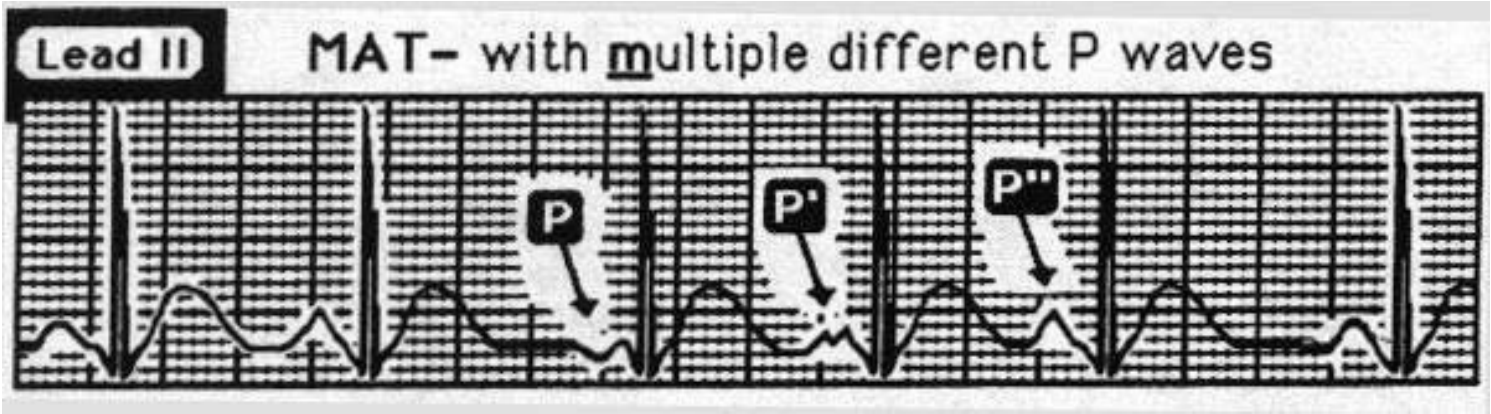


Quick Review – Rhythm



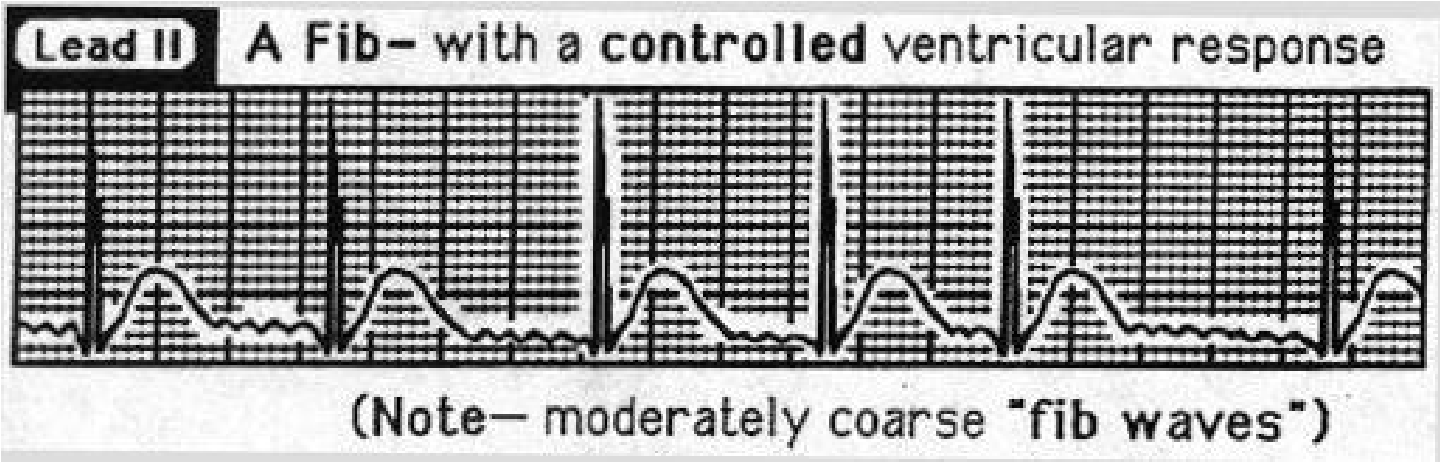


Quick review – Rhythm



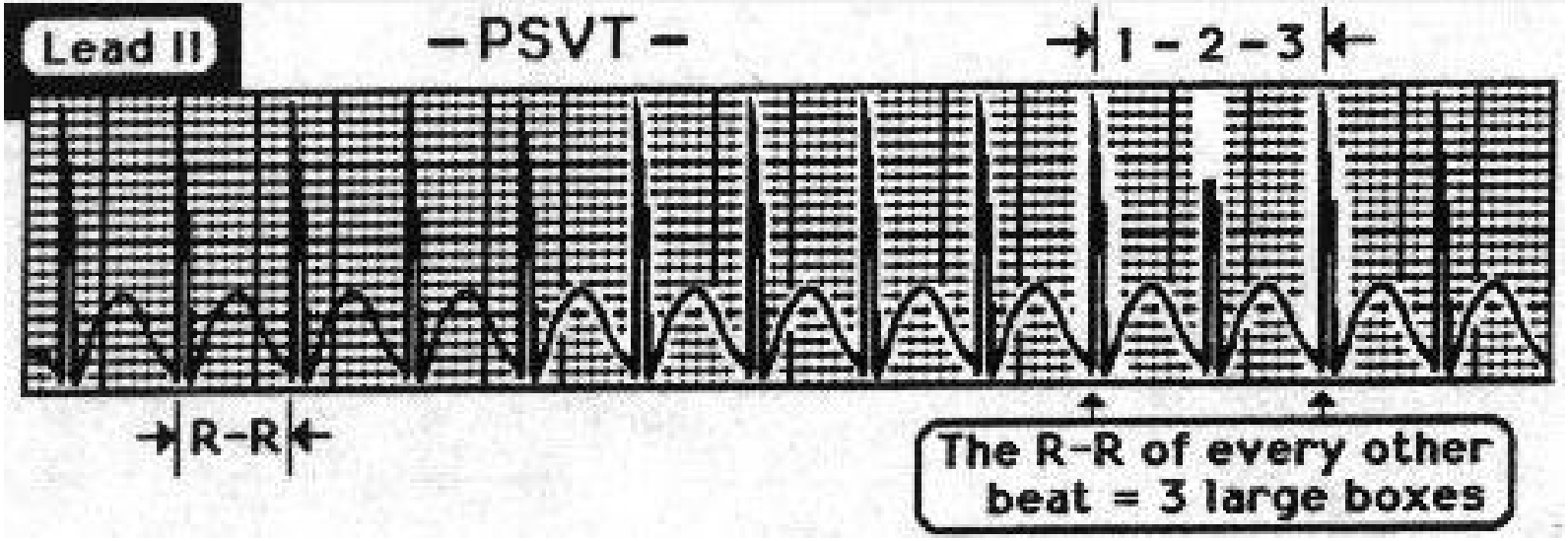
Also called… Wandering atrial pacemaker if HR < 100

Quick review – Rhythm



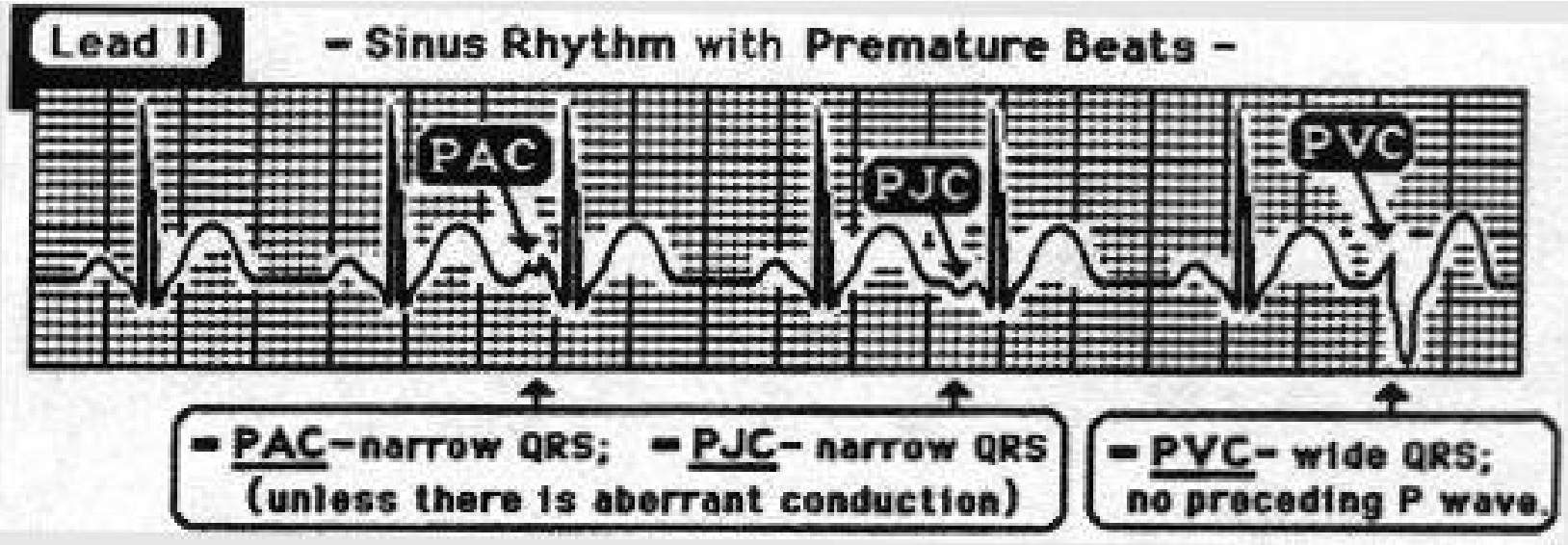
Remember… A Fib and A Flutter often co-exist

Quick review – Rhythm



Re-entry tachycardia at the AV node, due to accessory pathway

Quick review – Rhythm



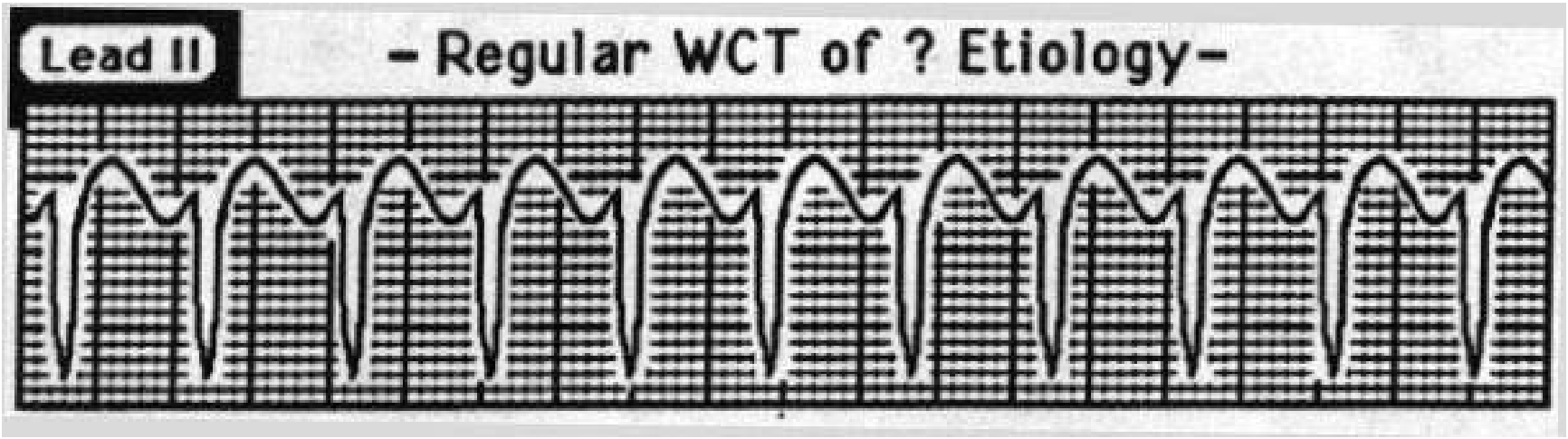
Quick review – Rhythm

- Ventricular rhythms are wide
- More likely to be ventricular if:
  - Old
  - Chronic illnesses
  - Known cardiac disease
- Aberrantly conducted supraventricular rhythms can be tough…

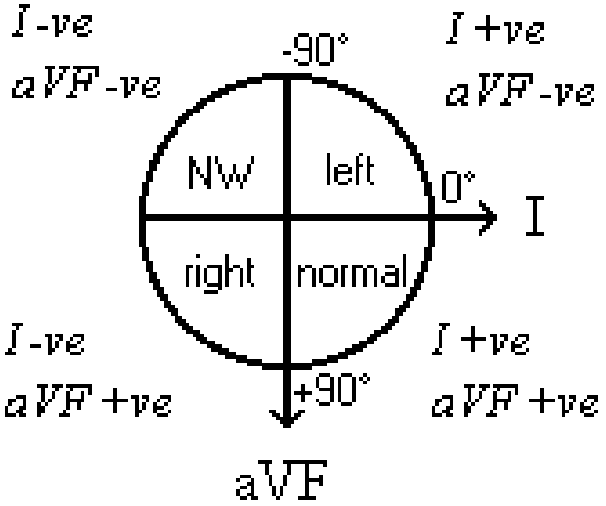
http://www.drsegal.com/medstud/ecg/vtach.gif

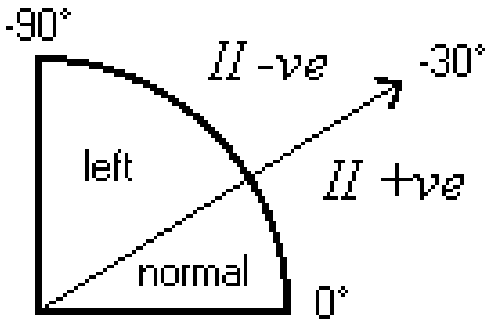
http://www.seattleavir.com/vtach.jpg

Quick Review – Rhythm



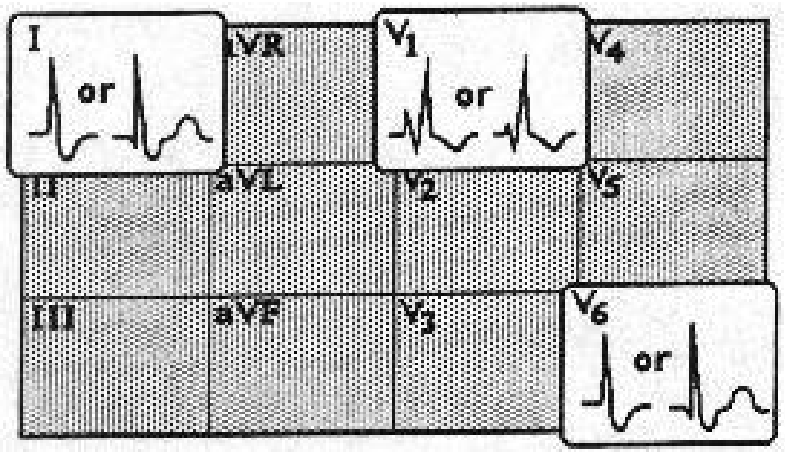
Quick review – Axis

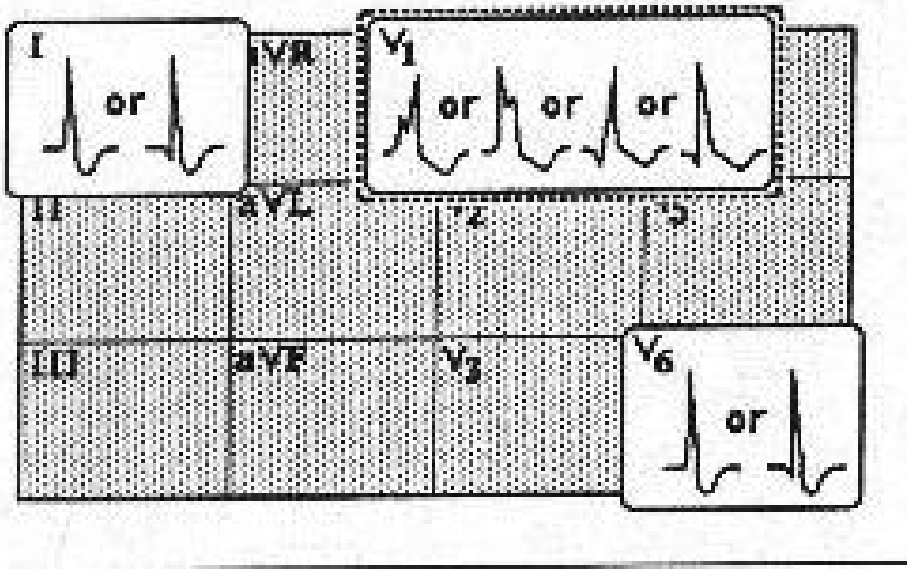




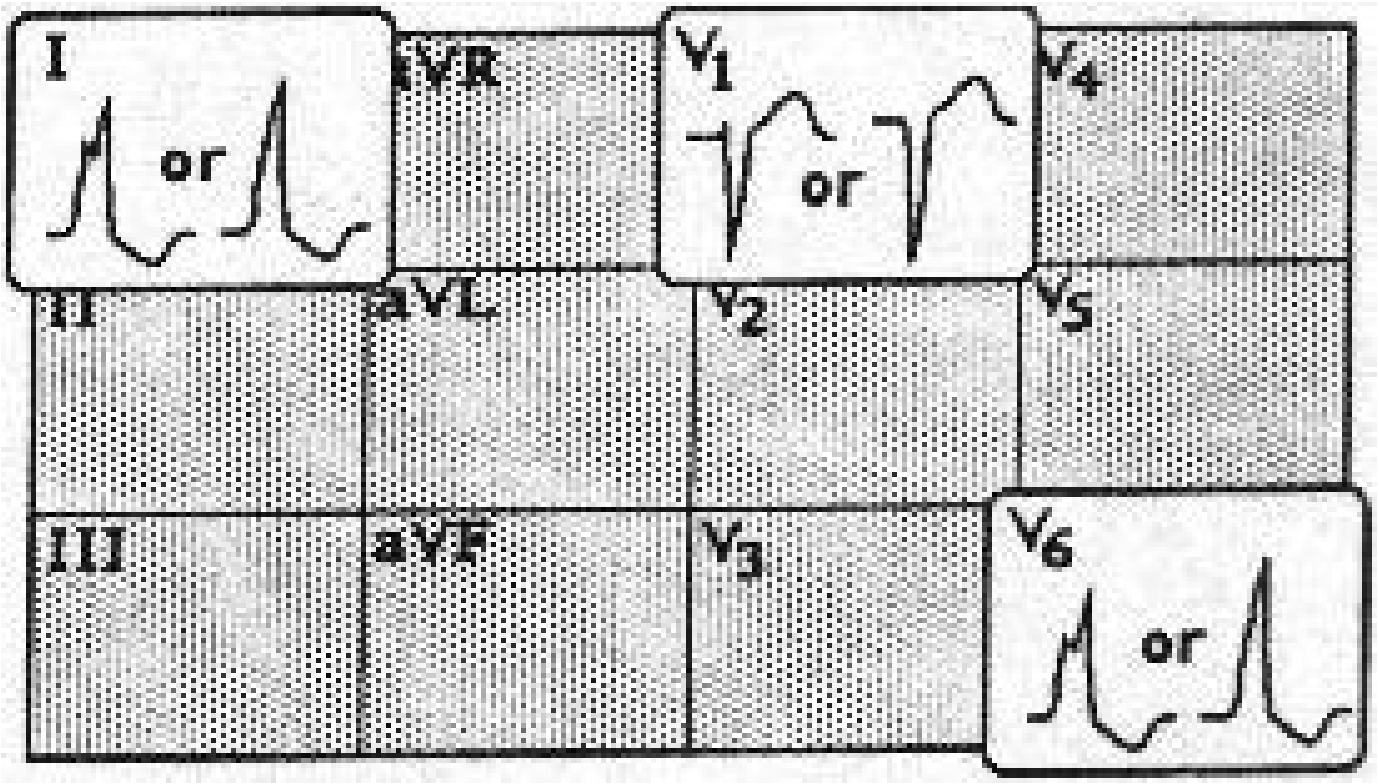
Courtesy of… www.ecglibrary.com

Quick review – RBBB

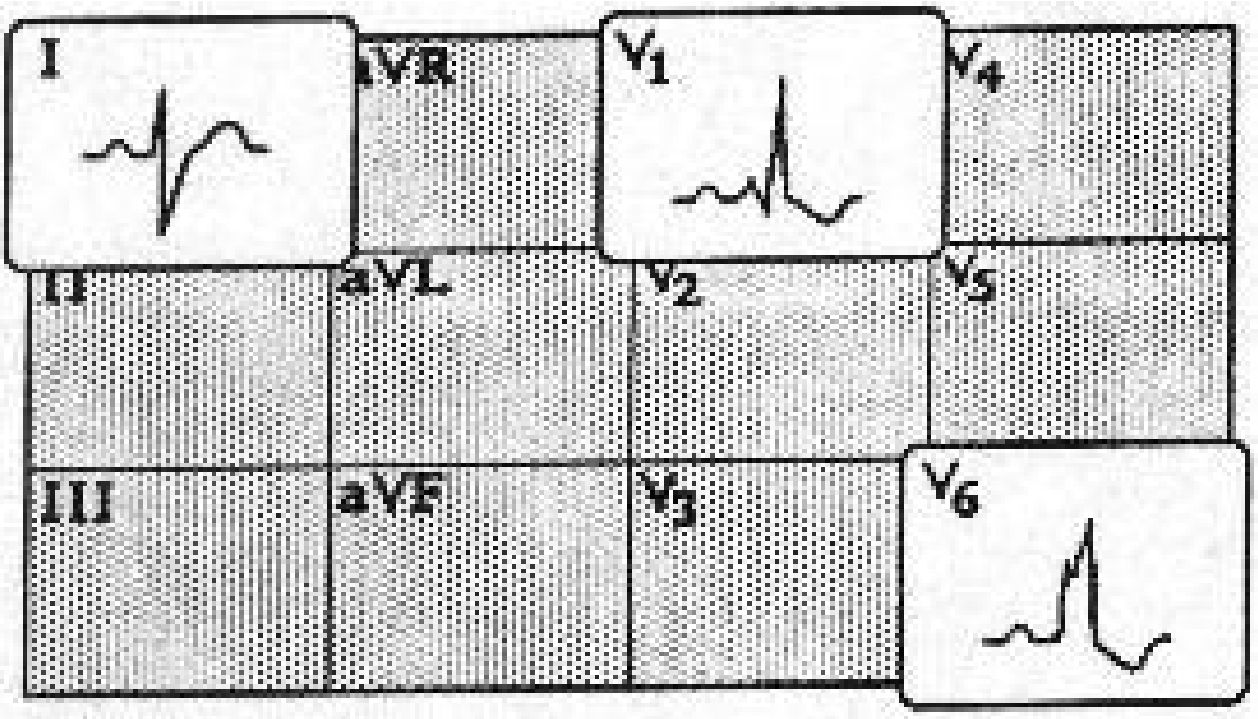




Quick review – LBBB



Quick review – IVCD

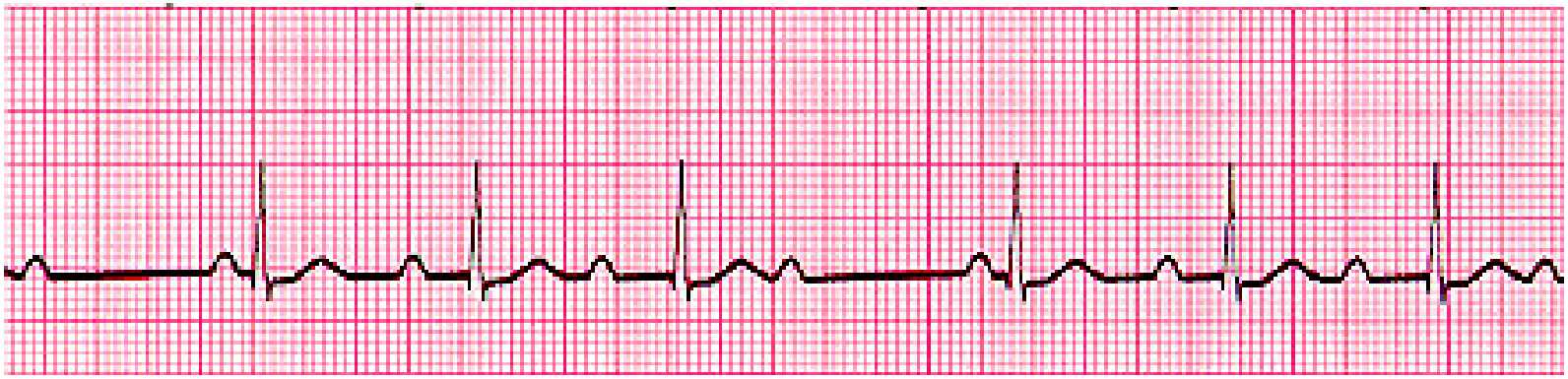


Quick review – Cond. blocks

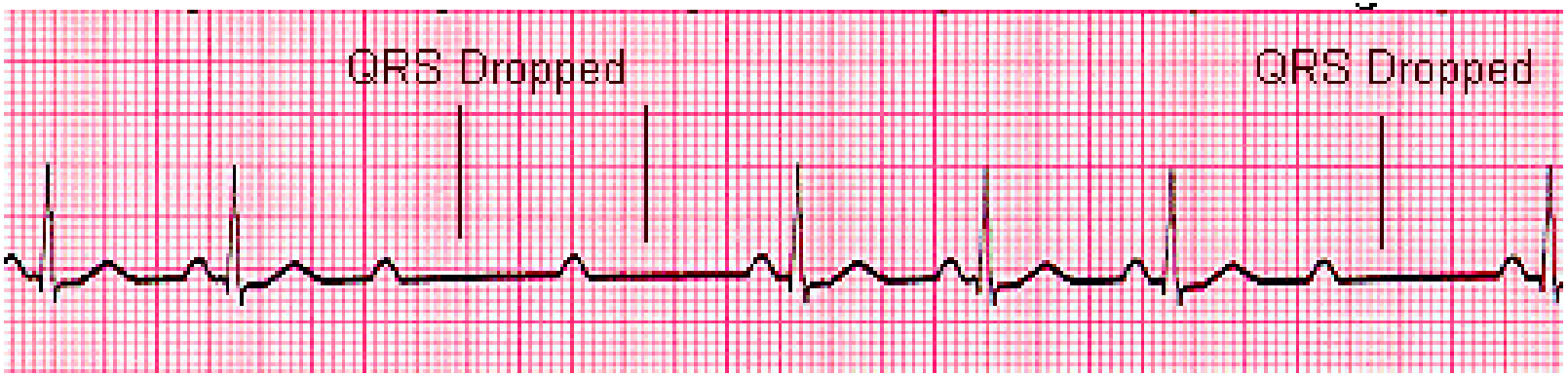
1st degree block – PR interval greater than 120 ms

http://www.pacemakerproject.com/assets/img/first_deg_AV.jpg

Quick review – Cond. blocks



2nd degree Type I “Wenckebach” – slowly increasing PR till drops beat



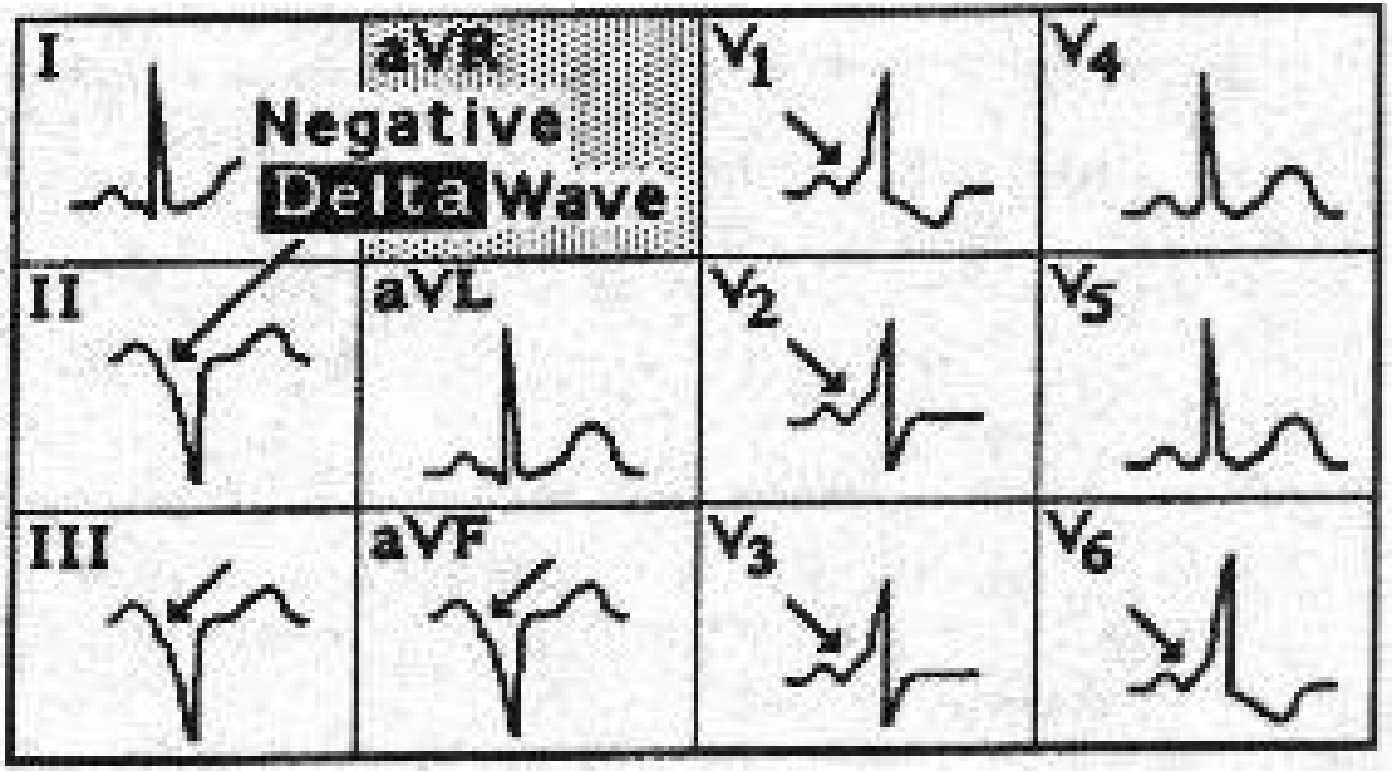
2nd degree Type II “Mobitz” – randomly dropped QRS, PR stays same

www.ambulancetechnicianstudy.co.uk/rhythms.html

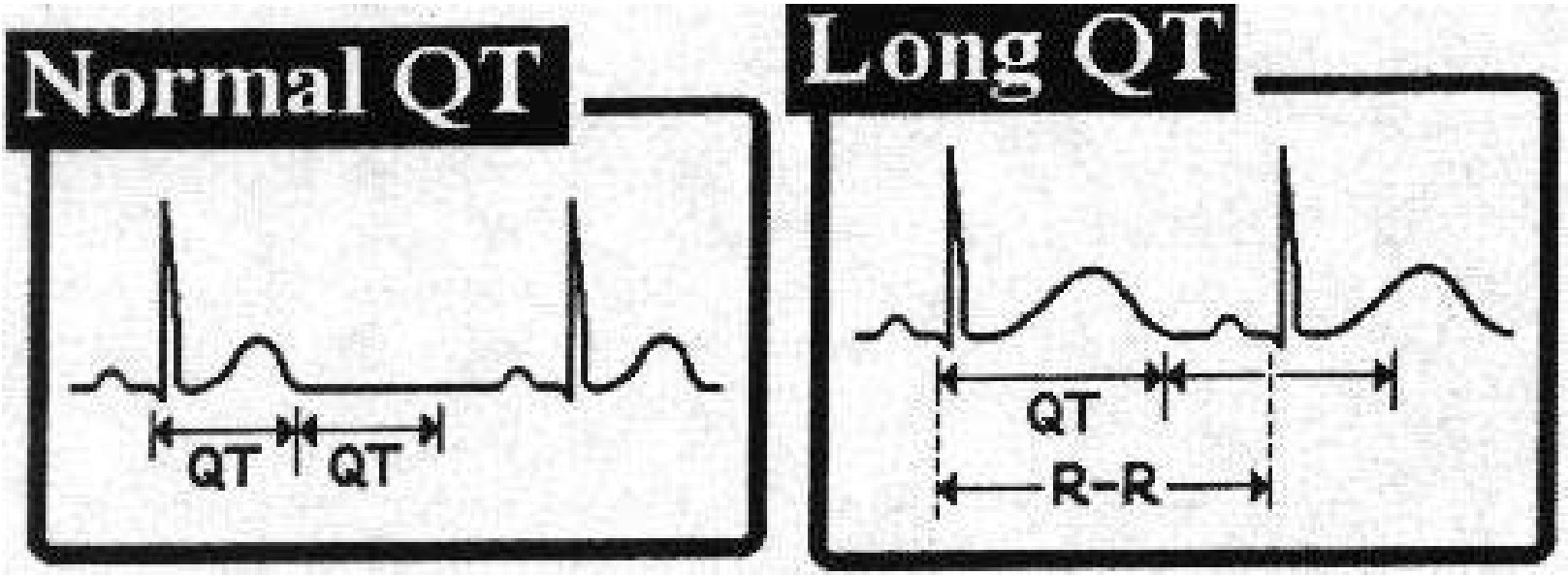
Quick review – Cond. blocks

3rd degree block – P waves and QRS complexes march out independently

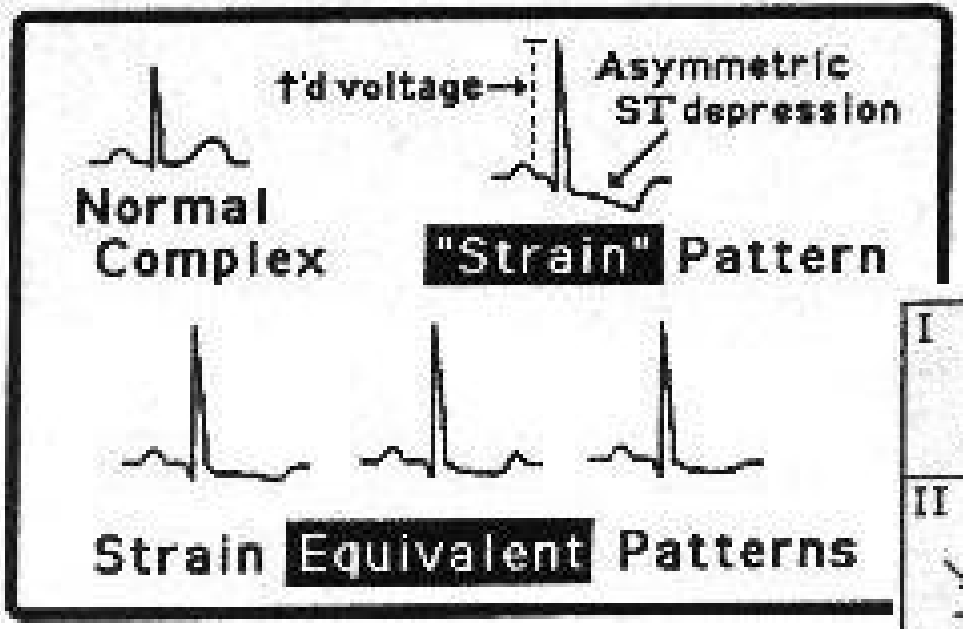
Quick review – WPW

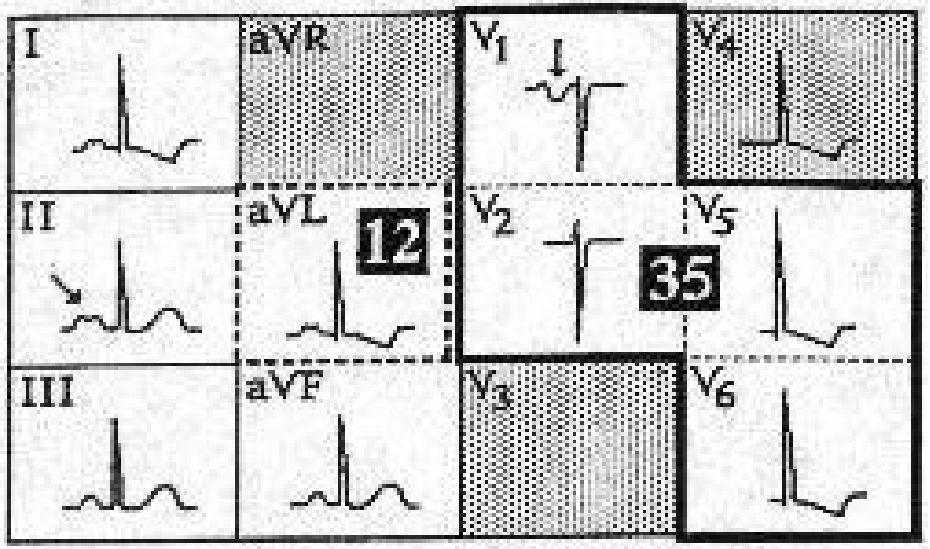


Quick review – Long QT



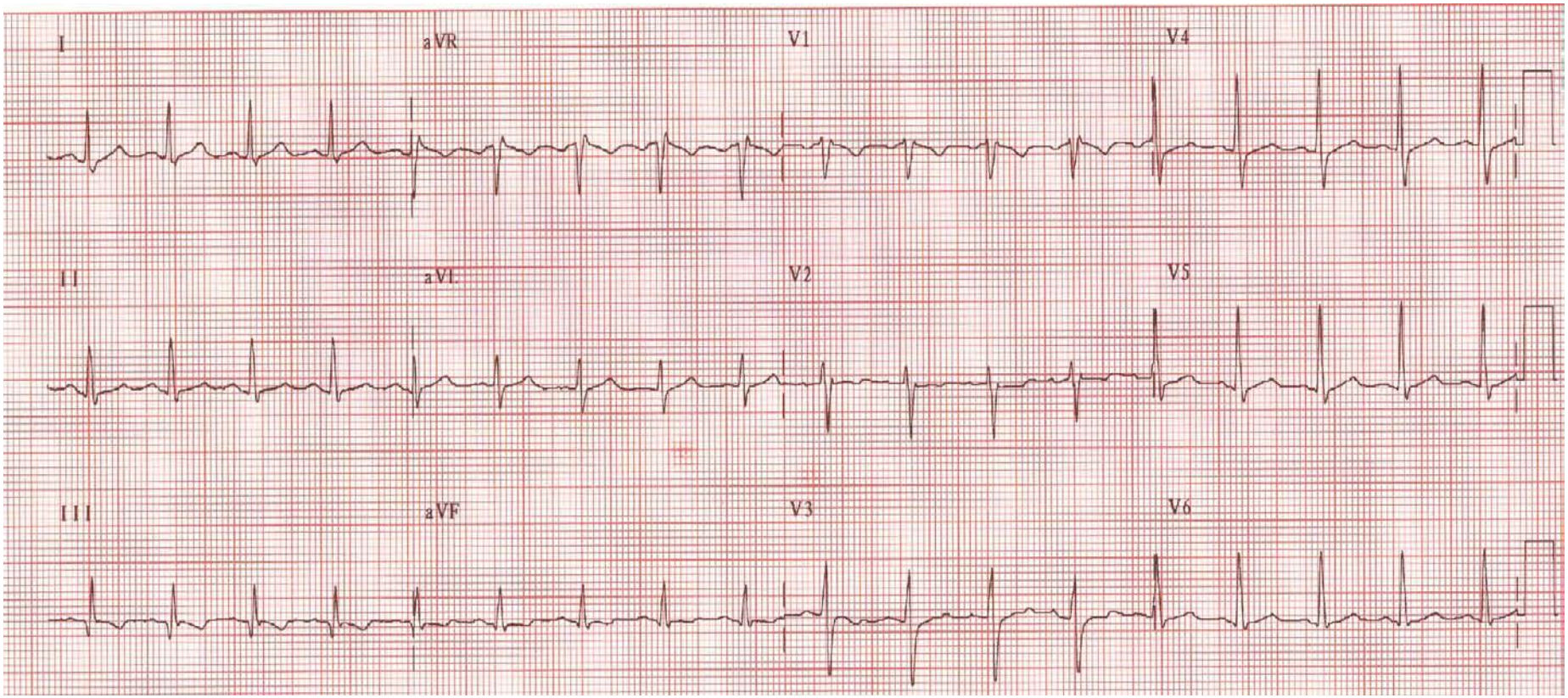
Quick review – ST changes





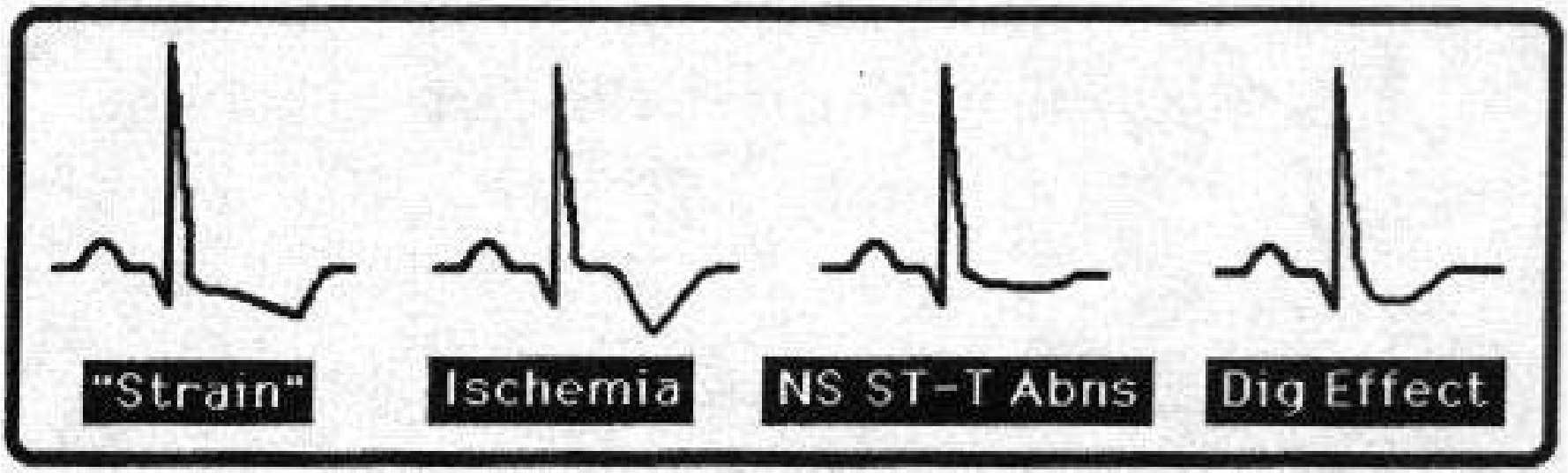
Strain patterns are associated with muscle hypertrophy i.e. LVH

Quick review – ST changes

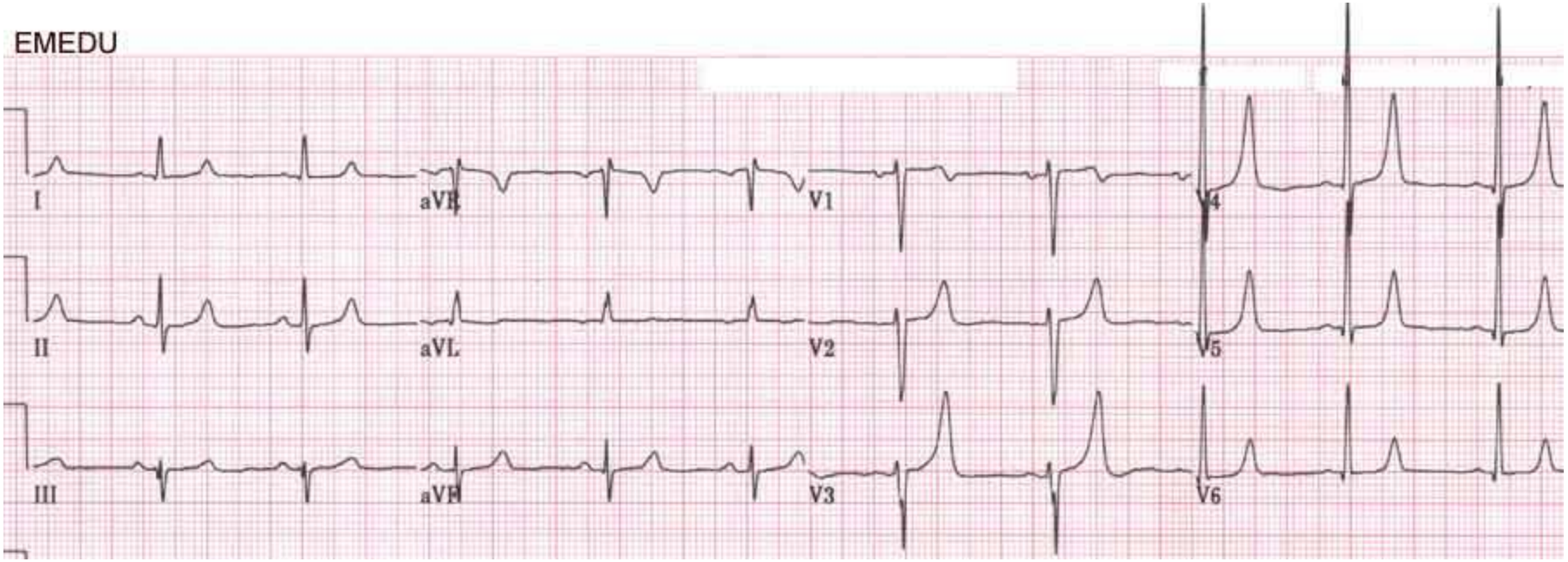


https://secure.muhealth.org/~ed/students/EKG/ekg_002.jpg

Quick review – ST changes



Quick review – ST changes



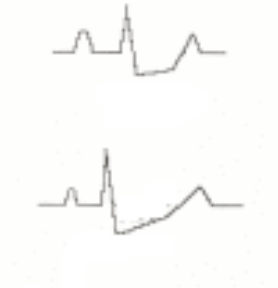
Early hyperkalemia – notice the peaked T waves. Higher levels cause wide bizzare QRS complexes and arrhythmias, eventually V-tach or fib

http://www.emedu.org/ecg/images/k_1a.jpg

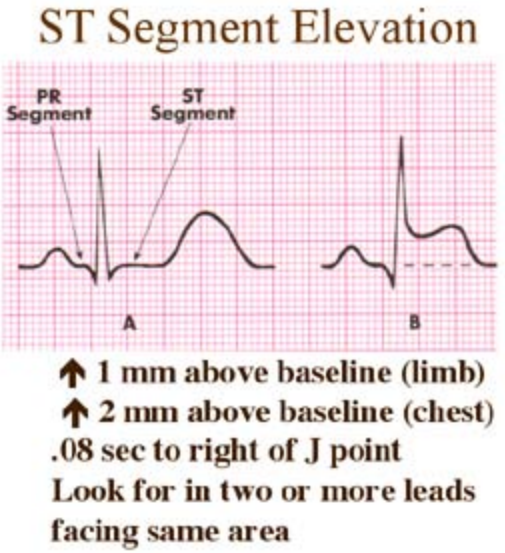
Quick review – ST changes

- **Inferior leads** - II, III, aVF
- **Septal leads** - V1, V2
- **Anterior leads** - V2 to V4
- **Lateral (left-sided) leads:**
  - Lateral precordial leads - V4 to V6
  - High lateral leads - I, aVL

Quick review – ST changes



- ST depression or T wave inversion
  - Subendocardial ischemia
- ST elevation
  - Transmural ischemia
- “Q waves”
  - Tissue death / scar



http://www.unm.edu/~lkravitz/Media/stelevation.jpg
http://www.ganfyd.org/images/8/84/Ecg_q-wave_cropped.png
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=cm&part=A347

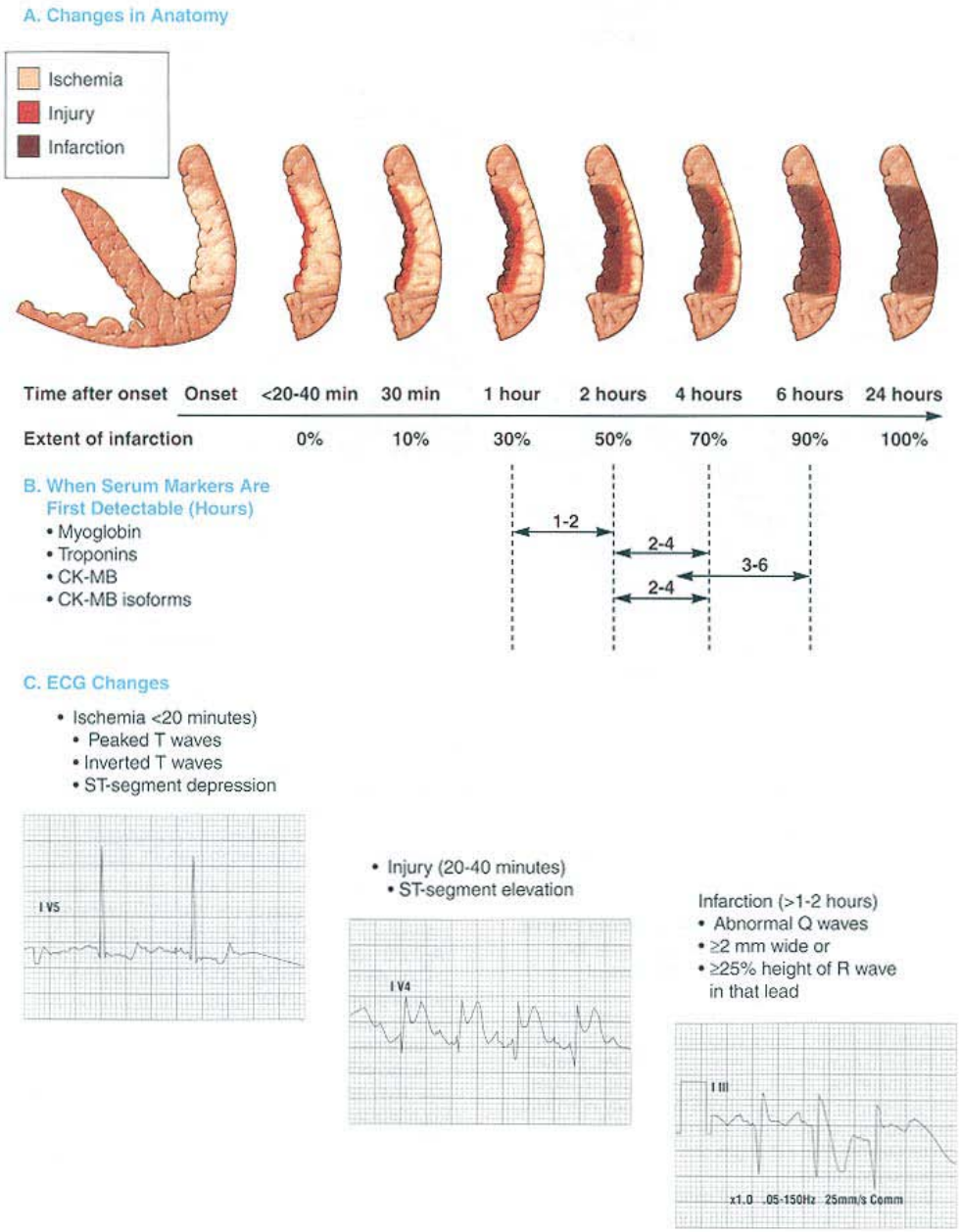
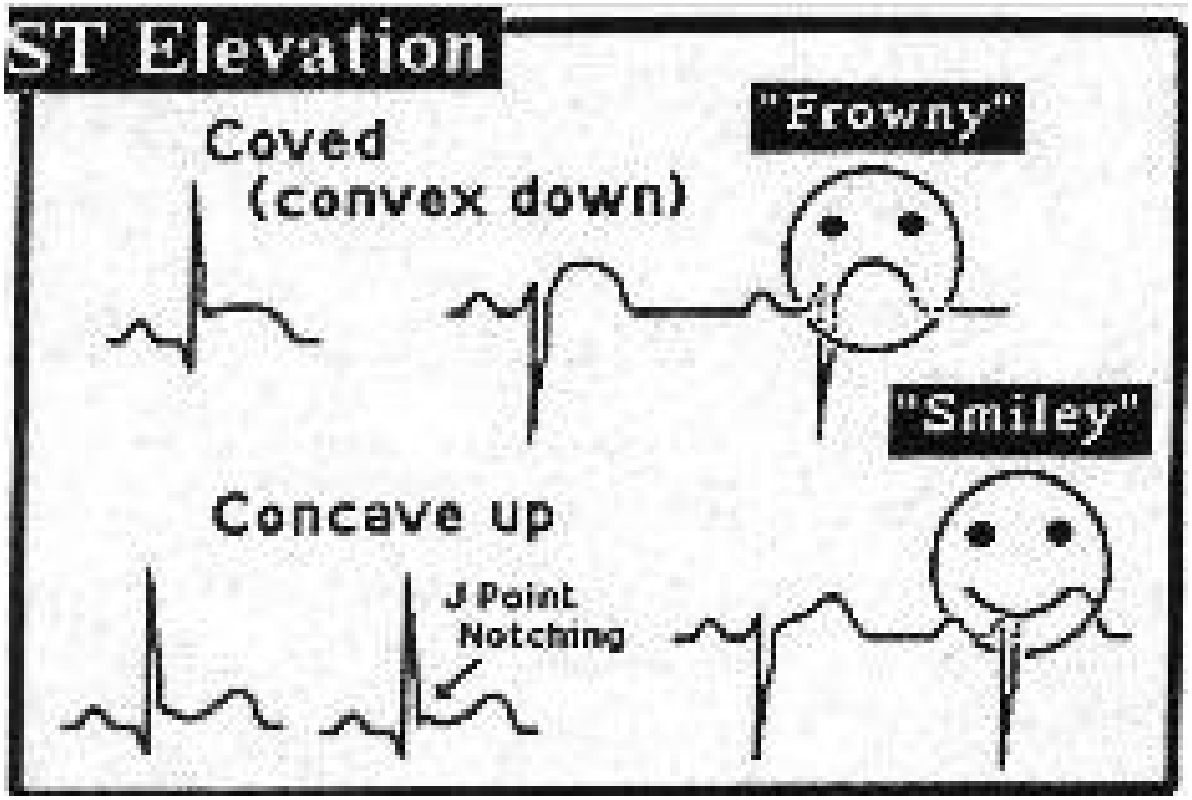
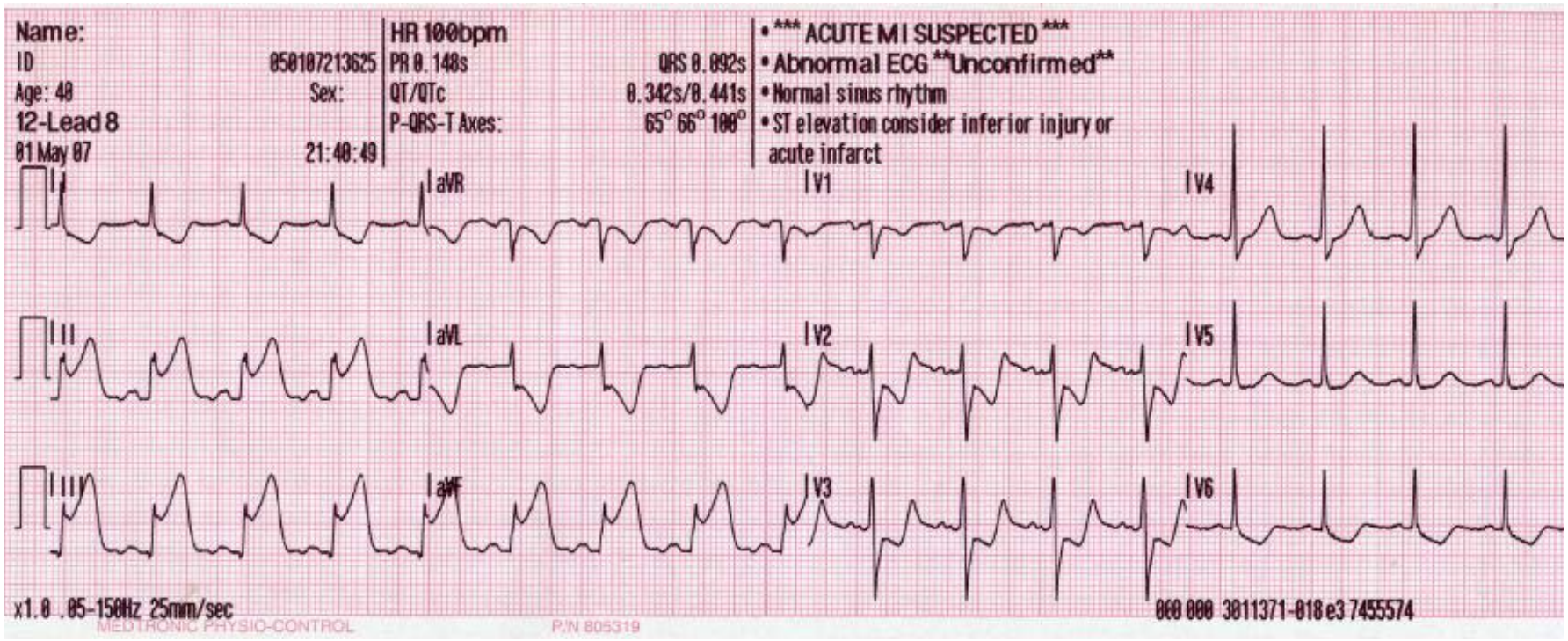


Fig 5. Changes in anatomy, serum markers, and ECG over time: ischemia, injury, and infarction.

Quick review – ST changes

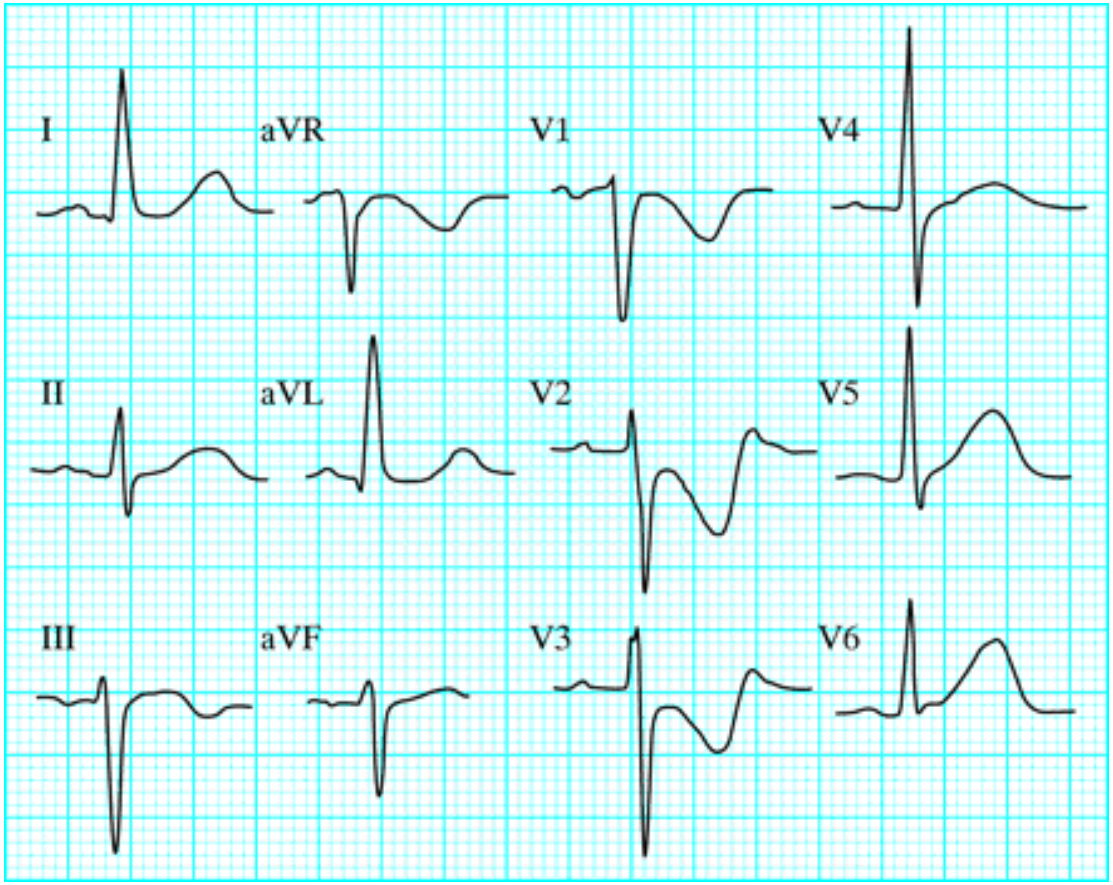


Quick review – Inferior MI



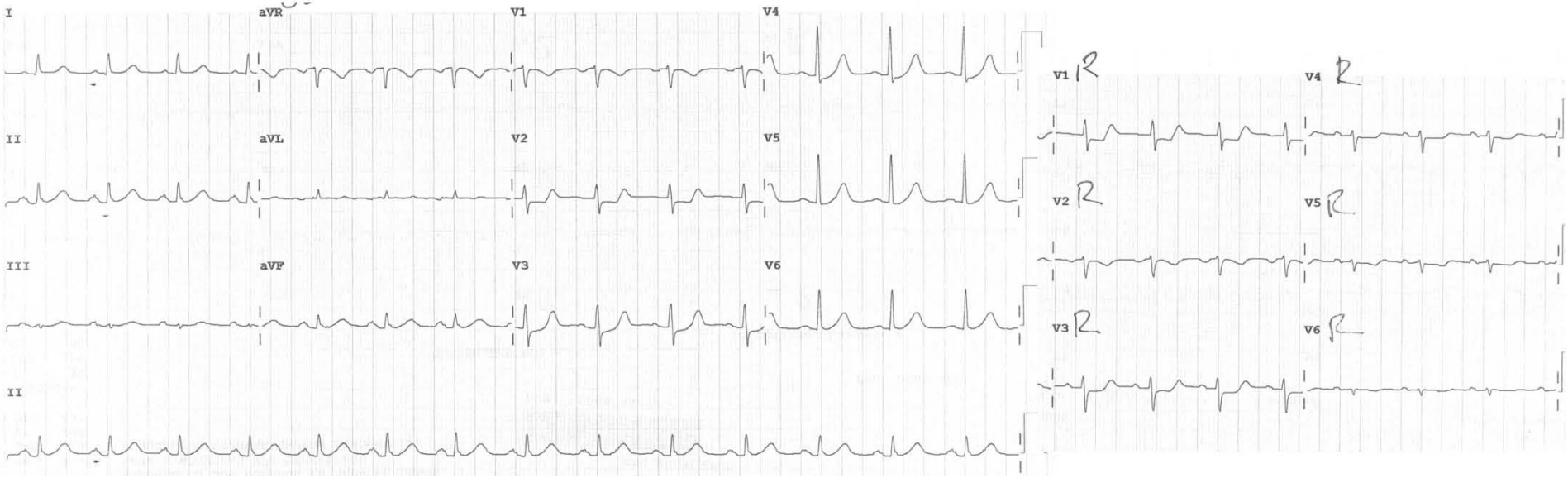
http://upload.wikimedia.org/wikipedia/commons/5/59/12_lead_generated_inferior_MI.JPG

Quick review – Posterior MI



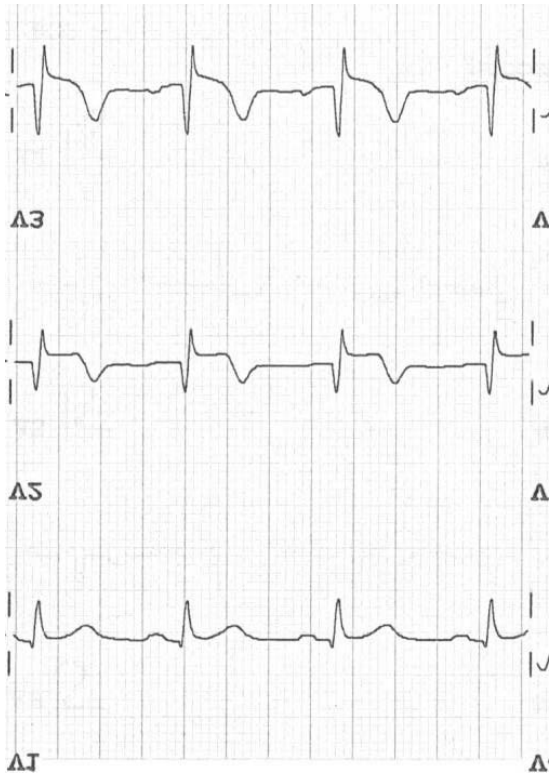
http://www.emspecialists.com/images/posterior.gif

Quick review – Posterior MI



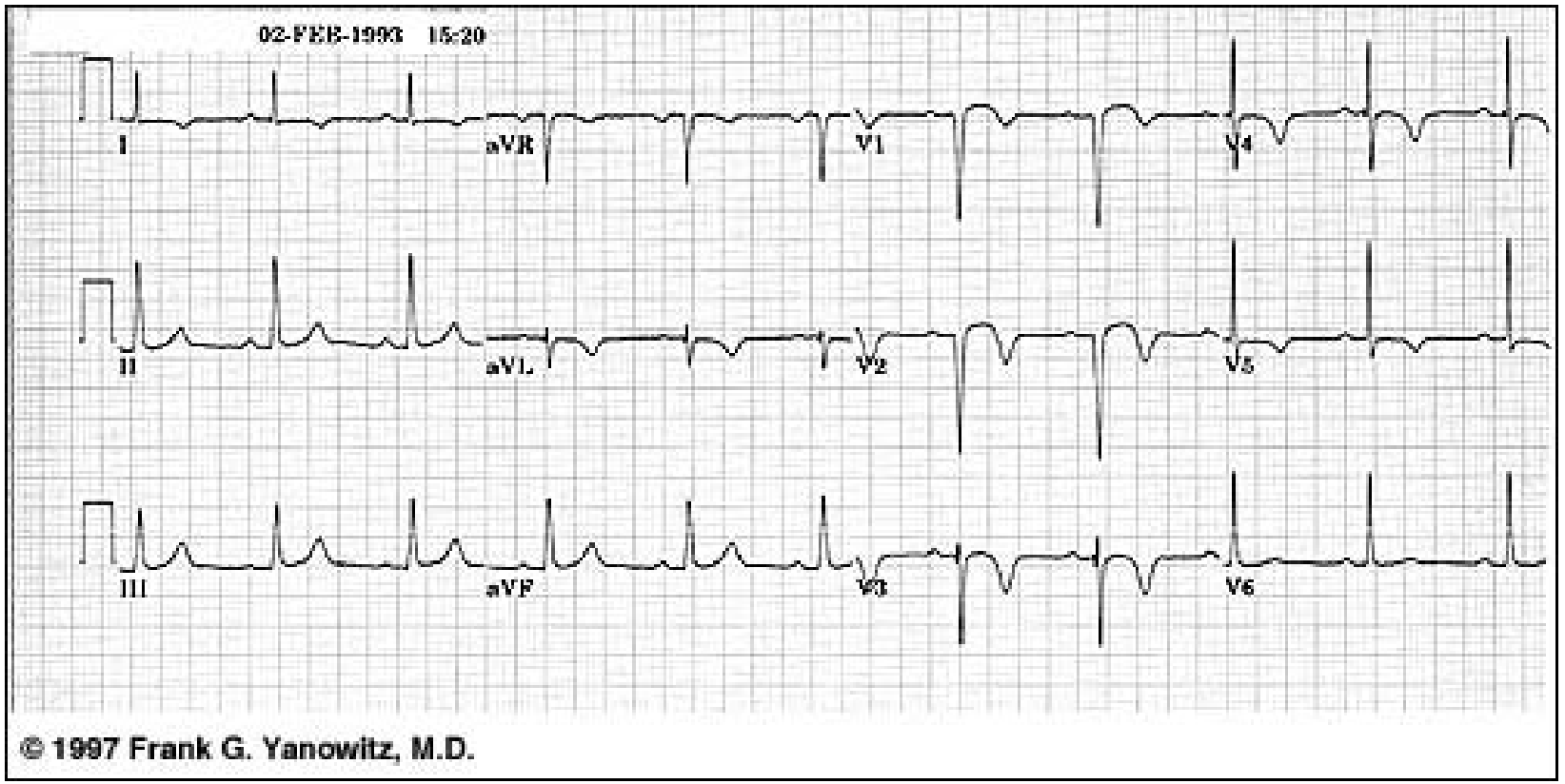
Posterior MI's will appear as flat ST segment depressions in V1-V3, ST elevation in AVR. Right sided leads will show diffuse ischemic changes.

Quick review – Posterior MI



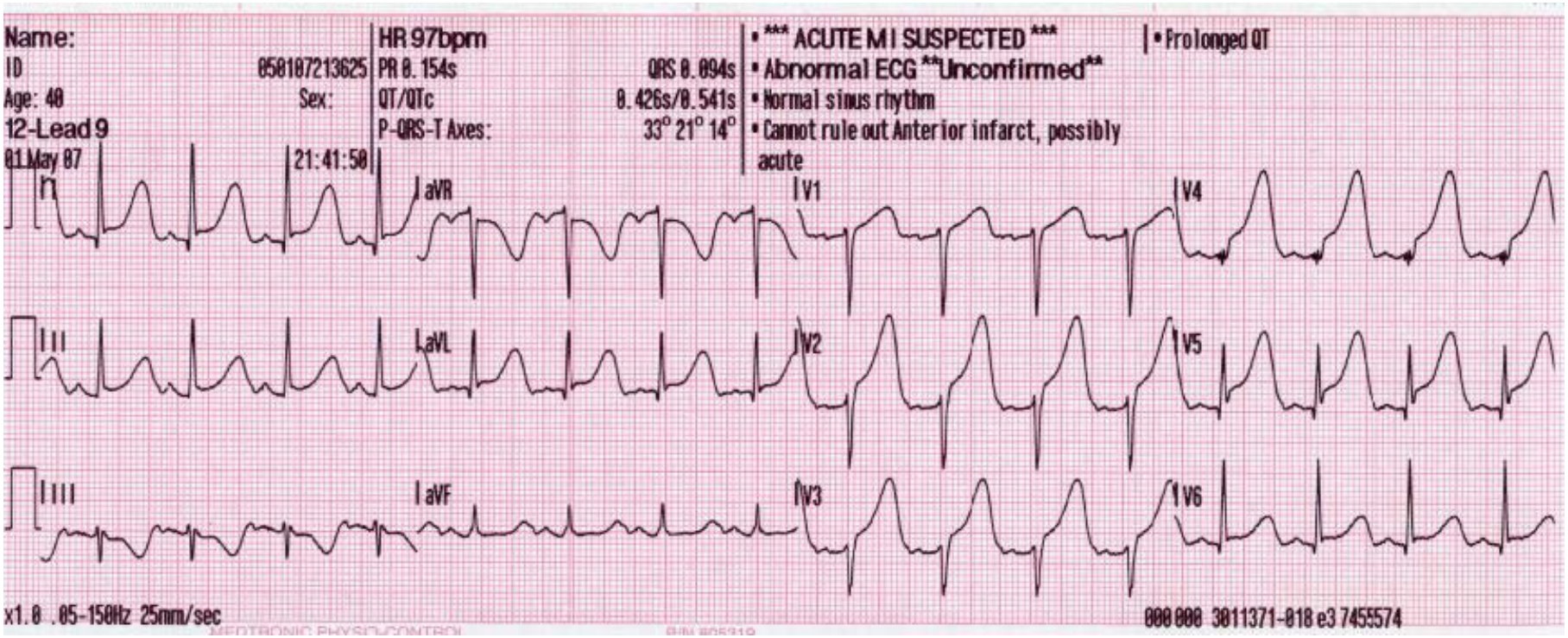
Leads V1-V3 directly mirror the posterior side of the heart. If you turn the EKG upside down along the horizontal axis you will see the STEMI…

Quick review – Septal MI



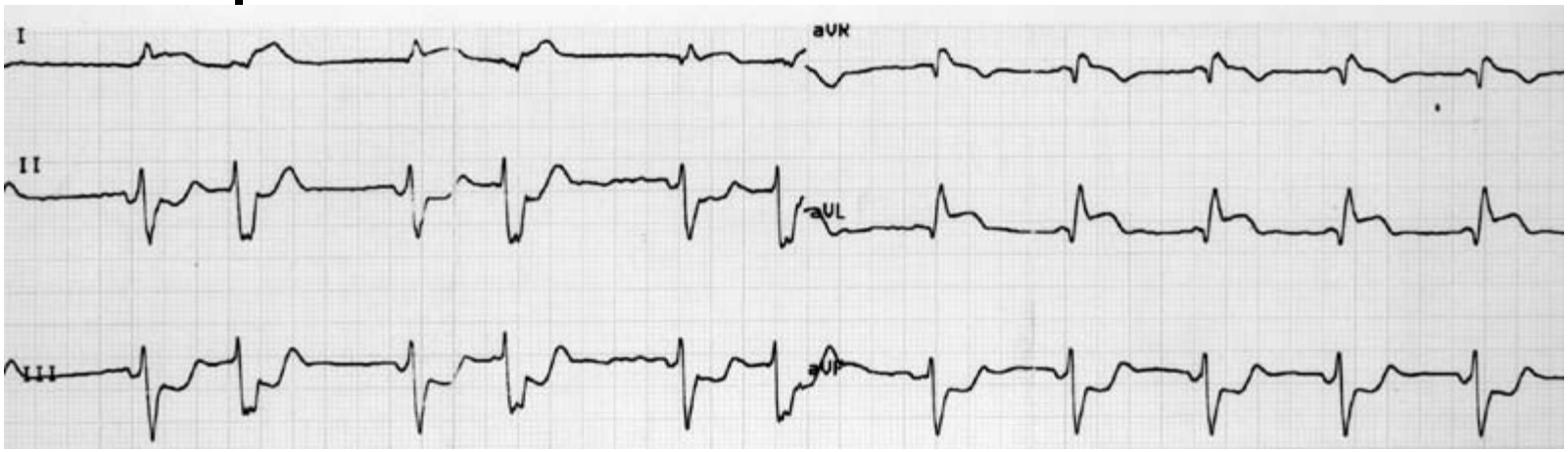
http://www.frca.co.uk/images_main/resources/ECG/ECGresource45.jpg

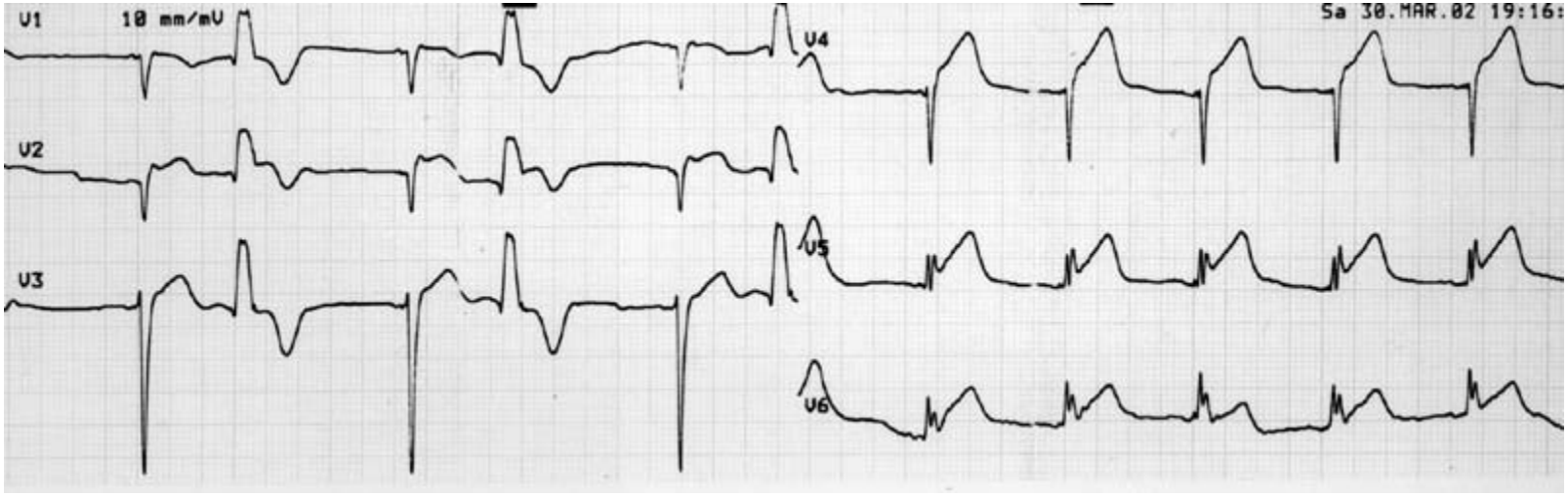
Quick review – Anterior MI



http://upload.wikimedia.org/wikipedia/commons/1/11/12_lead_generated_anterior_MI.JPG

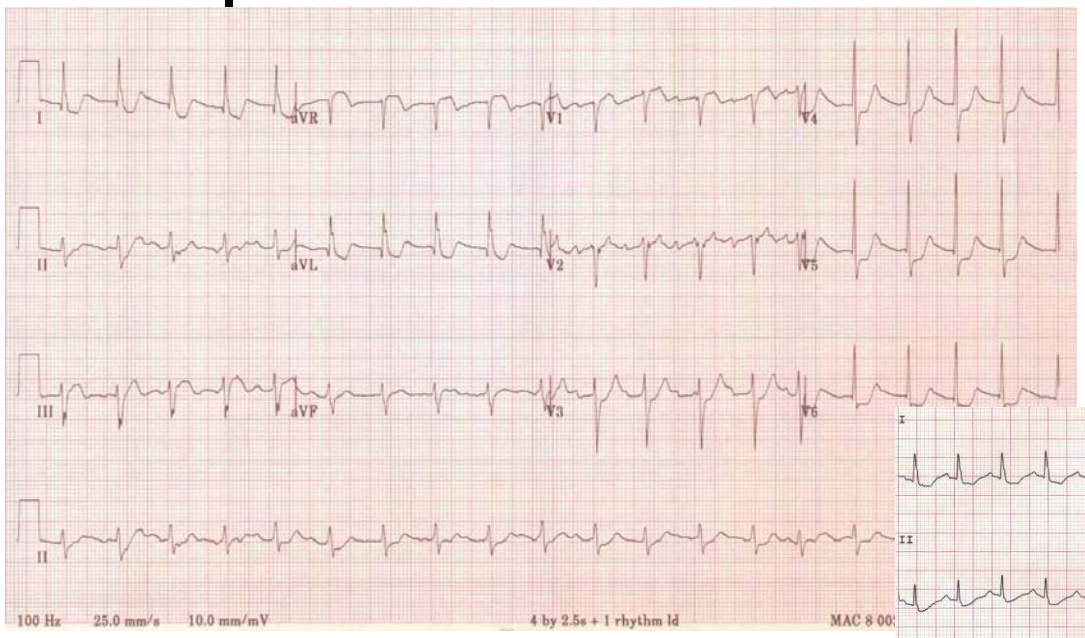
Quick review – Lateral MI



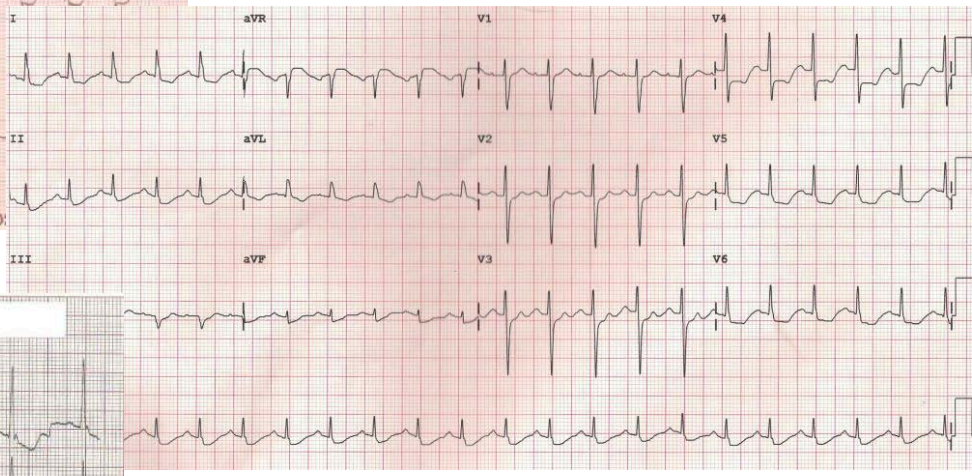


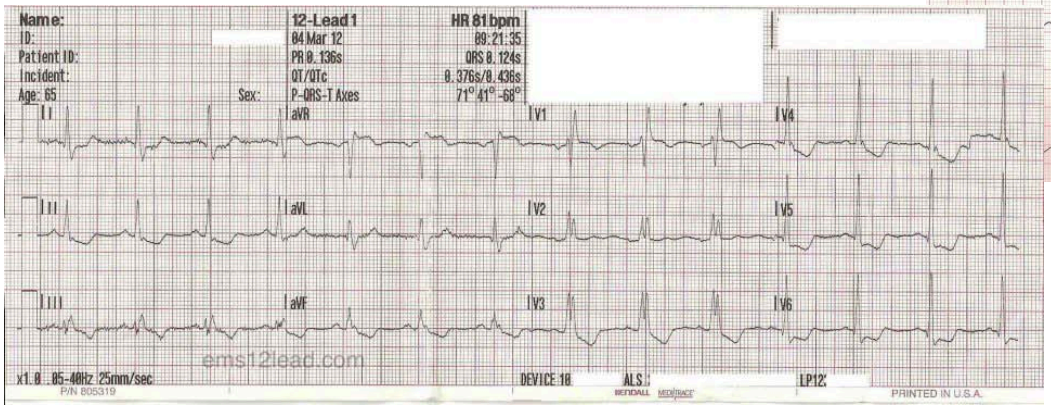
http://www.medscape.com/content/2004/00/47/13/471329/art-jic471329.fig1.jpg

Don’t forget AVR!

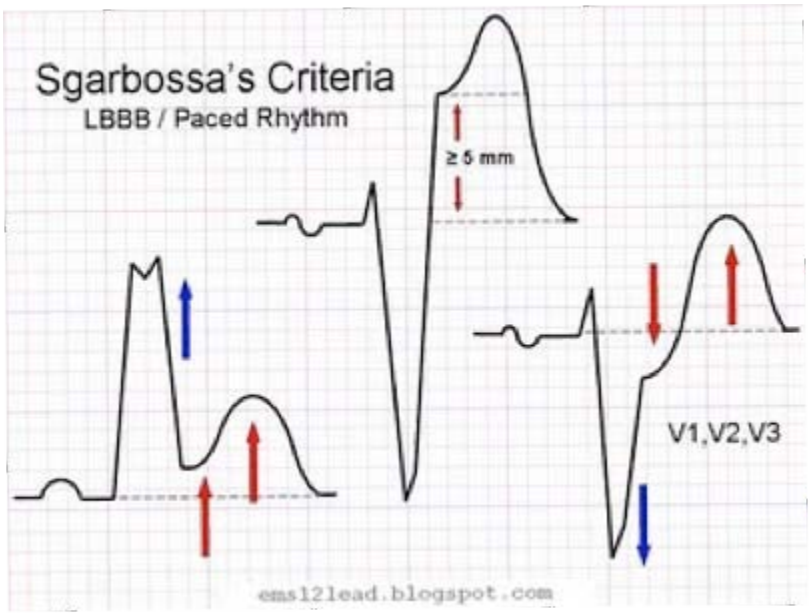


ST elevation in AVR with reciprocal changes indicates LEFT MAIN or THREE VESSEL disease. This is an ominous finding…





Sgarbossa's Criteria



Used to diagnose STEMI in patient's with LBBB. Criteria:

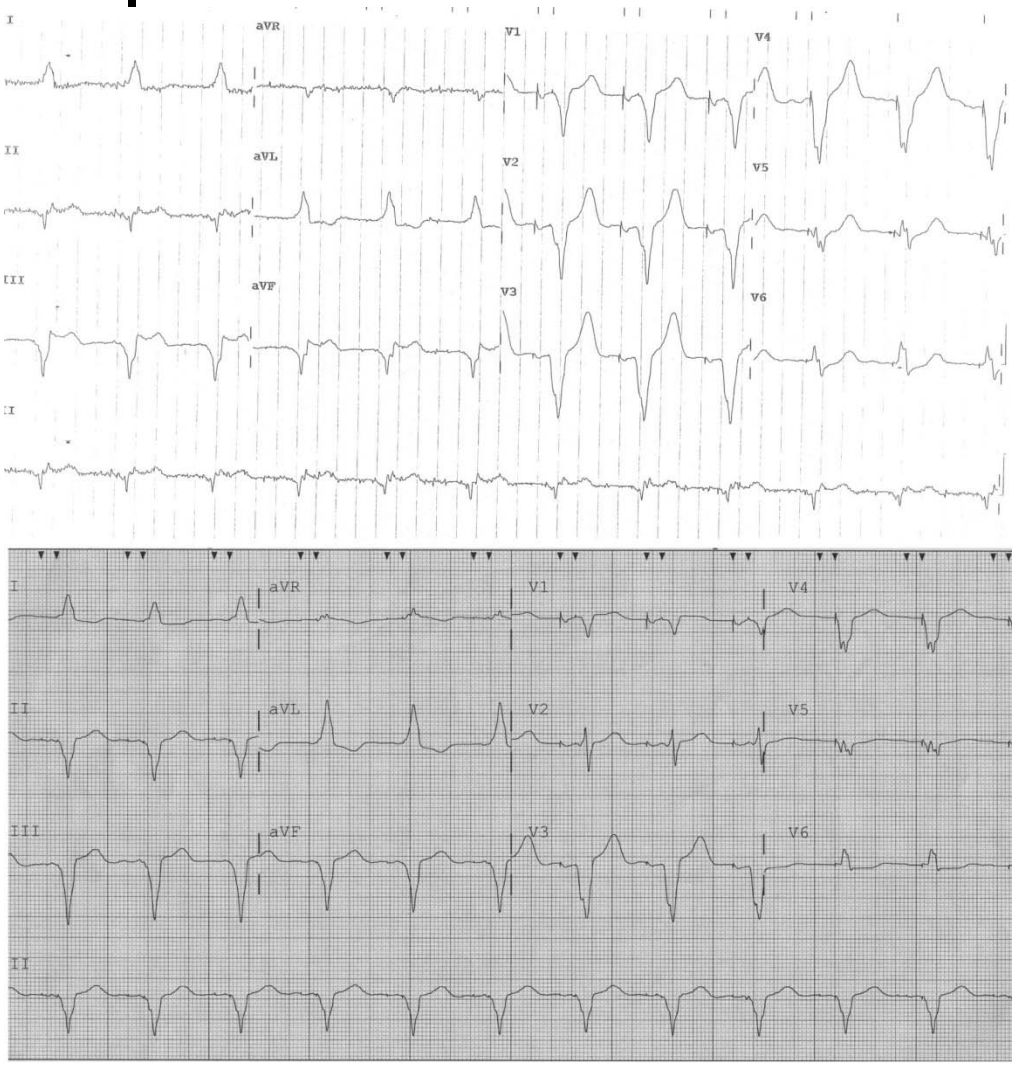
Excessively discordant ST segment elevation ≥5 mm or ≥ 20% the depth of the S wave in leads with a negative QRS complex

Concordant ST elevation ≥1 mm in leads with positive QRS

Concordant ST depression ≥1 mm in leads V1, V2, or, V3

Courtesy of Life in the Fast lane blog… www.lifeinthefastlane.com

Sgarbossa's Criteria



New EKG on top
Old EKG on bottom

Meets Sgarbossa's criteria. ST segments in inferior leads are elevated greater than 20% the depth of the corresponding S wave

Case #1… Overdose

- Dispatched to an overdose you arrive on scene and a family member tells you, “She took a handful of anti-depressant pills,” but he’s unsure what kind. The pill bottles are unmarked.
- The patient has dry skin, is flushed, and her pupils are wide and unresponsive to light
- She is confused when you do a sternal rub and keep her awake long enough to talk to you.

Case #1… Overdose

- Vitals:
  - BP 106/74
  - HR 82
  - RR 14
  - SpO_2 98% RA

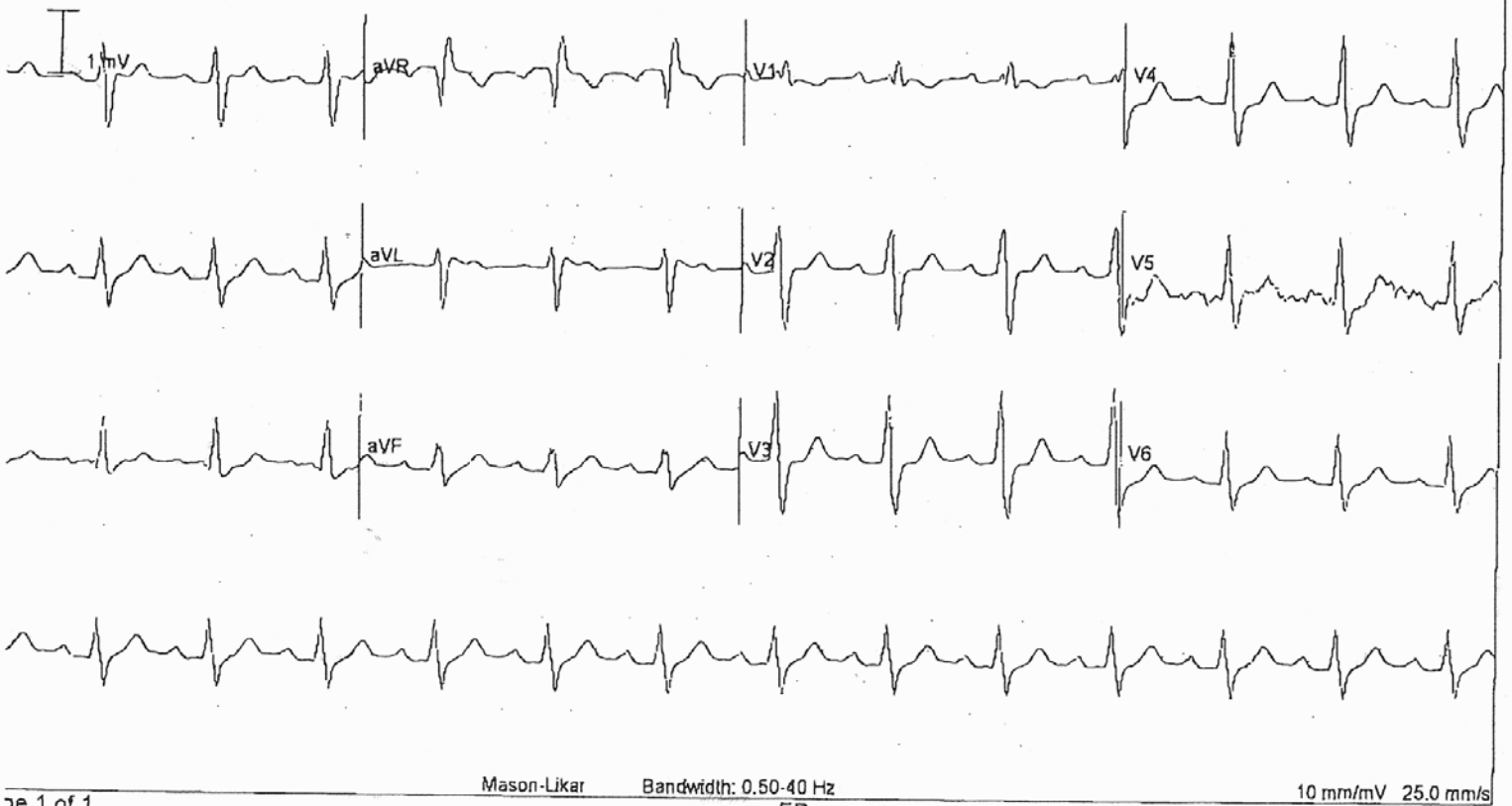
10/13/2005 08:17:38
53 yrs

ate	81 b/min
R	228 ms
RSD	150 ms
T	428 ms
Tc	497 ms

Axis	
	32 deg
RS	132 deg
	46 deg

- ABNORMAL ECG -

Preliminary - MD Must Review



Mason-Likar Bandwidth: 0.50-40 Hz 10 mm/mV 25.0 mm/s

ED

Woodhull Medical Center

F-401 P 001/003 T-877 7189635017 From-8 ICU Oct-13-2005 10:38am

Case #2… “Not feeling well”

- 66 year old male presents with complaint of “just not feeling myself,” and general malaise for the past week
- PMH: HTN, DM, ↑ cholesterol, gout
- Vitals:
  - BP 180/76
  - HR 67
  - RR 14
  - SpO_2 98% RA

ID: 1930731 30-Nov-2005 16:50:55 ALBANY MEDICAL CENTER

30-Dec-1940
Male

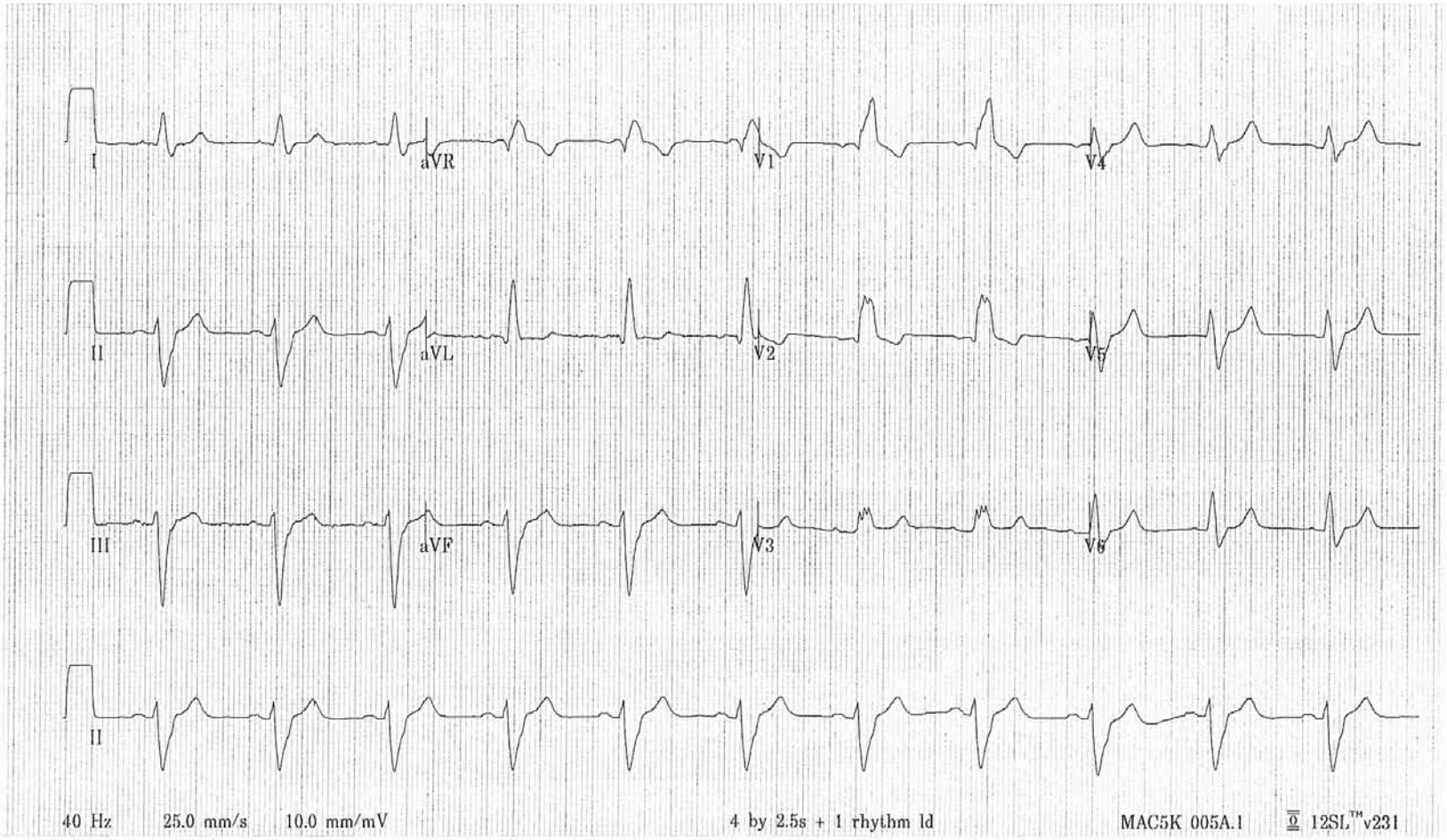
Loc: 0

Vent. rate	67 bpm
PR interval	162 ms
QRS duration	182 ms
QT/QTc	446/471 ms
P-R-T axes	67 -67 47

Technician: 442
Test ind: REPEAT

Referred by: TRINER

Unconfirmed



Case #3… Palpitations

- 27 year old ER resident presents to the ED during his PICU rotation complaining of palpitations
  - Frequent “skipped beats” and pauses
- No PMHx, no meds
- No smoking, drug, or alcohol abuse
- Does note increased stress recently and lack of sleep during this rotation

Case #3… Palpitations

- Vitals:
  - BP 116/74
  - HR 79
  - RR 16
  - SpO_2 99% RA
- Exam:
  - Normal cardiac and lung exam

ID: 2078478 29-Jun-2005 20:10:40 ALBANY MEDICAL CENTER

9-Apr-1978
Male

Loc: 0

Vent. rate	79 bpm
PR interval	108 ms
QRS duration	102 ms
QT/QTc	348/399 ms
P-R-T axes	30 88 40

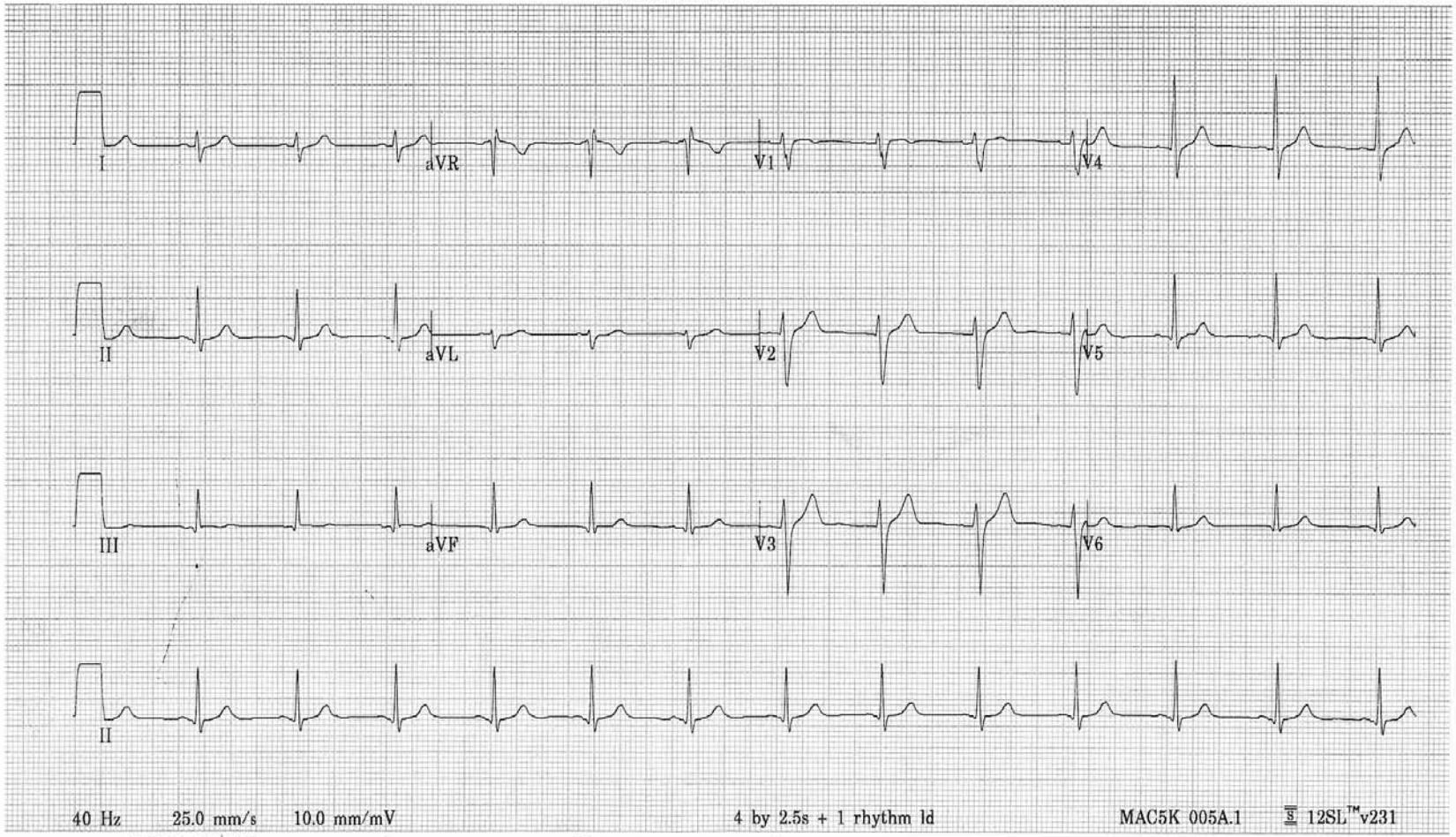
EMERGENCY DEPARTMENT RM 062 A
SERIAL#: 442193066 06/29/05
DOB: 04/09/1978 GENDER: M
MRN: 2078478

(3)

Technician: UDR
Test ind: 785.1

Referred by: MILES

Unconfirmed



40 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 1 rhythm ld MAC5K 005A.1 12SL™v231

Case #4… Palpitations

- 20 year old male complains, “my heart is racing”
- He is diaphoretic and you palp a radial pulse in the 120s
- BP 90/60
- You set up the Lifepack and obtain the following EKG…

ID: 0979935 22-Feb-2006 18:07:55 ALBANY MEDICAL CENTER

9-Aug-1986
Male

Loc: 0

Vent. rate	123 bpm
PR interval	122 ms
QRS duration	116 ms
QT/QTc	312/446 ms
P-R-T axes	115 43 213

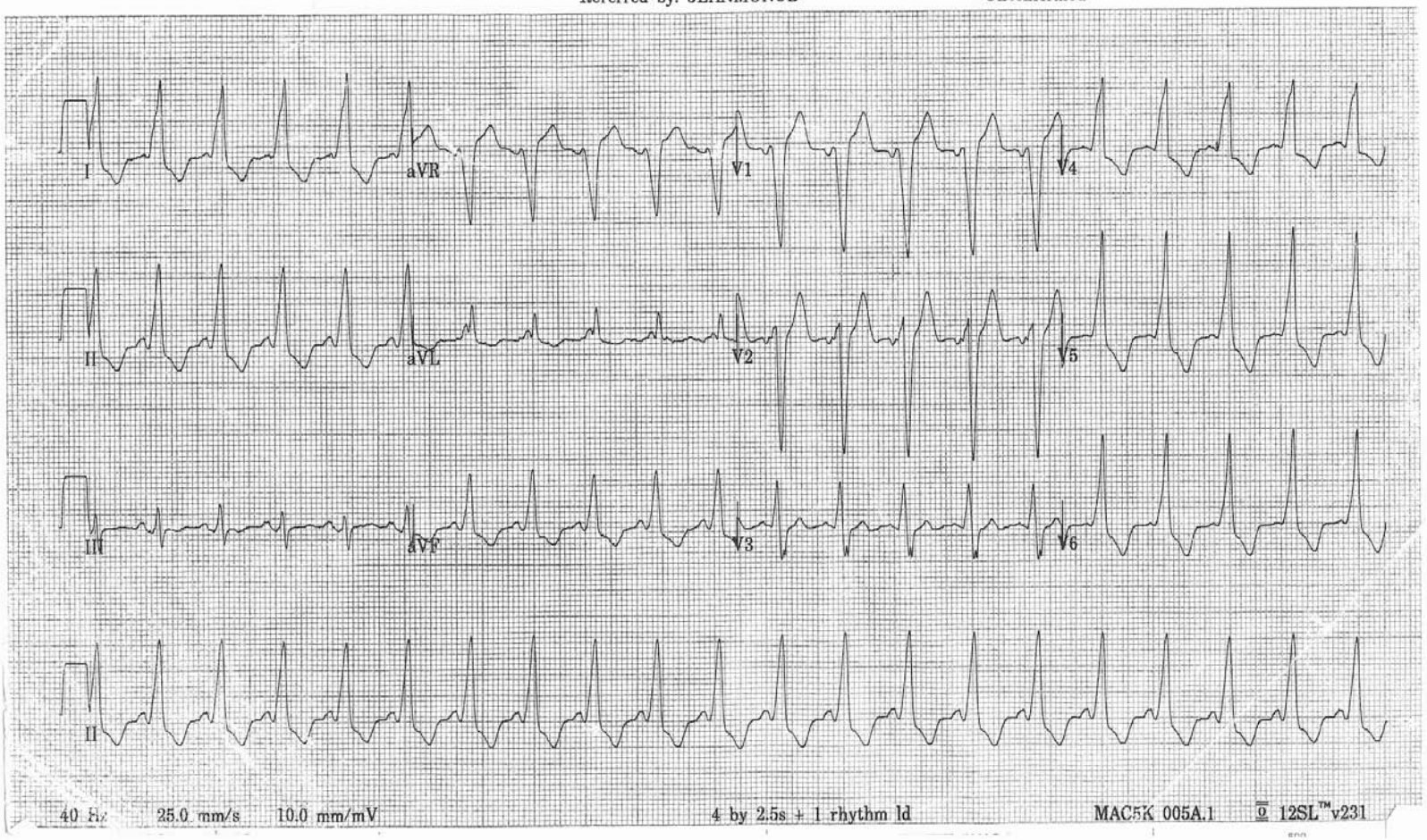
3-19

4A

Technician: 1321
Test ind: SYNCOPE

Referred by: JEANMONOD

Unconfirmed



Case #4… Palpitations

- Patient notes no previous medical history, other than he has had palpitations in the past… but never this bad
- What treatments are appropriate?
- Which anti-arrhythmic is best (and worst) and why?

ID: 0979935 22-Feb-2006 21:09:10 ALBANY MEDICAL CENTER

9-Aug-1986
Male

Loc: 0

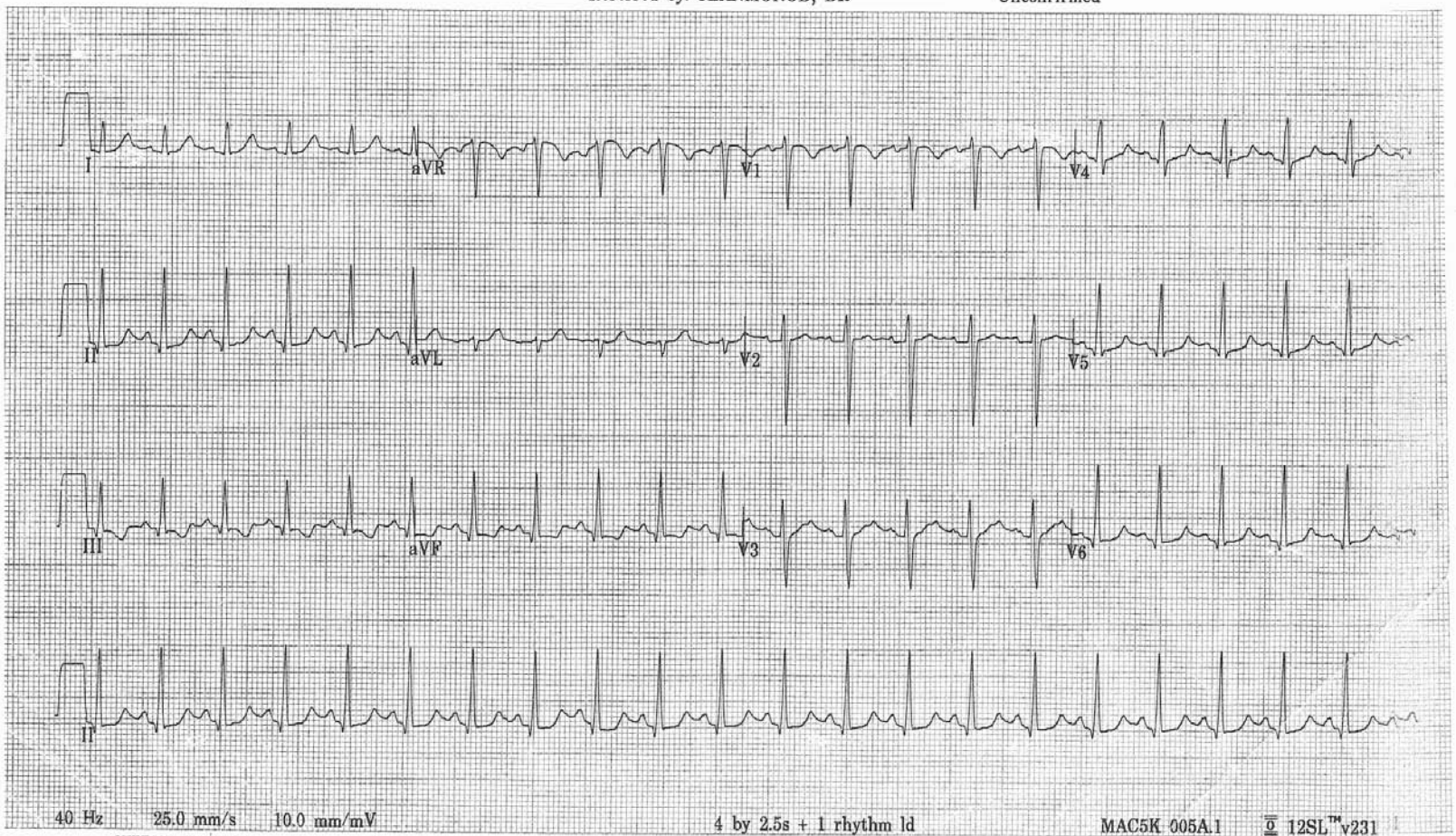
Vent. rate	126 bpm
PR interval	126 ms
QRS duration	80 ms
QT/QTc	328/475 ms
P-R-T axes	61 68 13

4B

Technician: 493
Test ind: 780.2

Referred by: JEANMONOD, DR

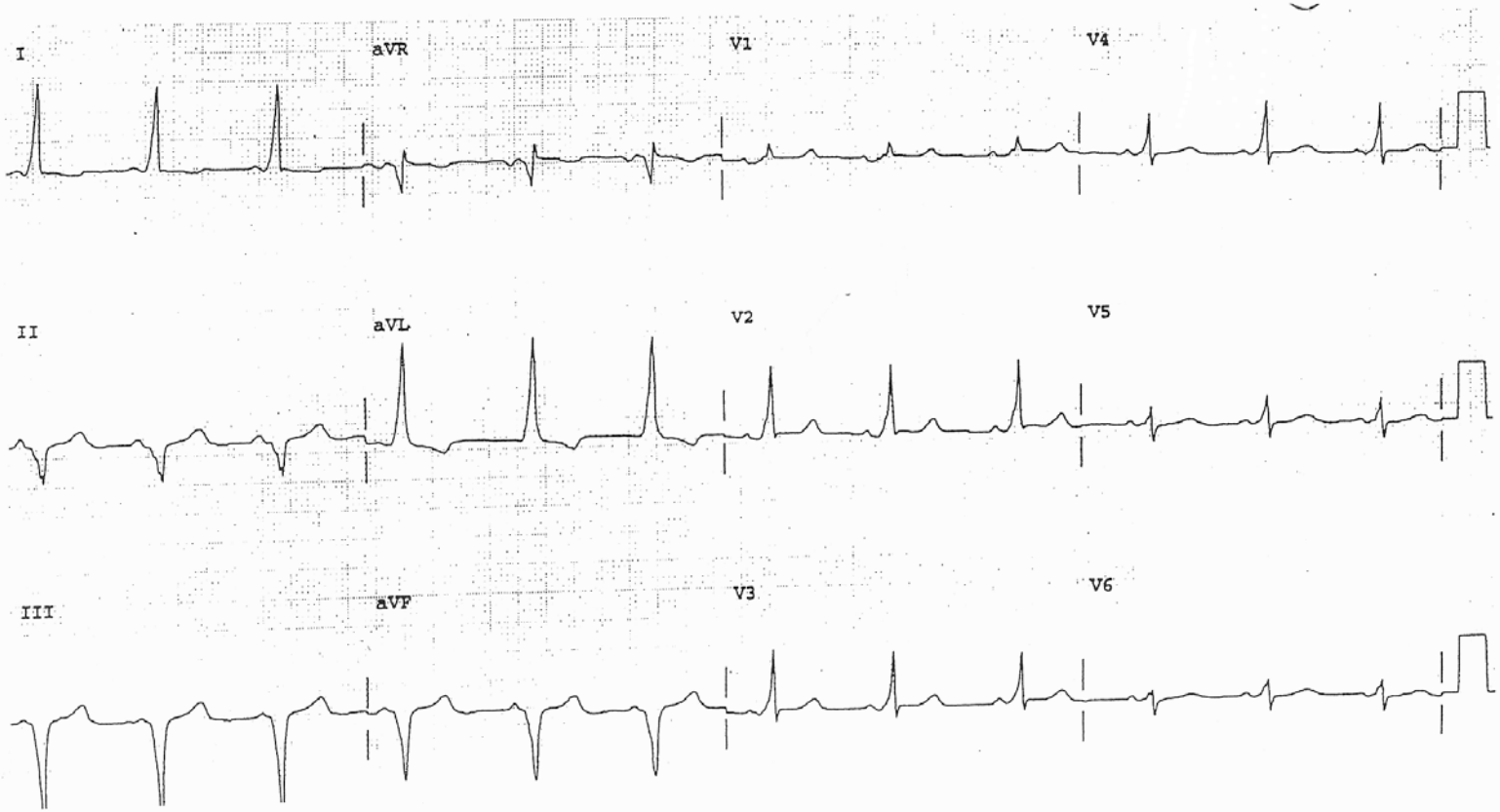
Unconfirmed



4c

Sample Tracing, Part 3: Electrocardiographic Clinical Correlations

Stem: A 48-year-old woman is seen after a one hour episode of rapid rhythm during which the pulse rate was 175 bpm



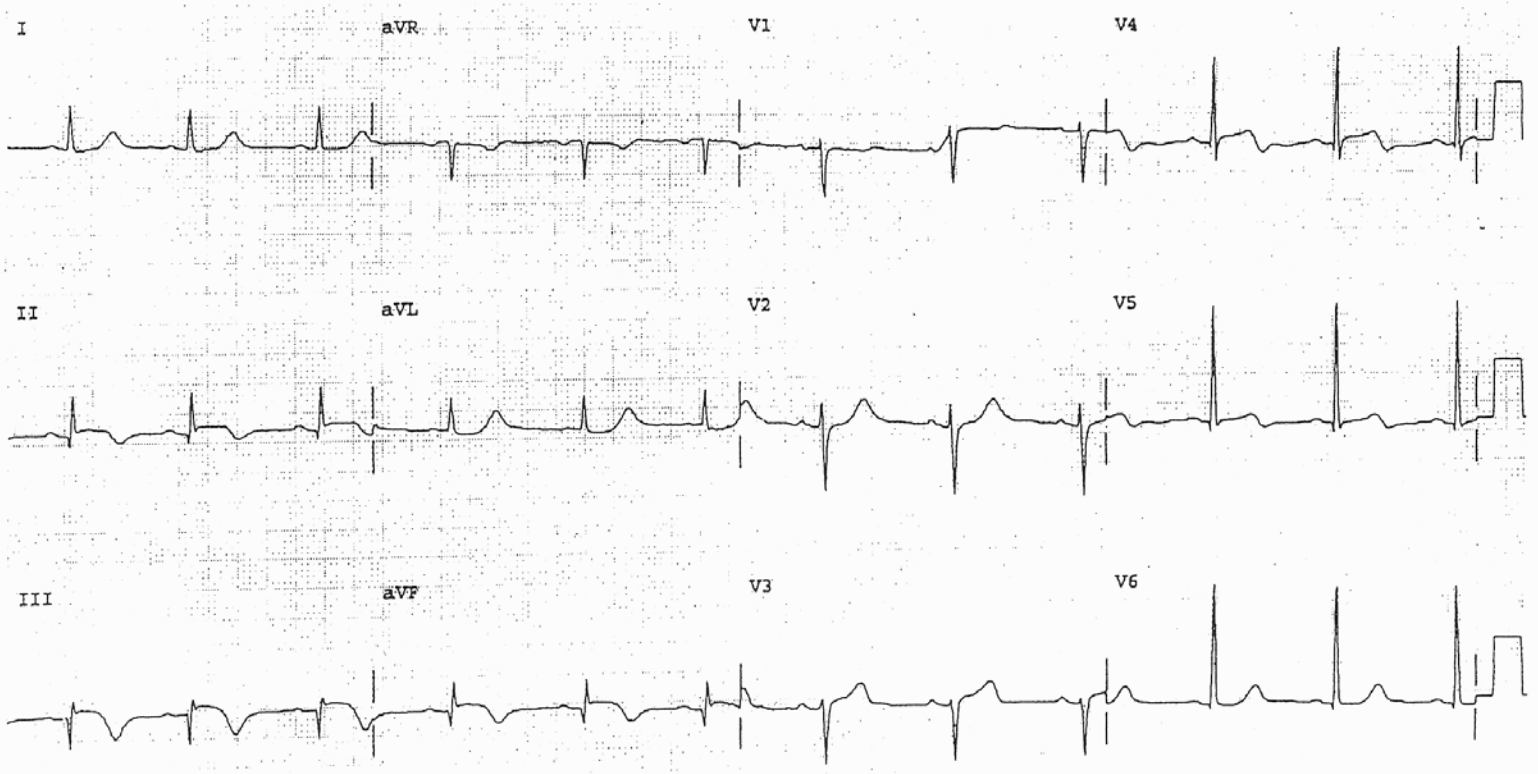
Case #5… Chest heavyness

- Called to a house for a “cardiac emergency,” you arrive to find an anxious appearing 55 year old female
- She states “my chest feels heavy.”
- PMHx: DM, HTN
- Vitals:
  - BP 110/50
  - HR 65
  - RR 22
  - SpO_2 97% RA

5

Sample Tracing, Part 1: Single ECG Tracing Interpretation

A 55-year-old woman



Case #6… Diabetic illness

- You are called to a “diabetic emergency” and arrive to find a 57 year old male, with ESRD from DM and on dialysis c/o “not feeling well” and dyspnea
- He does not pass the “look test”
- Pt obviously tachypneic with an irregular breathing pattern
- Notes “my sugars are running high”

Case #6… Diabetic illness

- Vitals:
  - BP 100/52
  - HR 71
  - RR 32
  - SpO_2 88% 4L N/C home oxygen

ID: 000405530 21-Jul-2006 15:21:46 Albert Einstein Medical Center

Vent. rate	71 bpm
PR interval	* ms
QRS duration	132 ms
QT/QTc	426/462 ms
P-R-T axes	* -1 -1

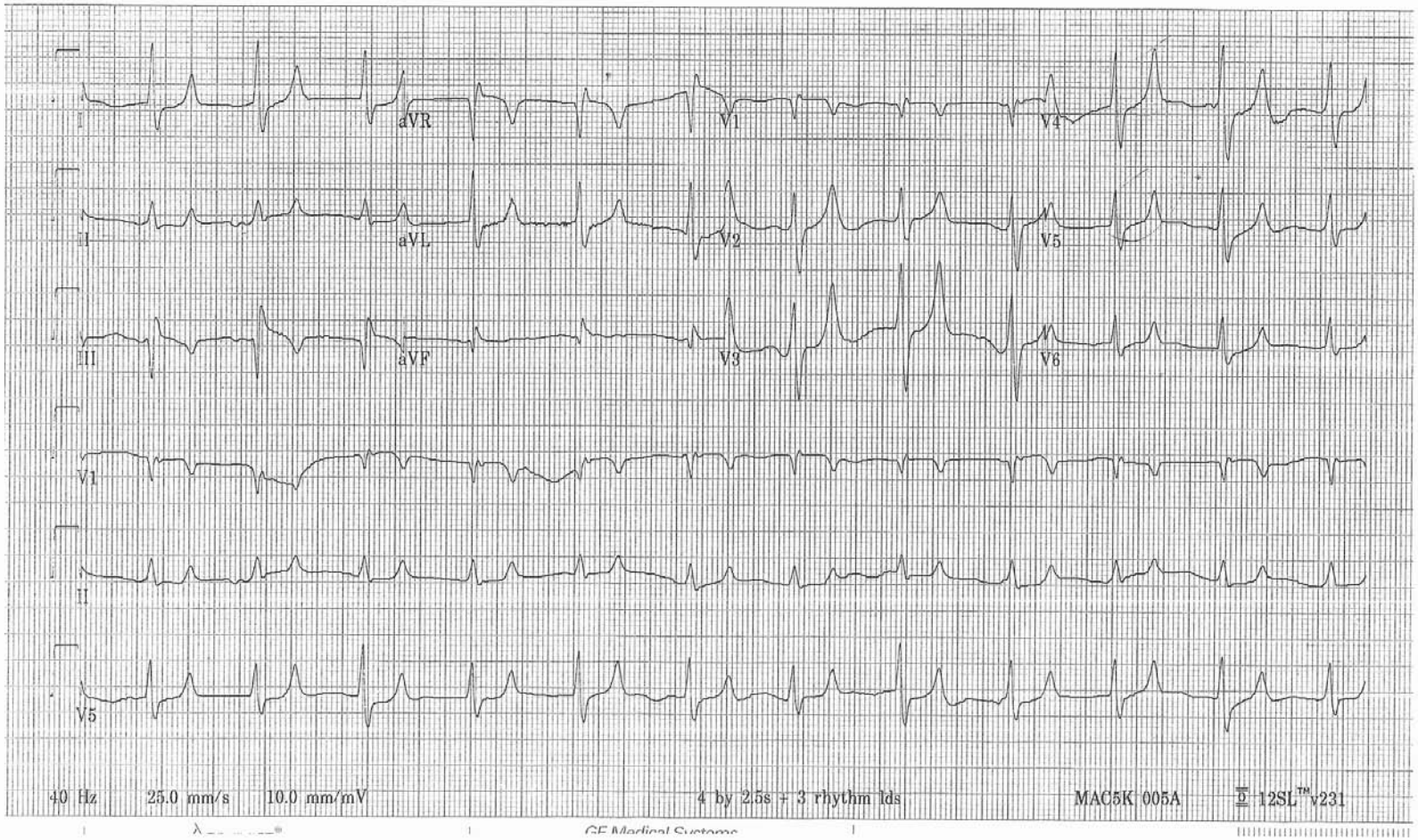
Abnormal ECG

Room:

6A

Technician:
Test ind:

Referred by: Unconfirmed



Case #6… Diabetic illness

- What immediate treatments must you give to prevent a fatal arrhythmia?

Albert Einstein Medical Center

57years

Vent. rate 64 bpm
PR interval * ms
QRS duration 116 ms
QT/QTc 412/425 ms
P-R-T axes 63 32 32

Abnormal ECG

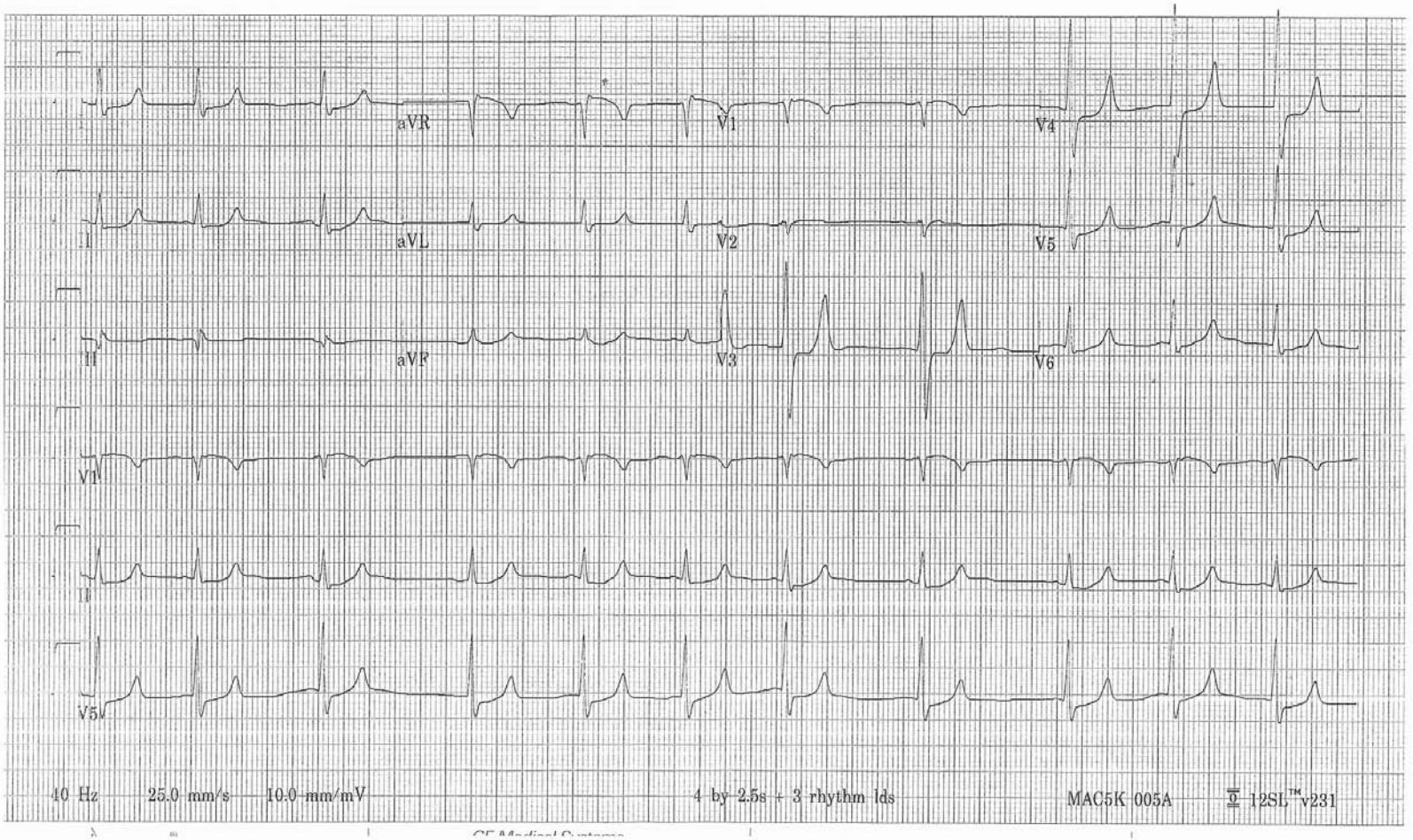
Room:

6B

Technician:
Test ind:

Referred by:

Unconfirmed



Case #7… Post stent issue

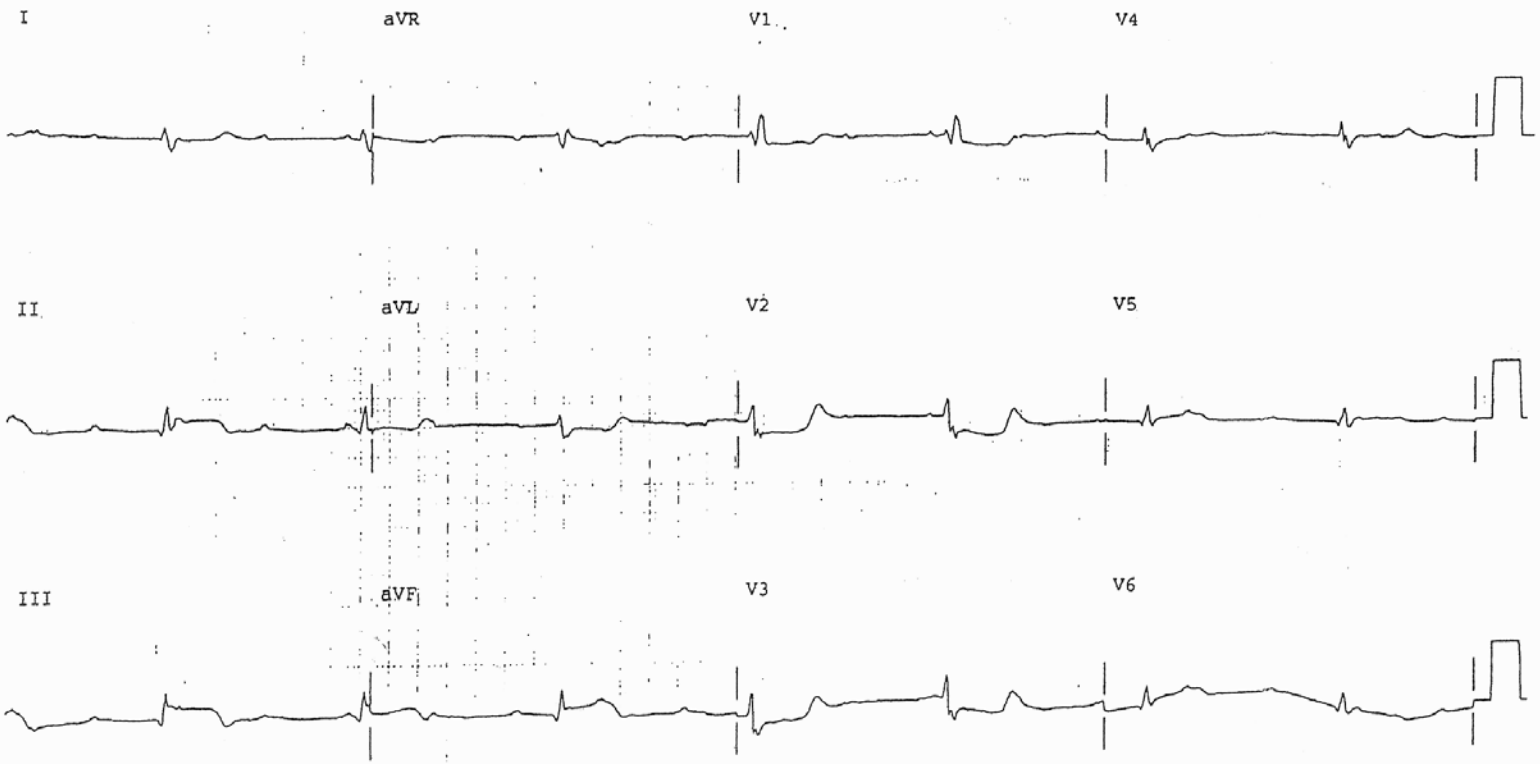
- You are called to a rehab center and are met at the bedside by a nurse
- She says to you “Mr. Jones’ heart rate is too slow… we need him taken to Phoenixville”
- You note a heart rate of 30 on the monitor
- Mr. Jones is diaphoretic, and says “My chest doesn’t feel right.” He then vomits.

Case #7… Post stent issue

- You review his paperwork and note that Mr. Jones had a cardiac cath 3 days ago, and had a stent placed for 90% occlusion of his RCA. There was also a 60% occlusion of his circumflex that was not stented.
- Vitals:
  - BP 78/34
  - HR 30
  - RR 12
  - $Sp0_2$ 91% RA

7

Stem: A 59-year-old man in the coronary care unit



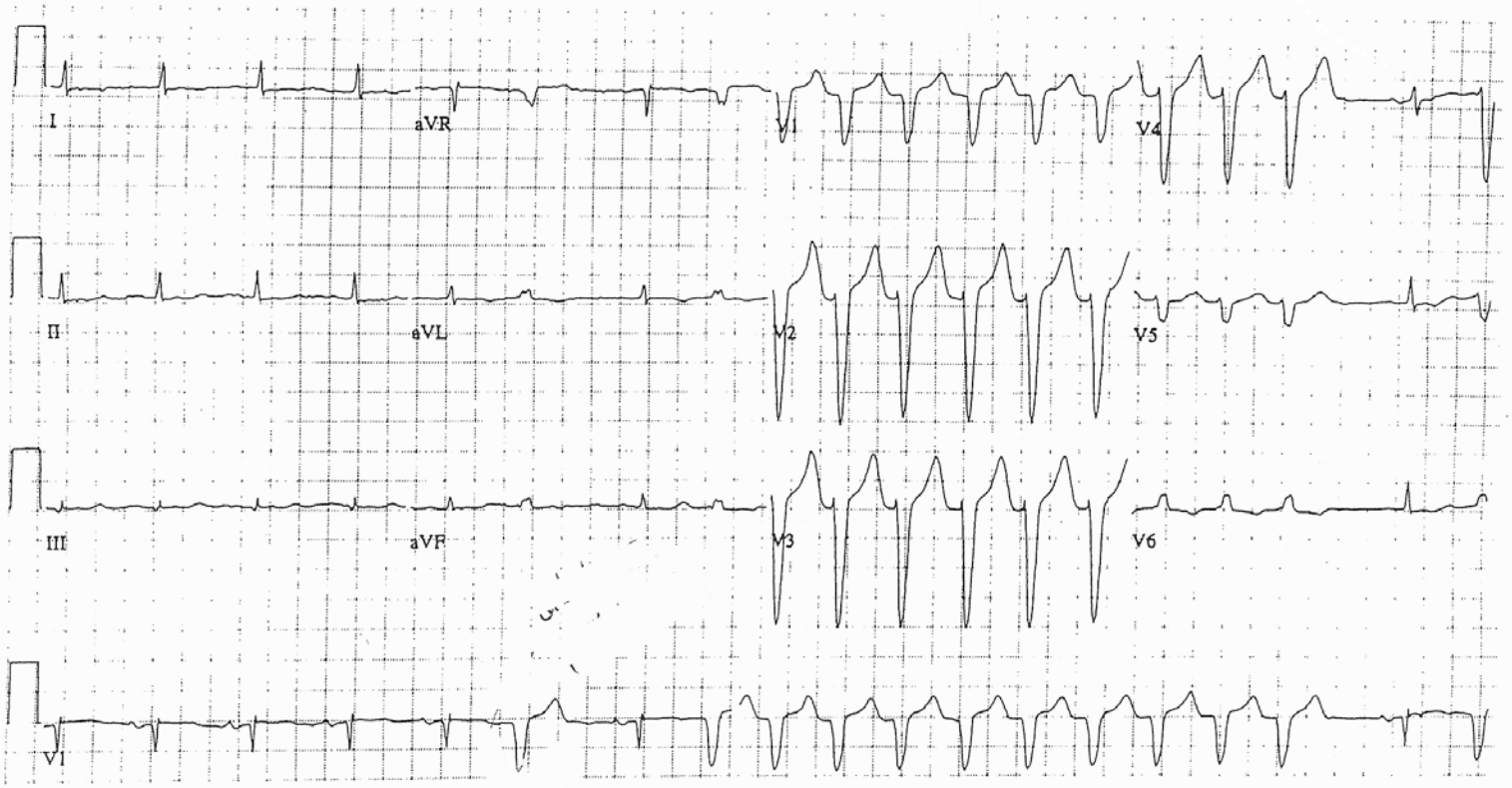
Case #8…Post-surgical ↑HR

- You pick up a 57 year old male that had a resection of a cancerous lung tumor last week, and just got home yesterday
- He states he's been feeling his heart racing on and off for the past hour
- As you are getting a 12 lead, he says to you… "there it goes again!"

8

Tracing 17, Part 1

Stem: A 57-year-old man following lung surgery



Case #9… Chest Pain

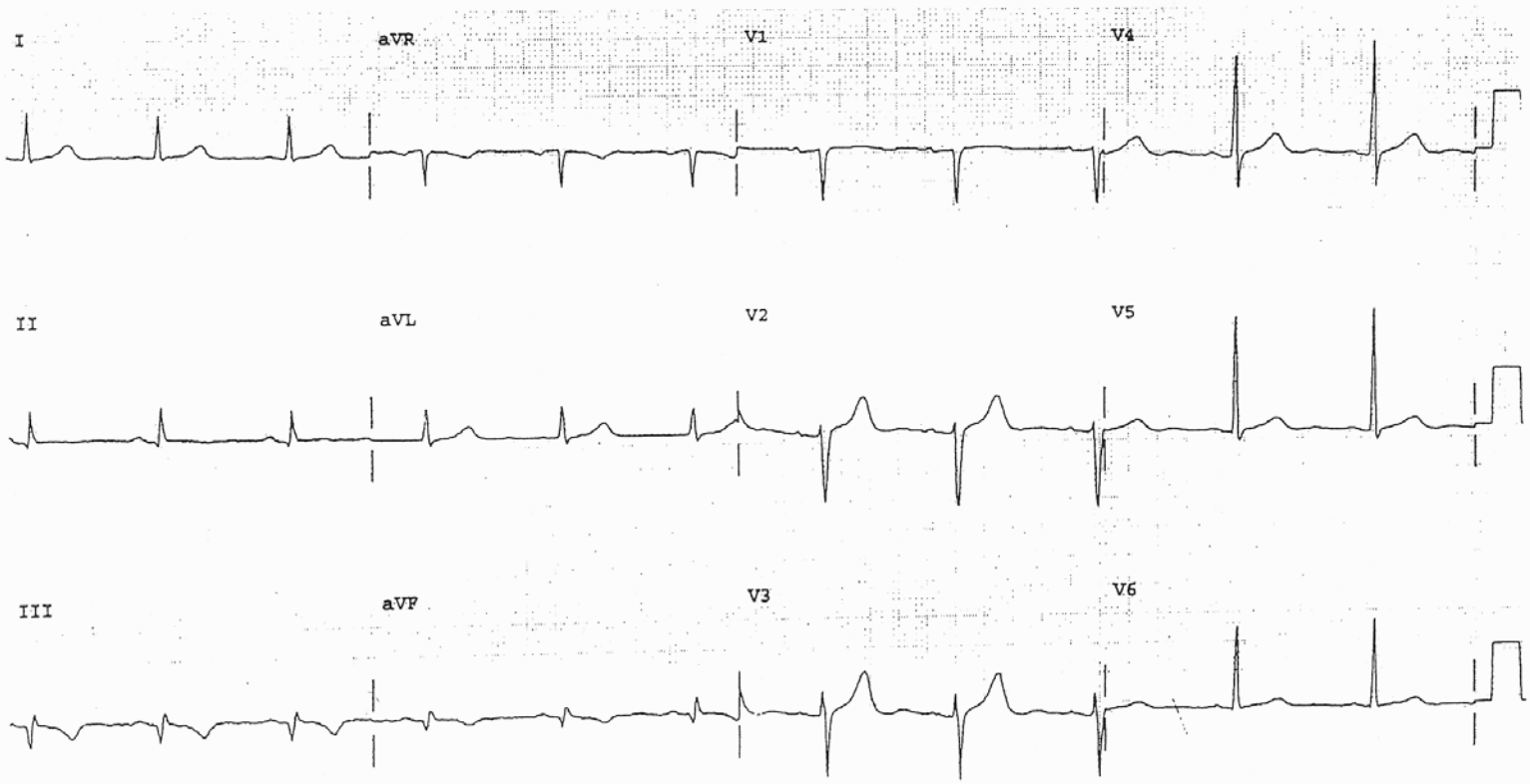
- 49 year old male presents c/o chest pain of one hour's duration. He notes a previous history of an MI two months ago
- You are at his MD's office and he is now pain free after ASA and nitro
- Vitals:
  - BP 174/68
  - HR 60
  - RR 14
  - SpO_2 95% RA

9A

Sample Tracing B, Part 4

Date: 5/4/96

Interpret this tracing.

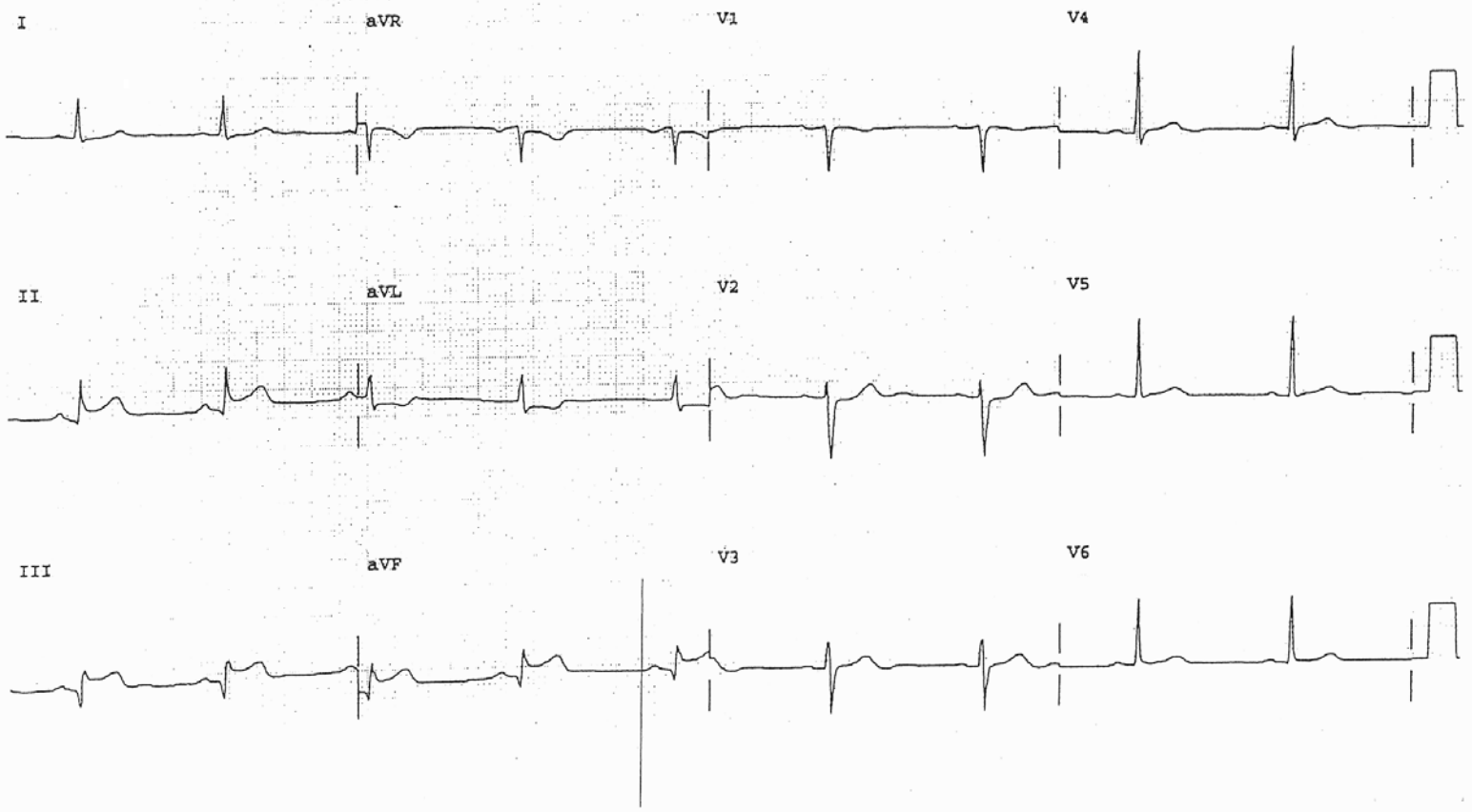


Case #9… Chest Pain

- The primary MD hands you his old EKG with his other paperwork…

9B

Sample Tracing A, Part 4: Serial Tracing



Case #10… ↑HR and SOB

- You meet a BLS crew for a patient with a “rapid heartbeat”
- As you board their ambulance, the EMT seems concerned and says, “Her heart rate is really fast.”
- The woman is on a NRB and appears very anxious

Case #10… ↑HR and SOB

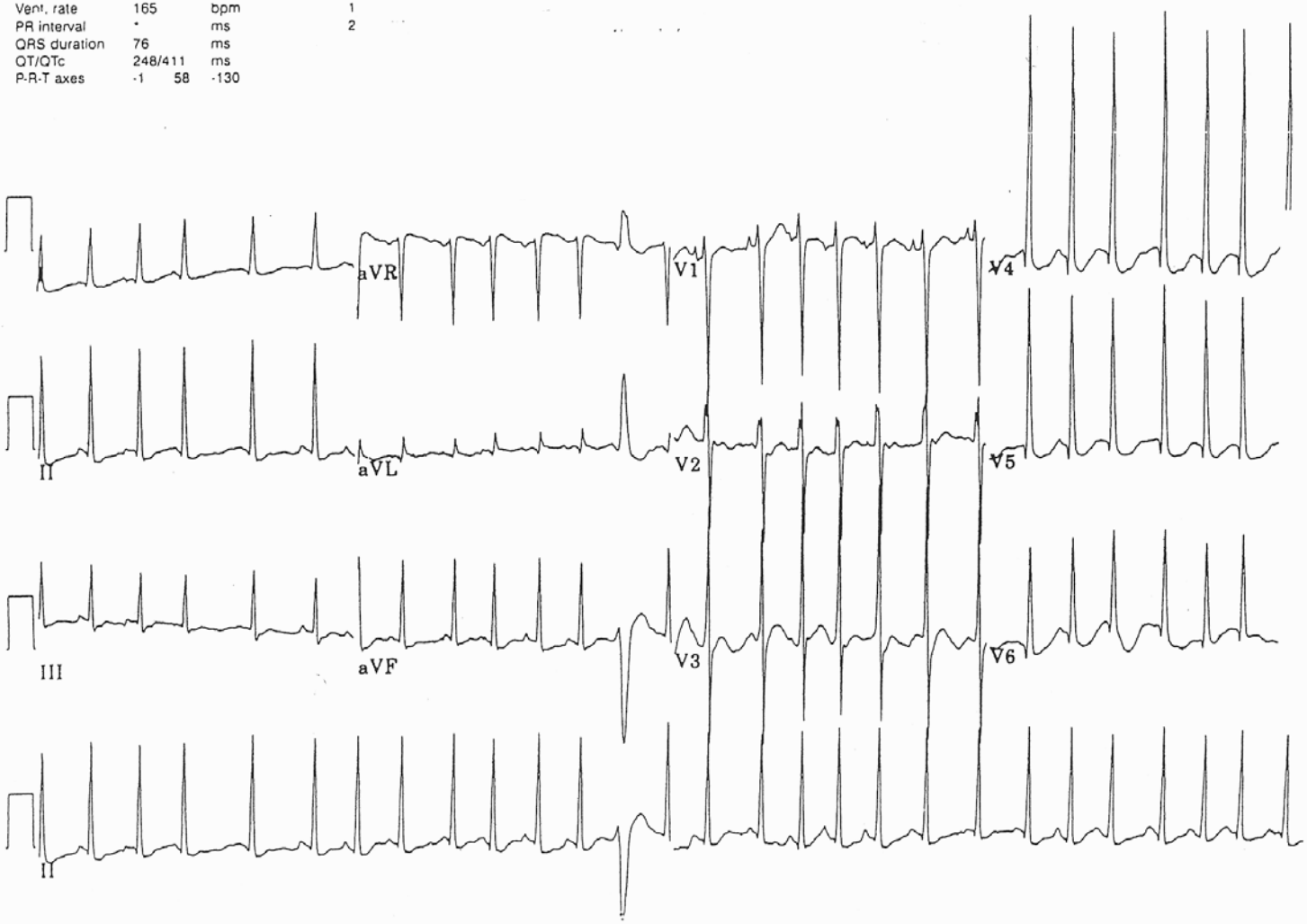
- She notes a history of COPD, and recently quit smoking after a 40 pack year habit
- You take her pulse and it is weak, fast, irregular, and thready
- Vitals:
  - BP 106/74
  - HR 165
  - RR 16
  - SpO_2 100% NRB

Tracing 6, Part 2

10

Stem: A 60-year-old woman

Vent. rate	165	bpm	1
PR interval	•	ms	2
QRS duration	76	ms	
QT/QTc	248/411	ms	
P-R-T axes	-1 58	-130	



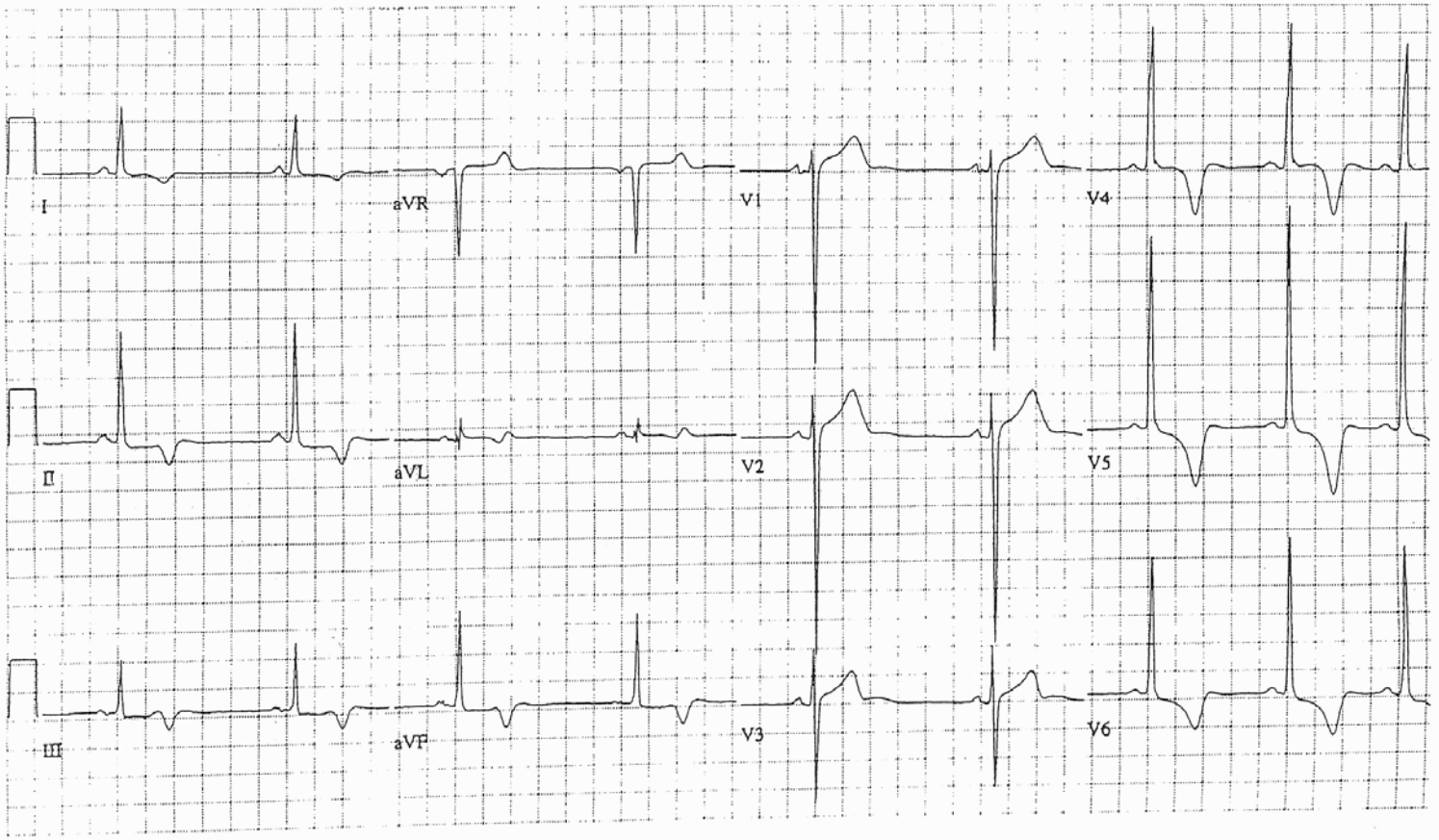
Case #11… Exertional CP

- You are called to a college gymnasium
- Upon arrival you find a 20 year male with an athletic build complaining of chest pain that started when he was running vigorously during a basketball game
- He notes he passed out while lifting weights the other day… and that has never happened to him before

11

Tracing 6, Part 3

Stem: A 22-year-old man with chest pain



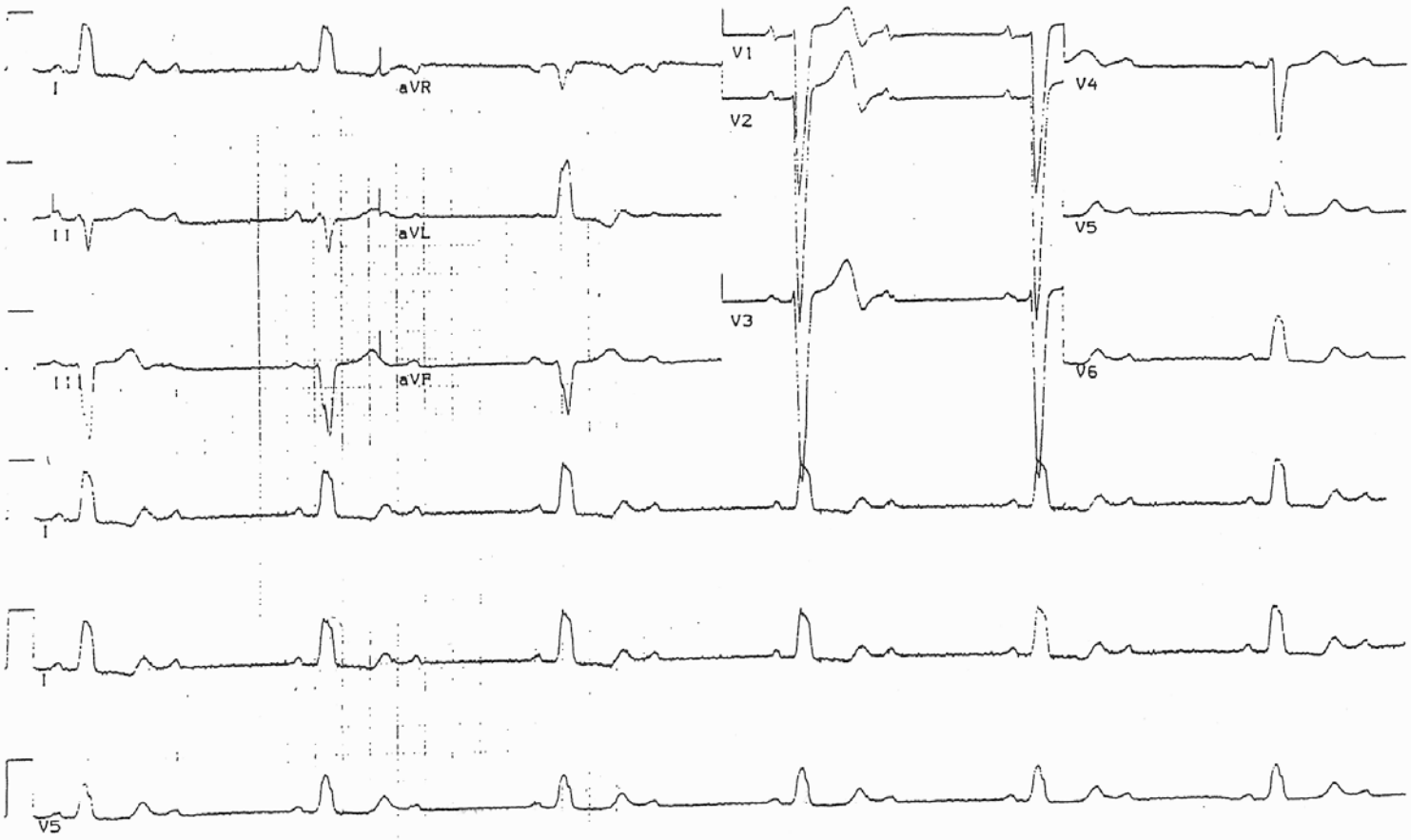
Case #12…Dizziness

- You are called to a urologists office for a 72 year old male complaining of “dizziness”
- He was there for a routine check-up after treatment for prostate CA
- As you arrive, the doctor pulls you aside and says… “I think he has some kind of block on his EKG.”
- He notes to you the patient’s vitals have been within normal limits

12

Tracing 4, Part 1

Stem: A 72-year-old man with dizzy spells



Case #13… Fractured leg

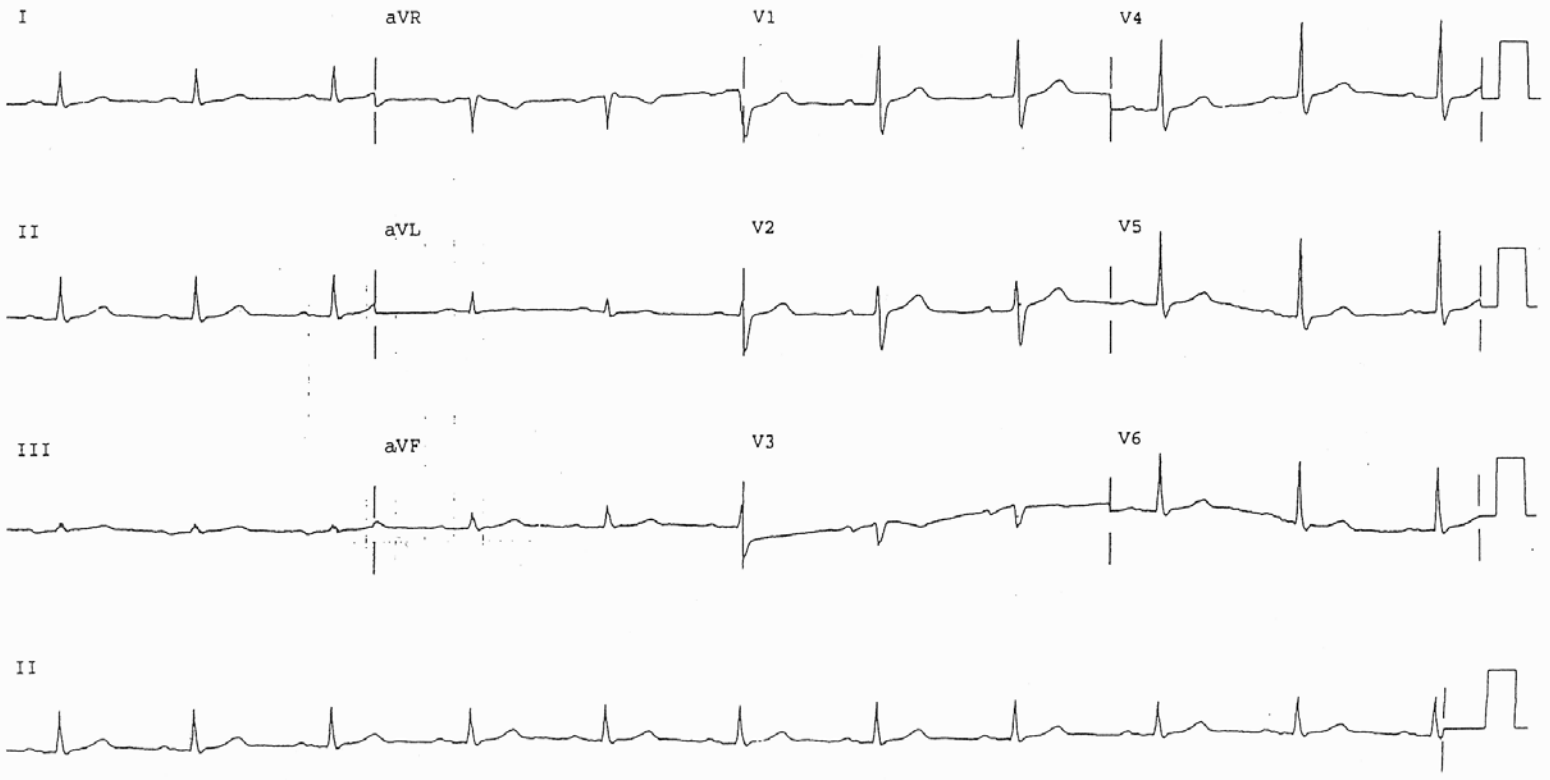
- 60 year old male involved in a motor vehicle collision
- He has a comminuted open right tib-fib fracture, and is complaining of chest pain from hitting the steering wheel
- Vitals are within normal limits
- En-route to the hospital you obtain an EKG

13

Tracing 2, Part 2

Stem: A 60-year-old man

Vent. rate	63	bpm	
PR interval	220	ms	
QRS duration	99	ms	
QT/QTc	388/397	ms	
P-R-T axes	0 31	50	



Case #14… Abnormal labs

- You are called for “general malaise”
- Upon arrival, you walk into the house and find a 39 year old female complaining of “pain all over.” She notes her doctor called, “and my labs are all out of whack.”
- PMHx: Recently treated for breast CA, with a mastectomy and chemo

14

Tracing 18, Part 1

Stem: A 39-year-old female with breast cancer

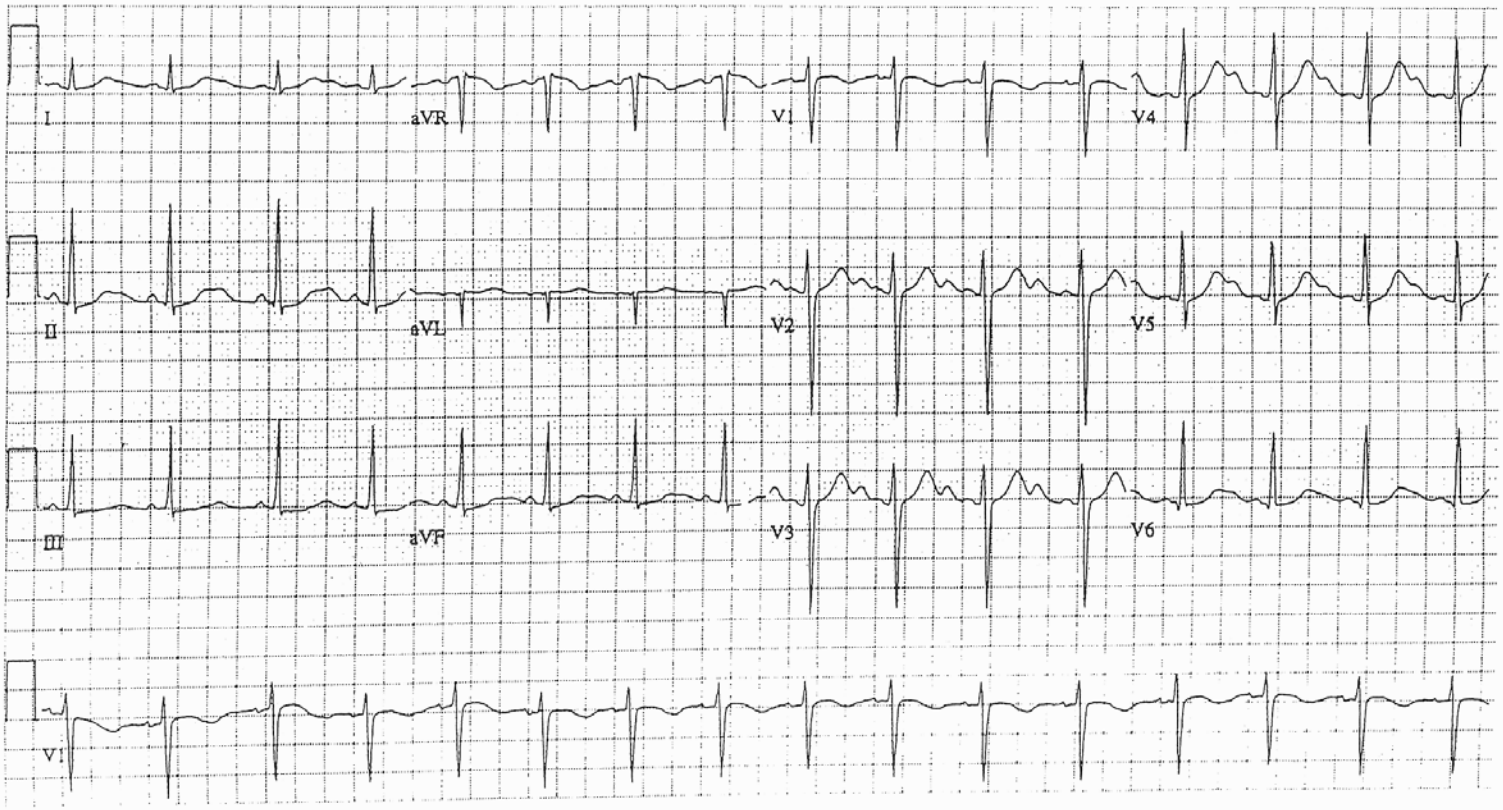
Case #15... Syncope

- You are called to the high school for “syncope”
- Upon arrival at the nurse’s office, you find a 16 year old female with no complaints
- She was talking to her friends between classes when she felt “funny” and passed out

15

Tracing 2, Part 3

Stem: A 16-year-old woman referred to neurology for syncope



Case #16… Palpitations

- Called to a pediatrician's office for a "cardiac emergency"
- Upon arrival 12 year old male complains of palpitations and feels anxious
- Mom notes history of palpitations before
- MD noted HR of 220

ID: 0000000 11-Jun-2008 13:31:32 The Reading Hospital and Medical Center

12years
Male

Room:
Loc: 3

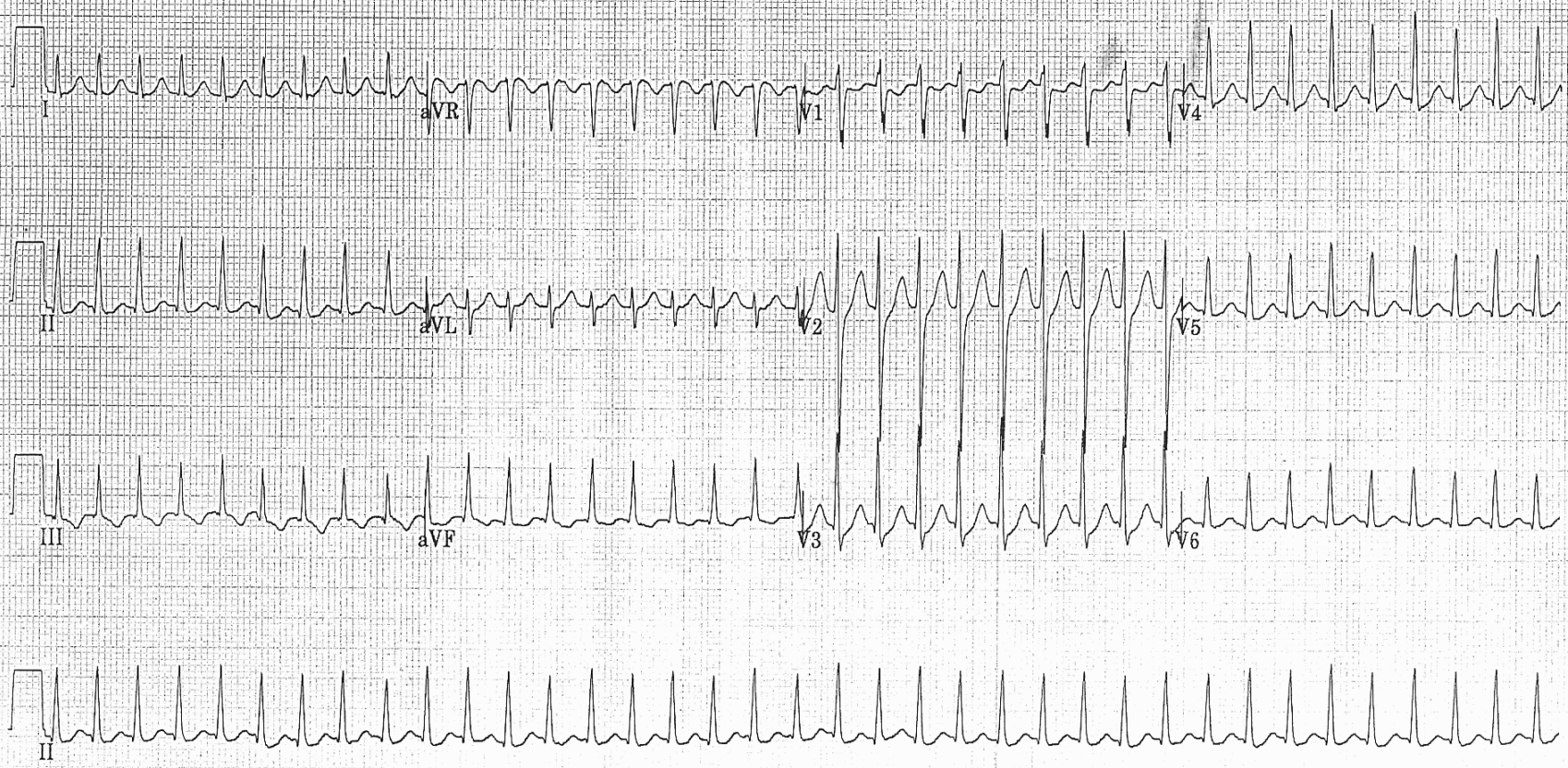
Vent. rate	220 bpm
PR interval	* ms
QRS duration	74 ms
QT/QTc	212/405 ms
P-R-T axes	* 68 -27

16A

Technician: H WEISER

Unconfirmed

COMMENTS:



100 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 1 rhythm ld MAC5K 005A.1 12SL™v231

Premium™ GE Medical Systems

Case #16…Palpitations

- What anti-arrhythmic is the best choice?

ID: 0000000 11-Jun-2008 13:45:28 The Reading Hospital and Medical Center

12years
Male

Room:
Loc: 3

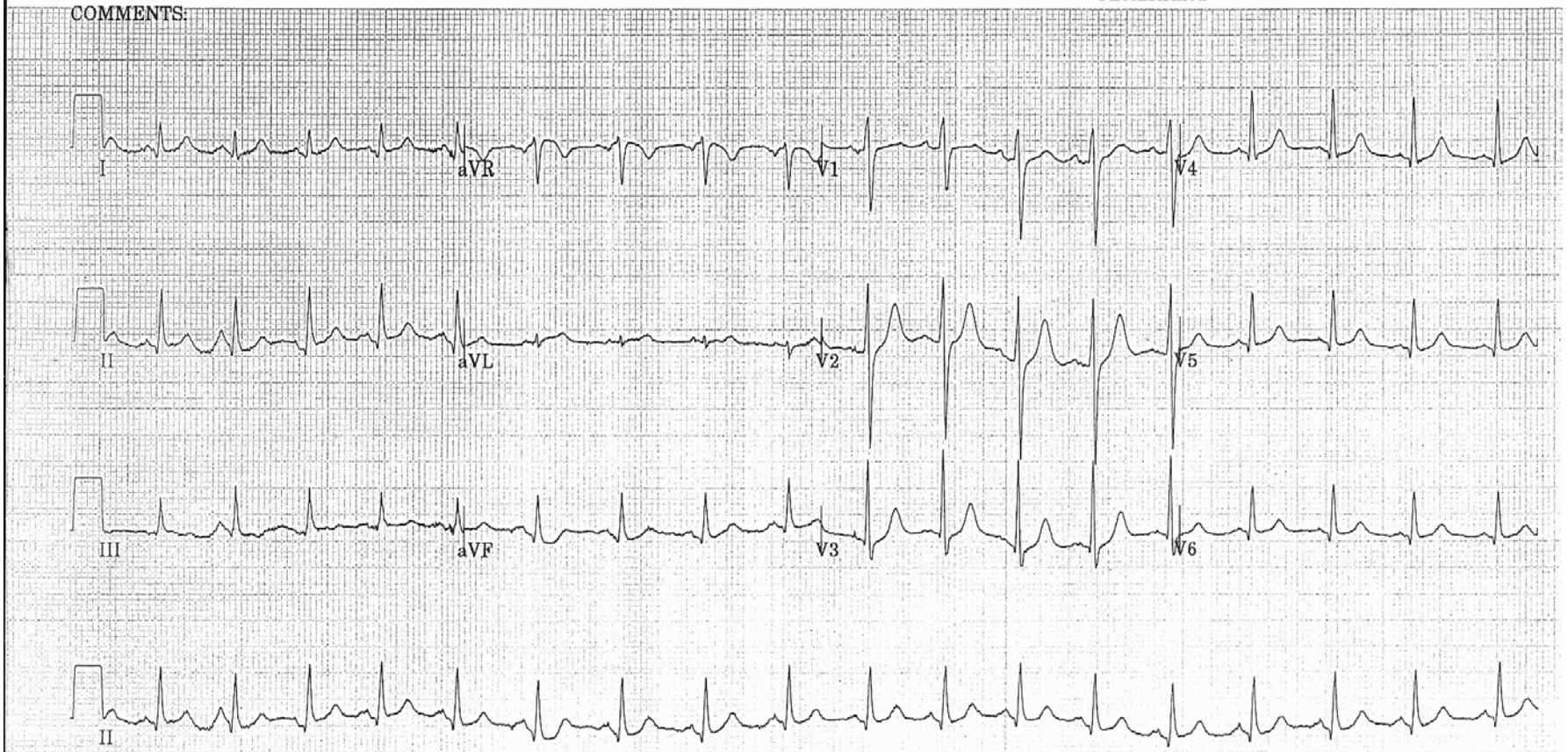
Vent. rate	109 bpm
PR interval	120 ms
QRS duration	82 ms
QT/QTc	320/430 ms
P-R-T axes	55 65 38

16B

Technician: H WEISER

Unconfirmed

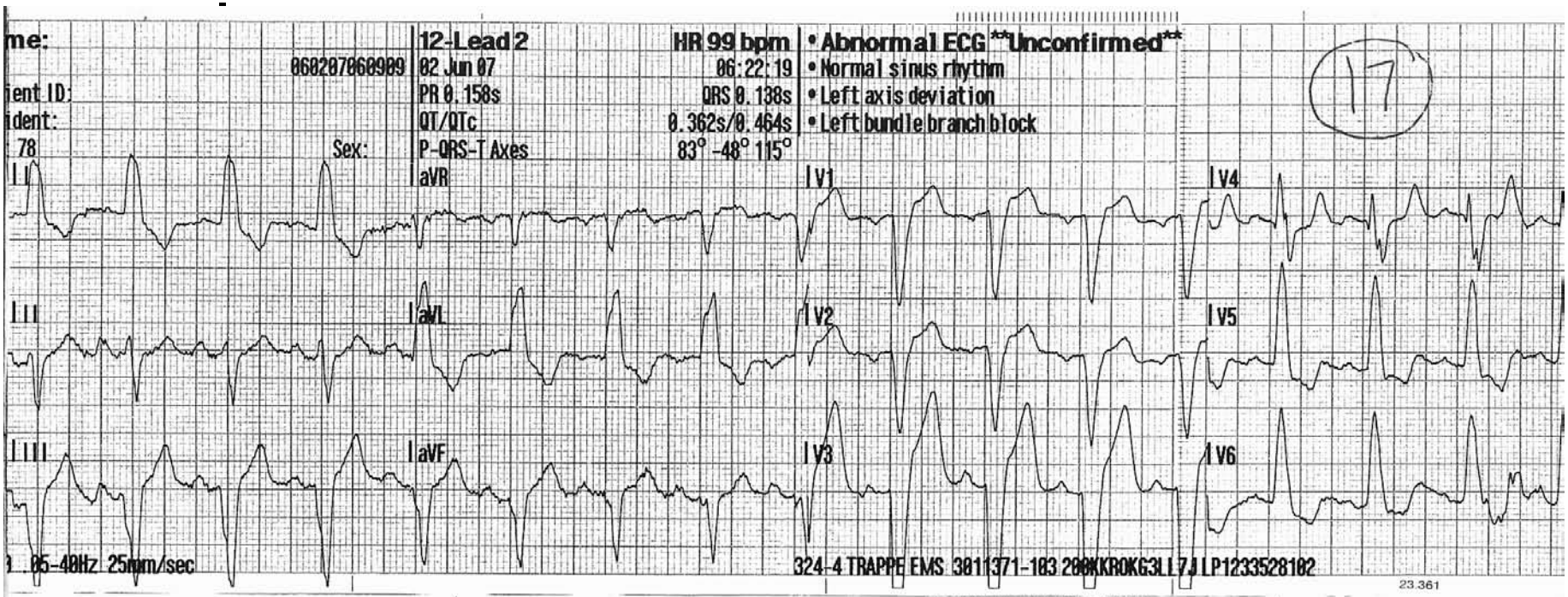
COMMENTS:

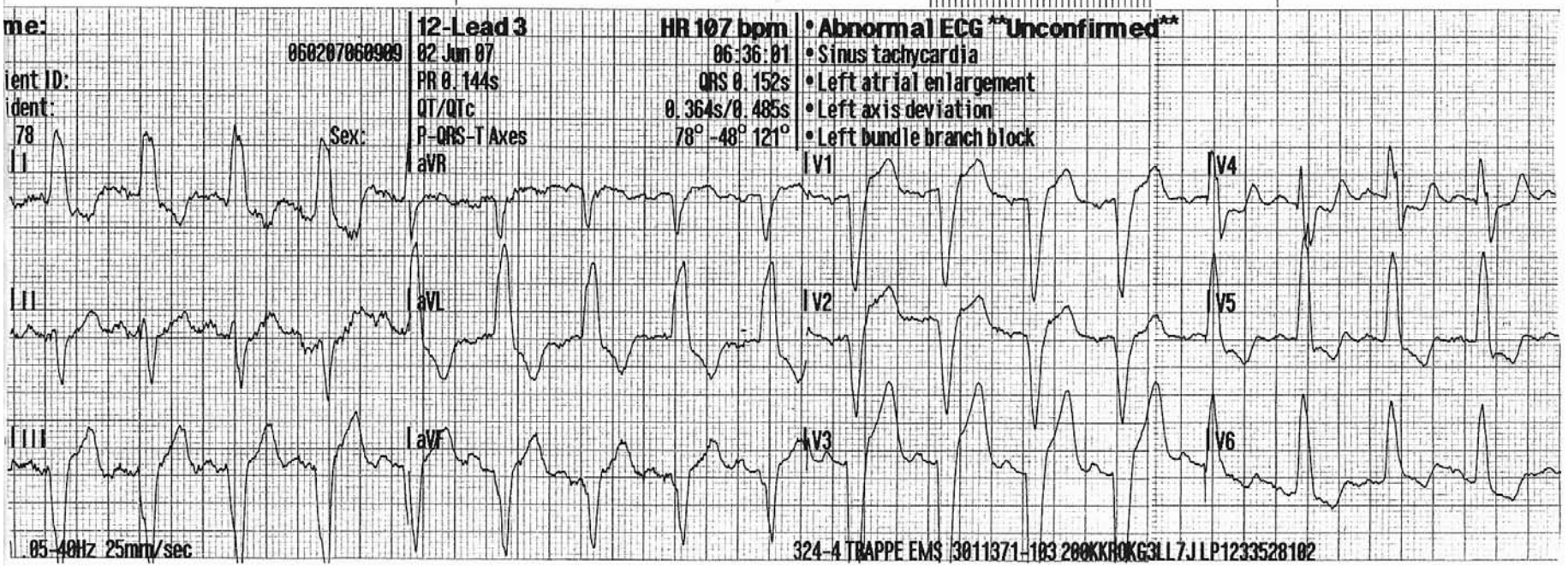


100 Hz 25.0 mm/s 10.0 mm/mV 4 by 2.5s + 1 rhythm ld MAC5K 005A.1 12SL™v231

Case #17… Intermittent CP

- Called to a residence for a “cardiac emergency”
- 62 year old male states he has been having intermittent CP for the past day
- He wife states, “I insist he gets checked out.” The patient says, “I’m fine” and currently is CP free after his own nitro
- Vitals all within normal limits


me:
ient ID:
ident:
78
Sex:
12-Lead 2
060207060909
02 Jun 07
PR 0.158s
QT/QTc
0.362s/0.464s
P-QRS-T Axes
83° -48° 115°
HR 99 bpm
06:22:19
QRS 0.138s
• Abnormal ECG **Unconfirmed**
• Normal sinus rhythm
• Left axis deviation
• Left bundle branch block
17
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
.05-40Hz 25mm/sec
324-4 TRAPPE EMS 3011371-103 200KKROKG3LL7J LP1233528102
23.361


me:
ient ID:
ident:
78
Sex:
12-Lead 3
060207060909
02 Jun 07
PR 0.144s
QT/QTc
0.364s/0.485s
P-QRS-T Axes
78° -48° 121°
HR 107 bpm
06:36:01
QRS 0.152s
• Abnormal ECG **Unconfirmed**
• Sinus tachycardia
• Left atrial enlargement
• Left axis deviation
• Left bundle branch block
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
.05-40Hz 25mm/sec
324-4 TRAPPE EMS 3011371-103 200KKROKG3LL7J LP1233528102

THE END

- Thanks!

- EKGs not from AMC, AEMC, Trappe Fire Co., or TRHMC courtesy of J. Franklin Richeson, MD… University of Rochester Medical Center