Fast & Slow
Tachy & Brady Arrhythmias

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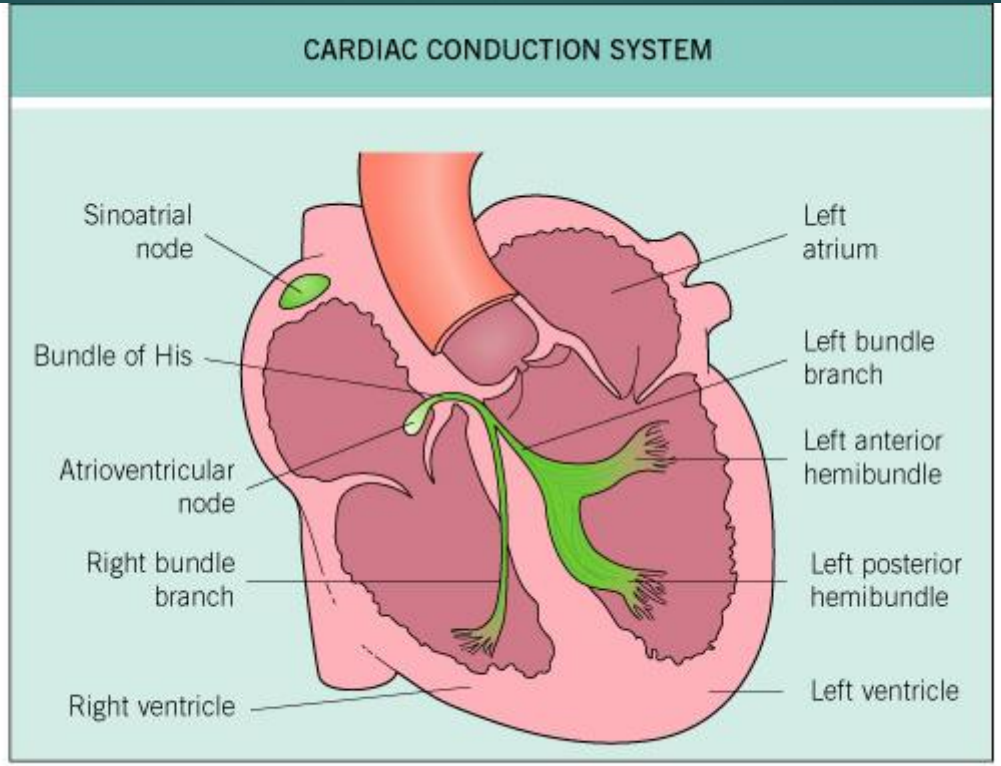
KPN HEART & VASCULAR
AUGUST 7, 2017



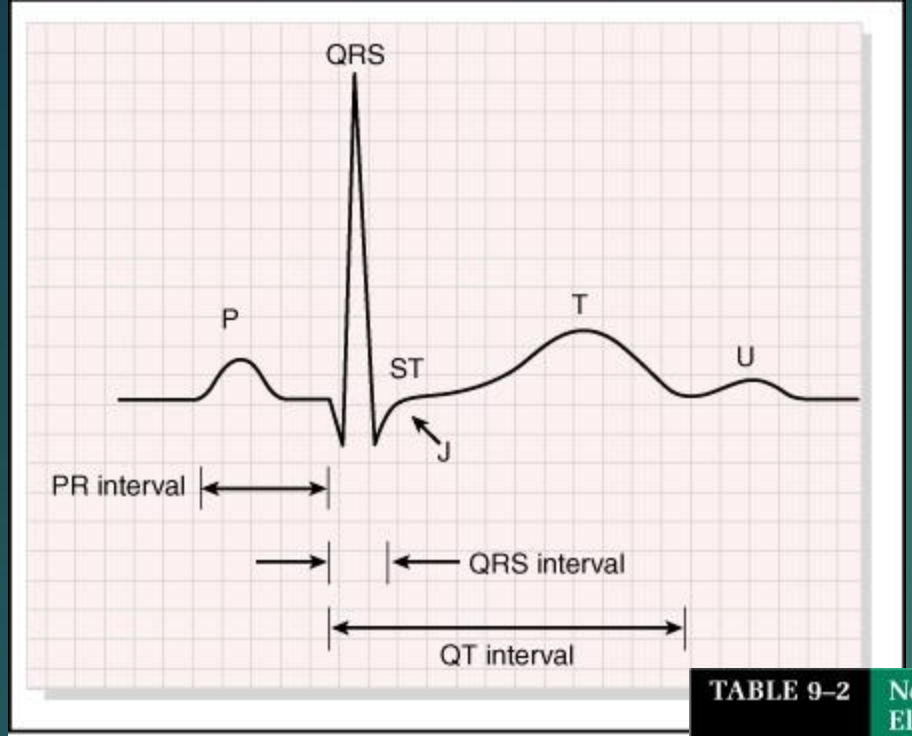
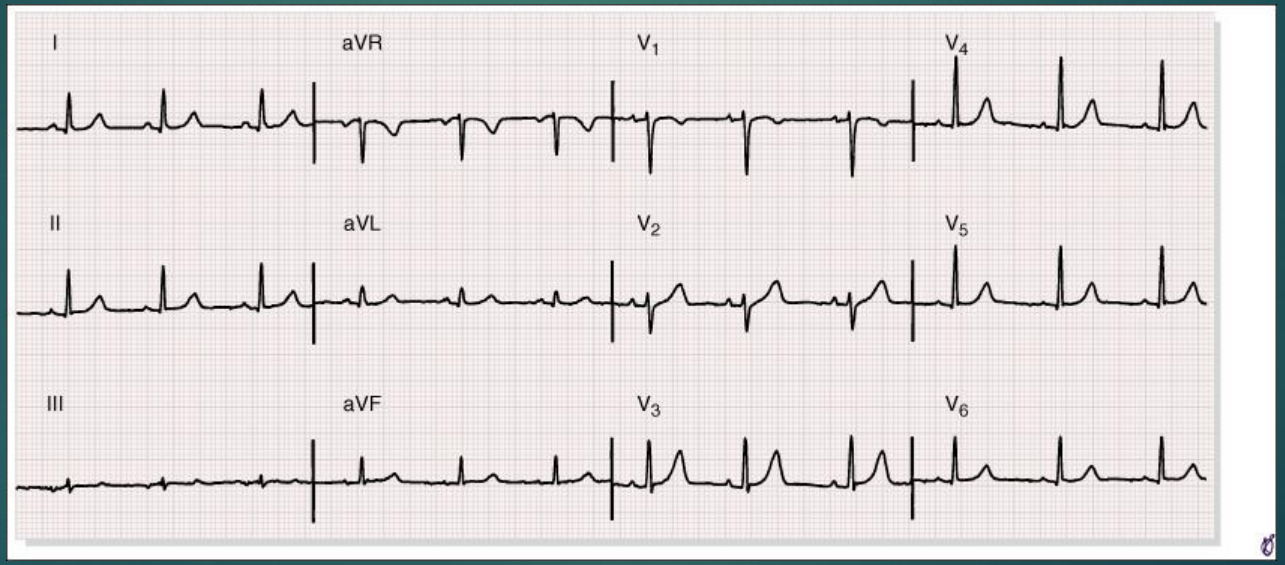


TABLE 9–2 Normal Values for Durations of Electrocardiographic Waves and Intervals in Adults

Wave/Interval	Duration (msec)
P wave duration	<120
PR interval	<120
QRS duration	<110-120*
QT interval (corrected)	≥440-460*

*See text for further discussion.

Normal EKG



EKG boxes

- Heart Rate
  - 1 big box = 200ms
  - 1 small box = 40ms

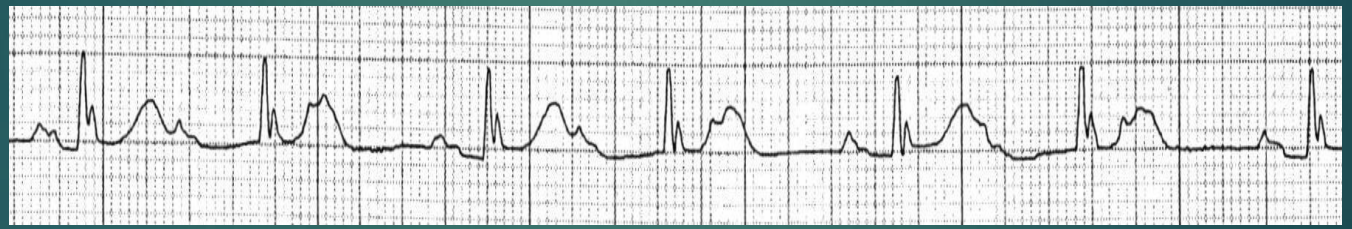
Big Boxes Between QRS complexes	1	2	3	4	5	6	7
Heart Rate (300/big boxes)	300	150	100	75	60	50	42

1st Degree AV Block

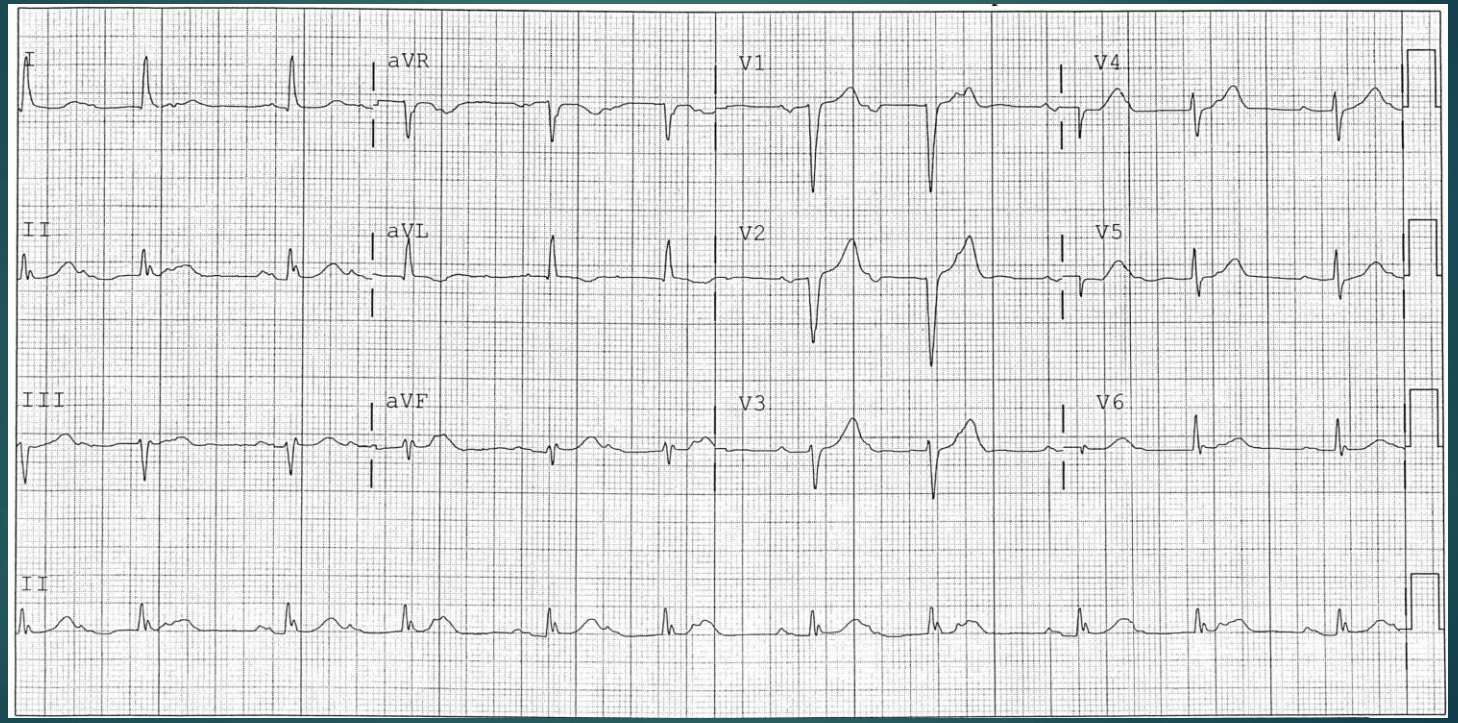
- >200 ms from onset of P wave to onset of QRS

2nd Degree AV Block Type 1 - Wenkebach

- P-R interval prolongs until QRS is dropped

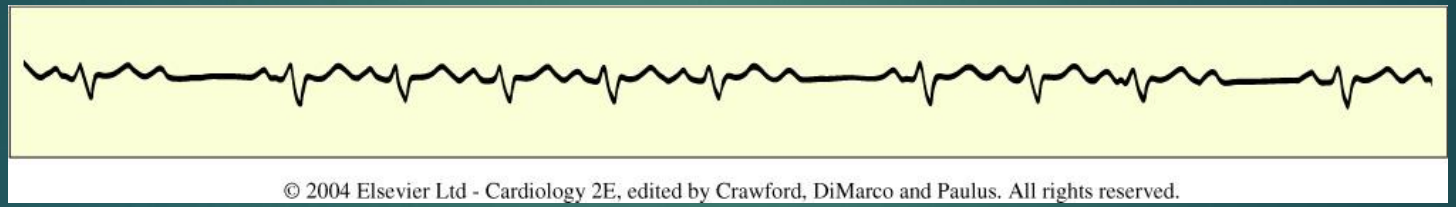


2nd Degree AV Block Type 1 - Wenkebach

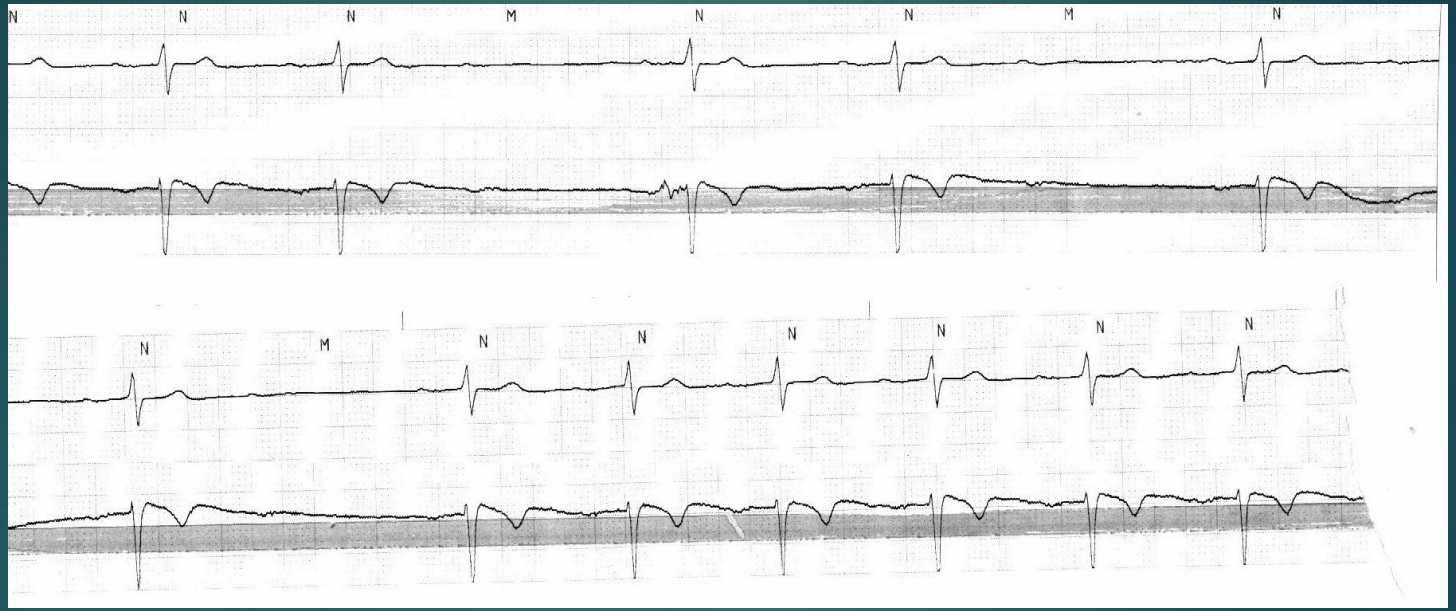


2nd Degree Heart Block Type 2

- PR interval remains constant, QRS drops unexpectedly

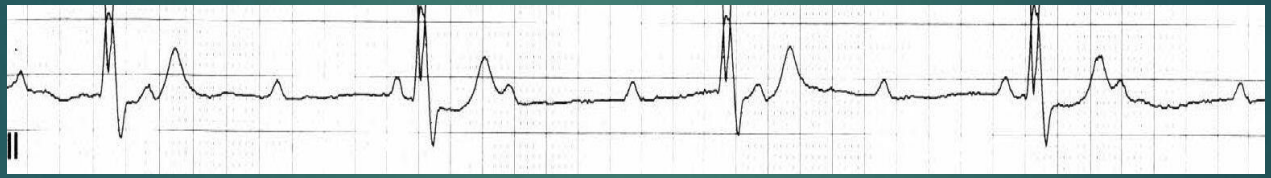


2nd Degree Heart Block Type 2



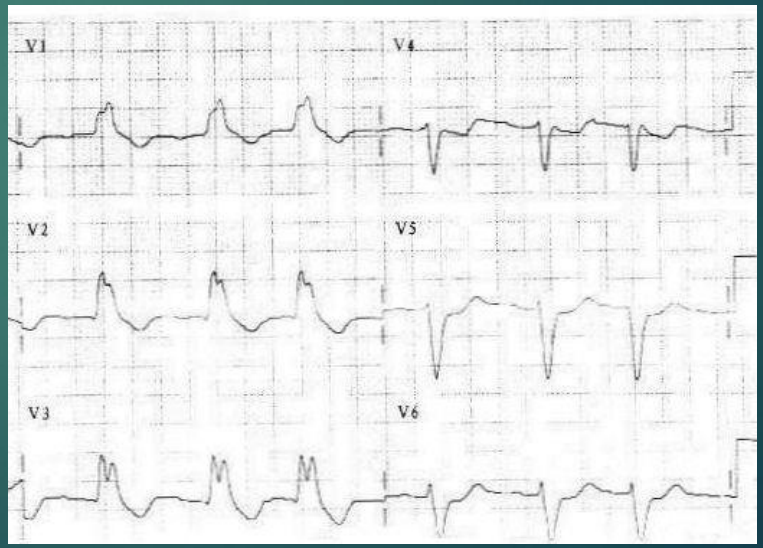
3rd degree Heart Block

- P rate faster than QRS rate
- No correlation between P's and QRS



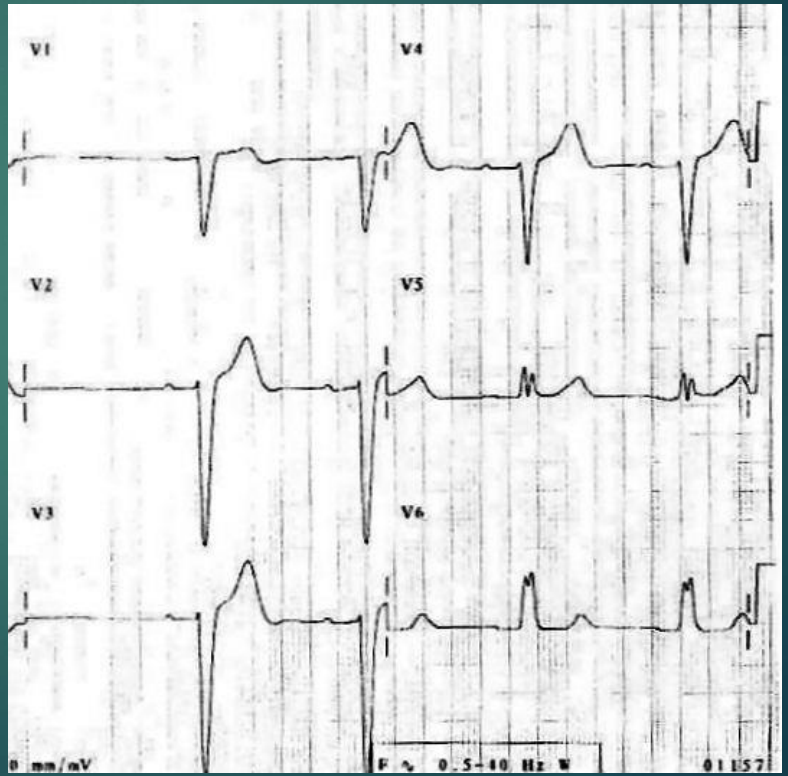
Bundle Branch Blocks

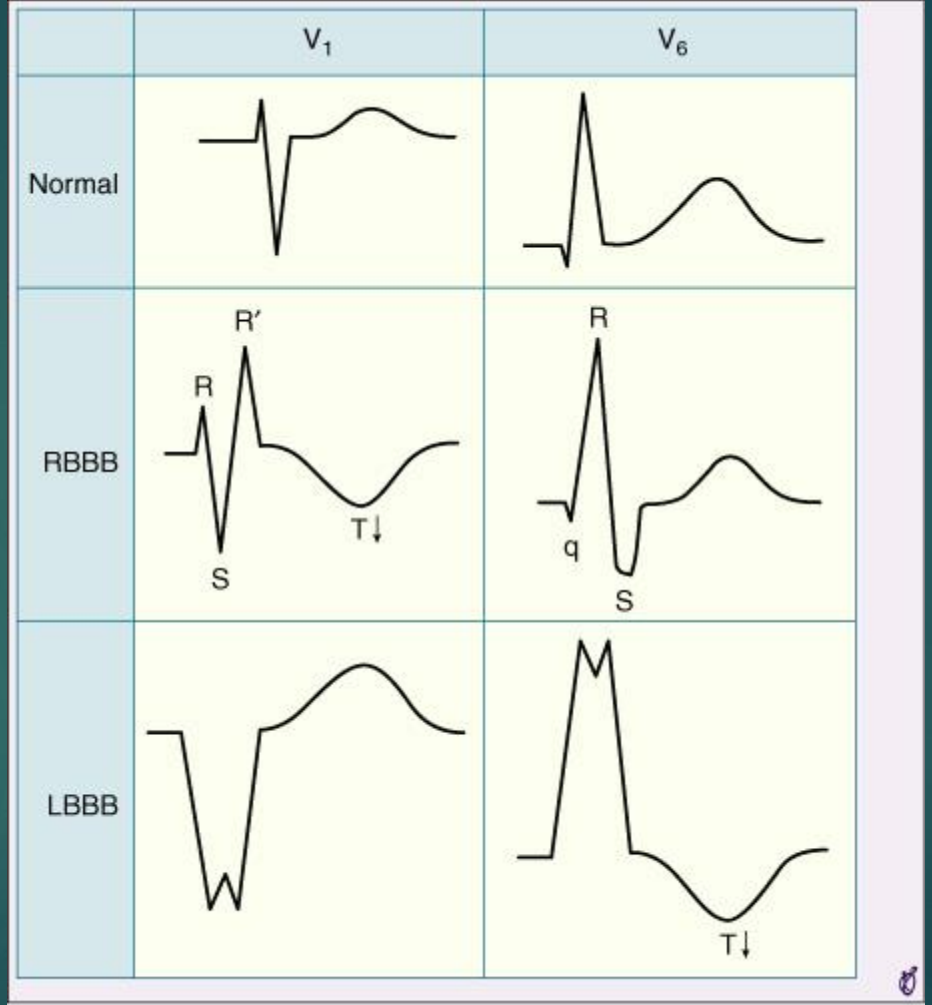
- Right Bundle Branch Block
  - QRS duration >120ms (3 small boxes)
  - rsR' in V1
  - 'Rabbit Ears'



Bundle Branch Blocks

- Left Bundle Branch Block
  - QRS duration >120ms (3 small boxes)
  - R in V6

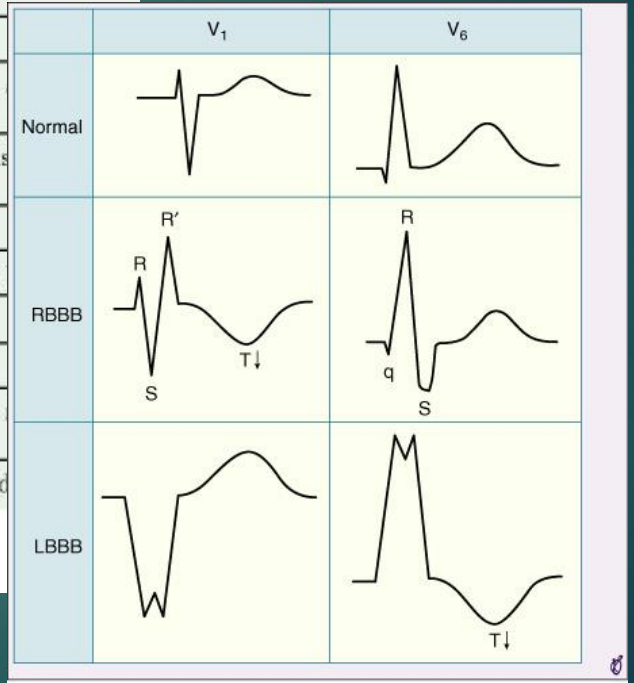




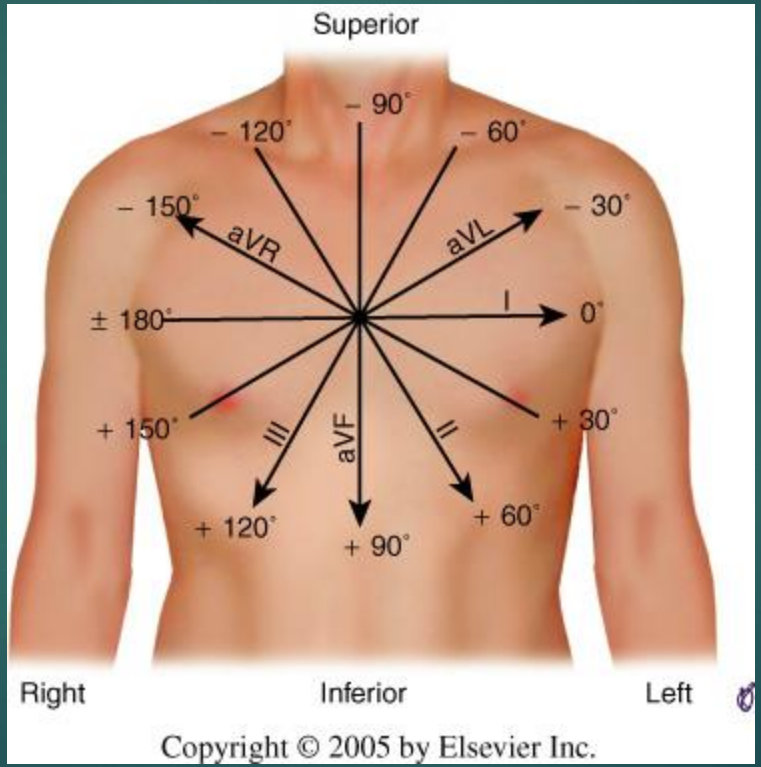
Bundle Branch Block Criteria

TABLE 9–7	Common Diagnostic Criteria for Bundle Branch Blocks
Complete left bundle branch block	
QRS duration ≥120 msec	
Broad, notched R waves in lateral precordial leads (V_5 and usually leads I and aV_L	
Small or absent initial r waves in right precordial leads (V_2) followed by deep S waves	
Absent septal q waves in left-sided leads	
Prolonged intrinsicoid deflection (>60 msec) in V_5 and	
Complete right bundle branch block	
QRS duration ≥120 msec	
Broad, notched R waves (rsr′, rsR′, or rSR′ patterns) in precordial leads (V_1 and V_2)	
Wide and deep S waves in left precordial leads (V_5 and	

*Criterion required by some authors.

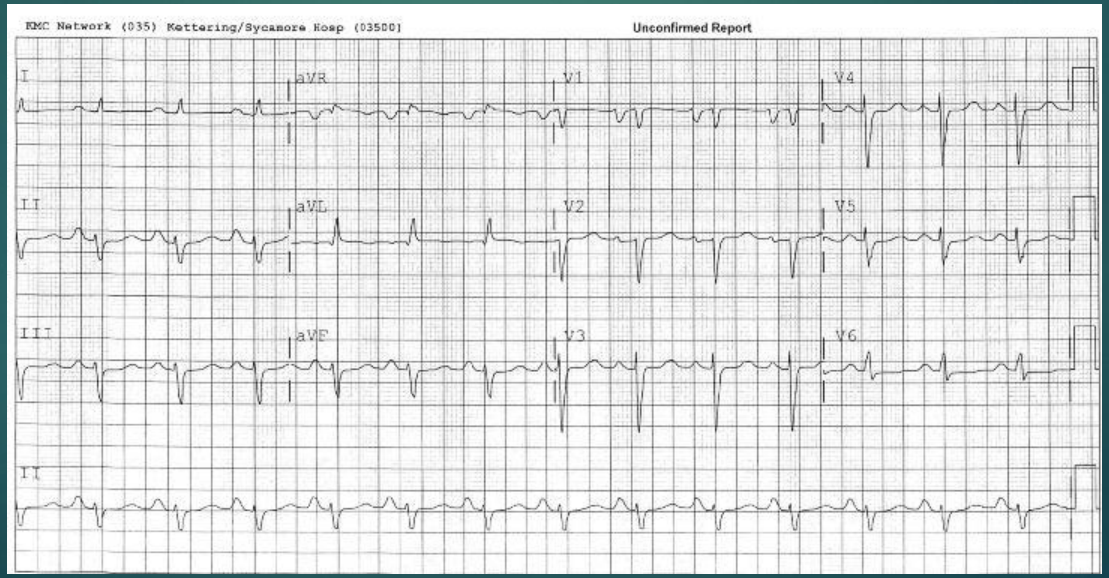


Axis

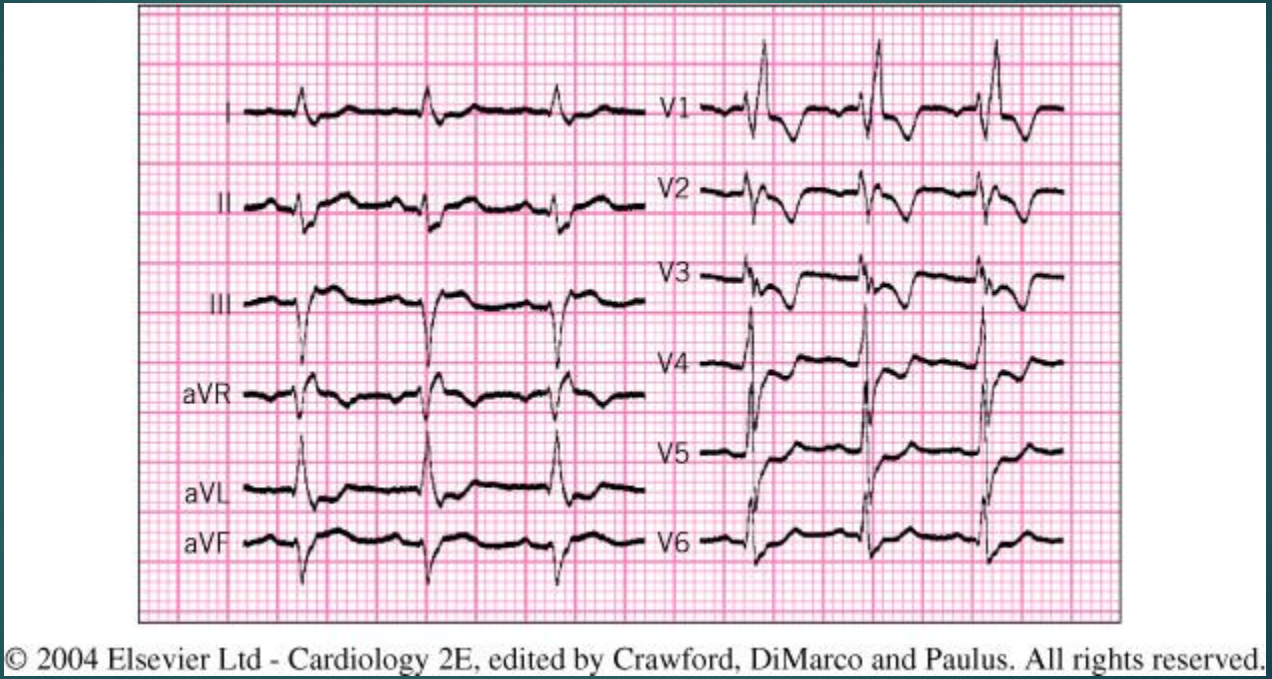


Left Anterior Fascicular Block

- Frontal Axis -45 to -90 degrees
- QRS <120ms
- rS pattern in II, II, aVF (inferior leads)



LAFB + RBBB



Left Posterior Fascicular Block

- Frontal Axis +/-120 degrees (typically right axis deviation)
- QRS <120ms
- R

Fascicular Blocks

QRS Duration <120ms

LAHB (LAFB)

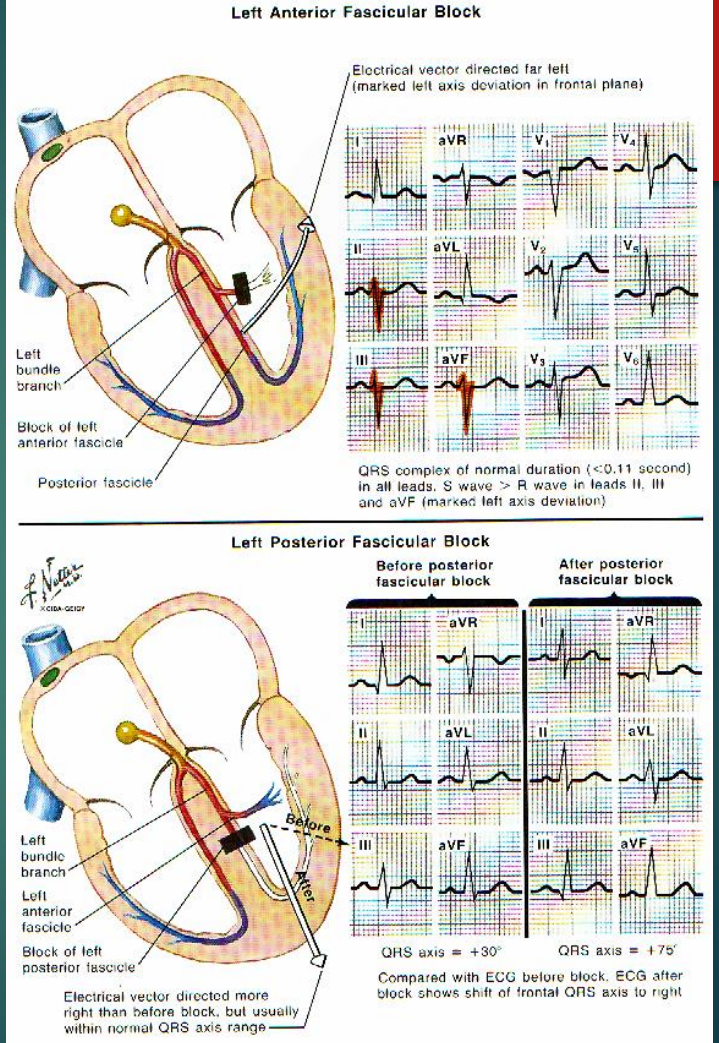
Severe LAD without explanation

- Deep S waves in II, III, aVF
- Frontal Axis <-45 to -60 degrees
- Positive in I, Negative in aVF
- Not explained by LBBB, LVH, inferior infarct

LPHB (LPFB)

*Opposite of LAFB, **Rare***

- Usually Right Axis deviation
- Negative in I, Positive in aVF
- Positive in II, III, aVF
- Not explained by RVH, anterolateral infarct



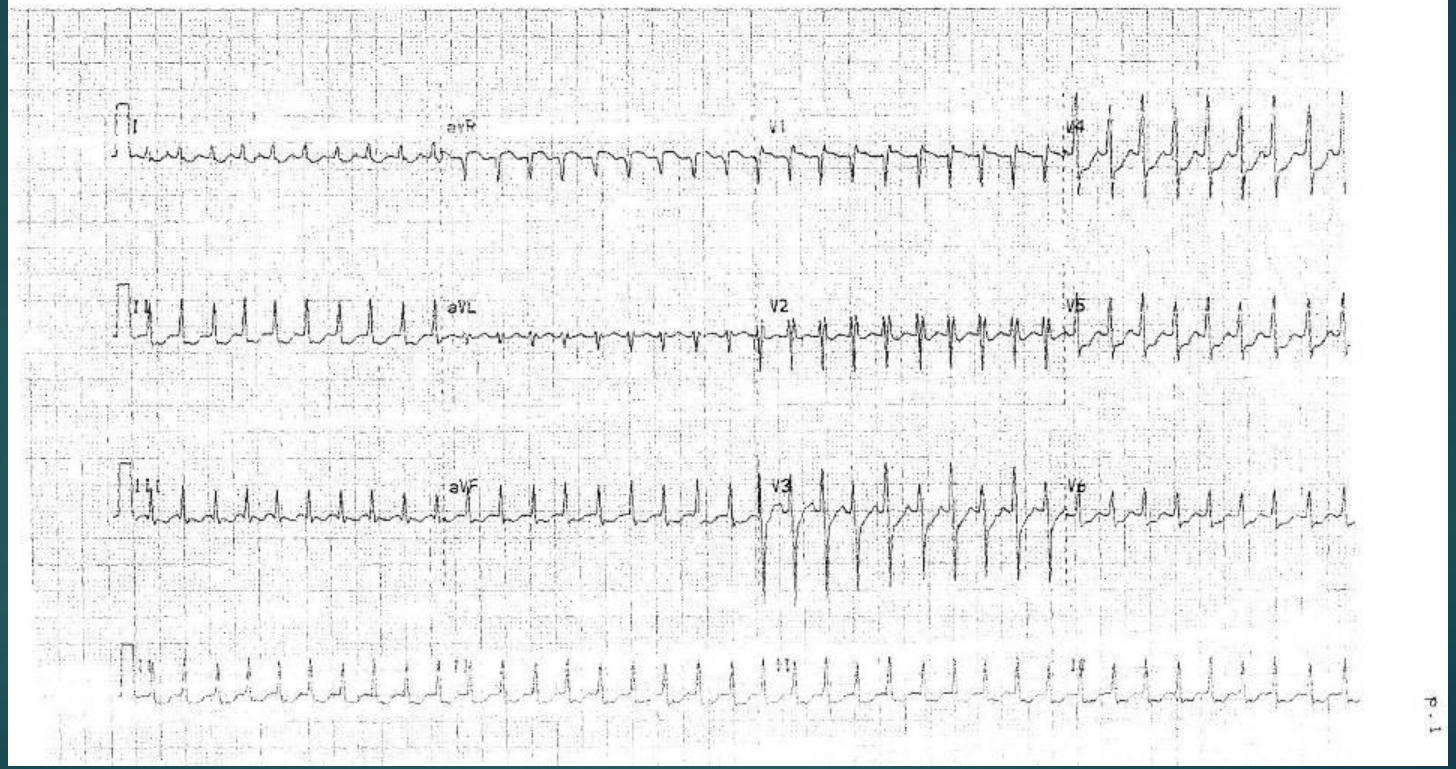
Schedit, S. Basic Electrocardiography. CIBA-GEIGY Pharmaceuticals, USA, p 49.

COMMON CAUSES OF ATRIOVENTRICULAR AND INTRAVENTRICULAR CONDUCTION DISTURBANCE	
Intrinsic causes	Congenital Sclerodegenerative Ischemia Trauma (surgical) Connective tissue disorders Tumors Sarcoidosis
Extrinsic causes	Drugs Autonomic disorders Hypothyroidism

Case presentation

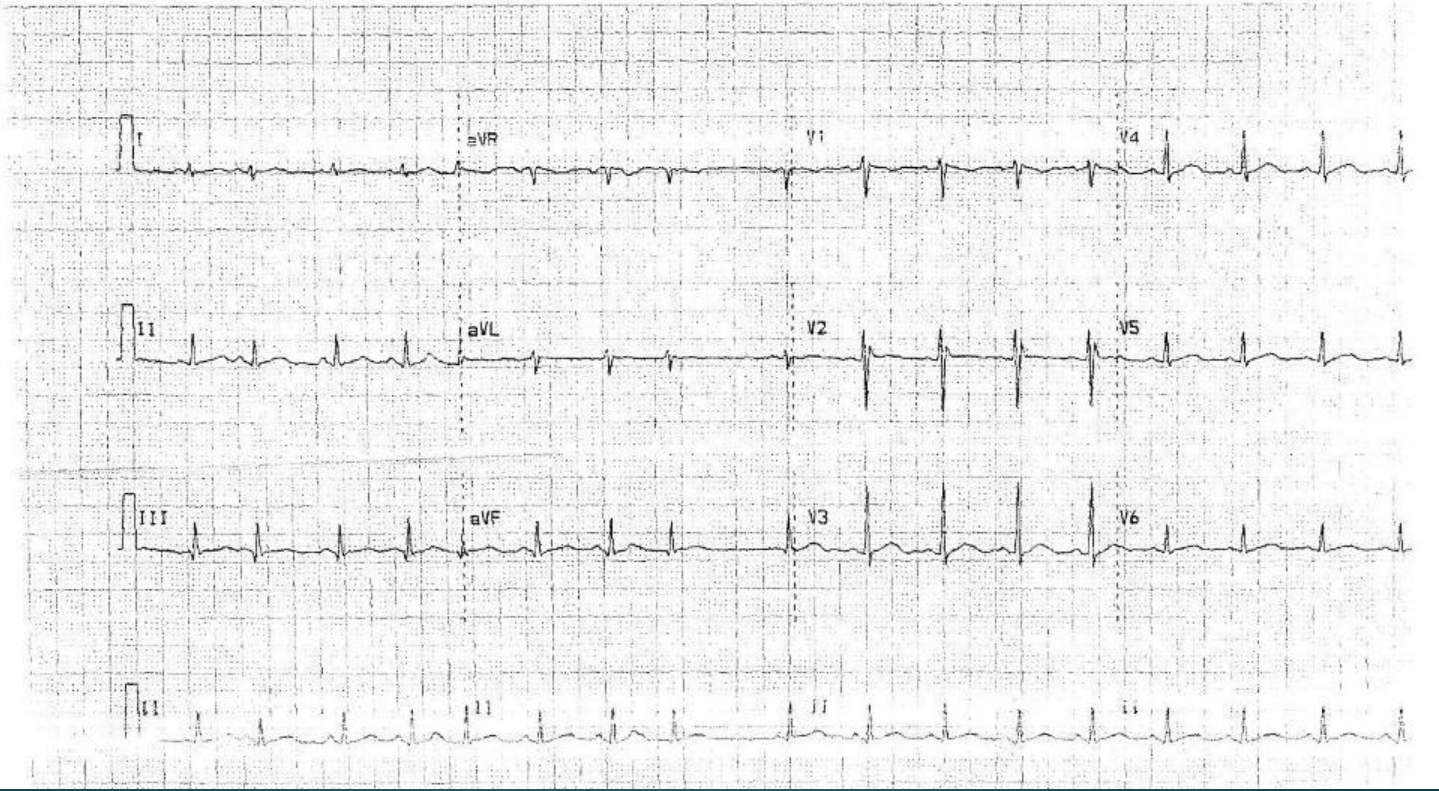
- 21 year old white female presents to the emergency room with palpitations for 1 hour
- Mild lightheadedness, no syncope
- No significant past medical history
- No meds except OCP
- Cramming for exams, took no doze and Red Bull this morning after pulling an all-nighter

Vent. Rate:	232	bpm
RR Interval:	256	ms
PR Interval:		
QRS Duration:	80	ms
QT Interval:	[illegible]	ms
QTc Interval:	530	ms
QT Dispersion:	30	ms
P-R-T AXIS:	66°	-99°



After intervention …

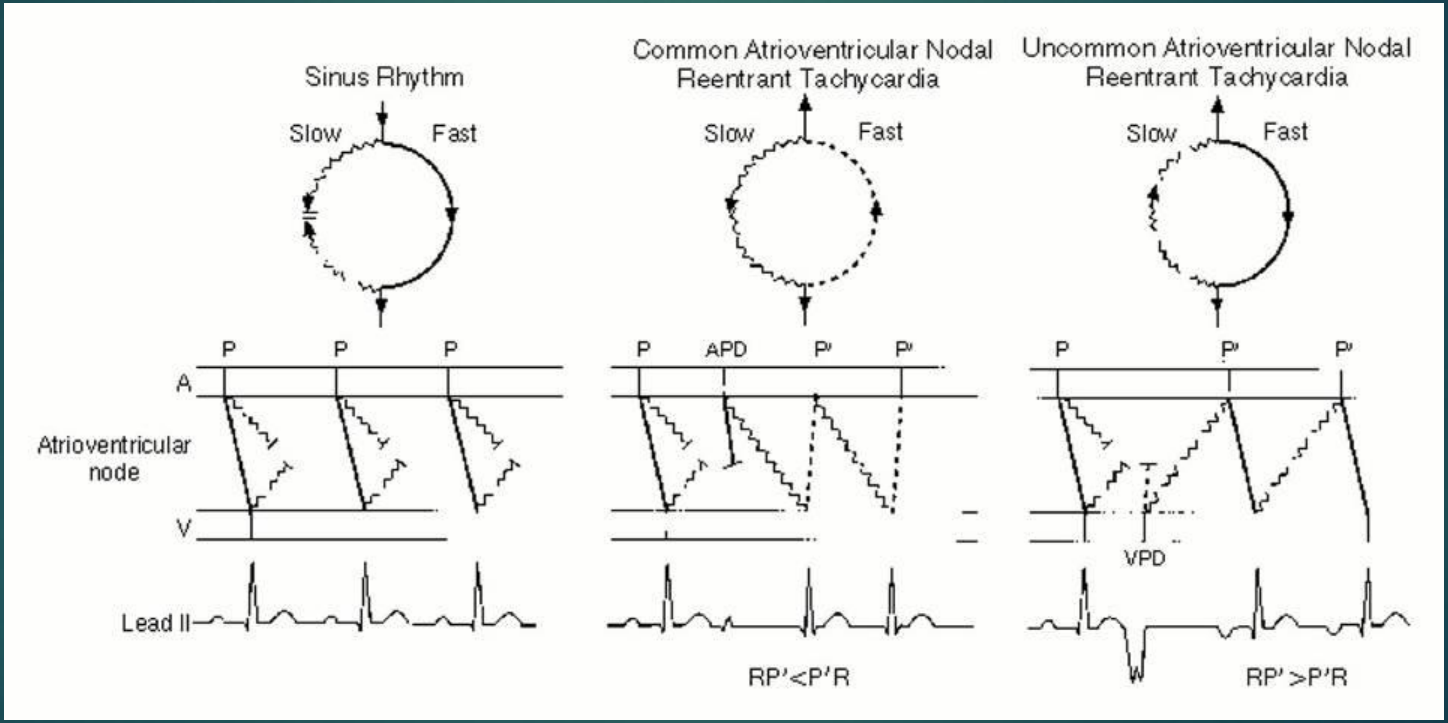
Vent. Rate:	103 bpm
RR Interval:	580 ms
PR Interval:	112 ms
QRS Duration:	76 ms
QT Interval:	334 ms
QTc Interval:	409 ms
QT Dispersion:	34 ms
P-R-T AXIS:	56° 74° 57°



General Mechanism of Nodal Dependent SVT

- Two Conduction Paths
  - Different conduction velocities
  - Different Refractory periods
- Faster conduction = longer refractory period
- AVNRT – two paths are within the AV node
- AVRT – one path is nodal, one is accessory

AVNRT


Sinus Rhythm
Slow
Fast
P
P
P
A
Atrioventricular node
V
Lead II
Common Atrioventricular Nodal Reentrant Tachycardia
Slow
Fast
P
APD
P'
P'
RP'<P'R
Uncommon Atrioventricular Nodal Reentrant Tachycardia
Slow
Fast
P
P'
P'
VPD
RP'>P'R

Ganz

AV Node Reentrent Tachycardia AVNRT

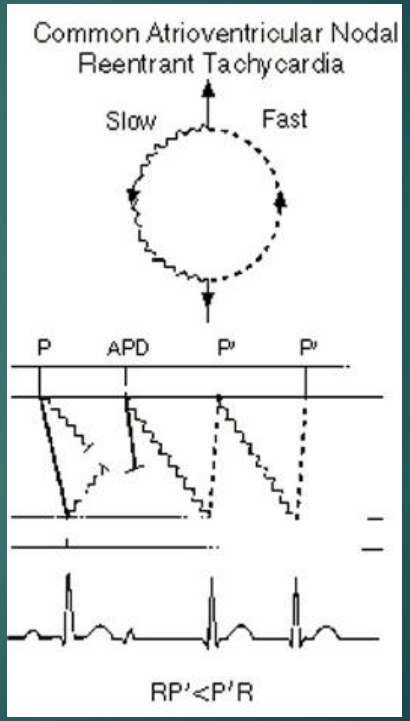
- 60% of all SVT's (most common)
- 70% are female
- Mostly patients age 30-40's
- 90% Typical (Slow-Fast)
  - Antegrade limb has slow conduction, retrograde is fast
- 10% Atypical
  - Fast-Slow
  - Slow-Slow
  - Fast-Fast

Typical AVNRT

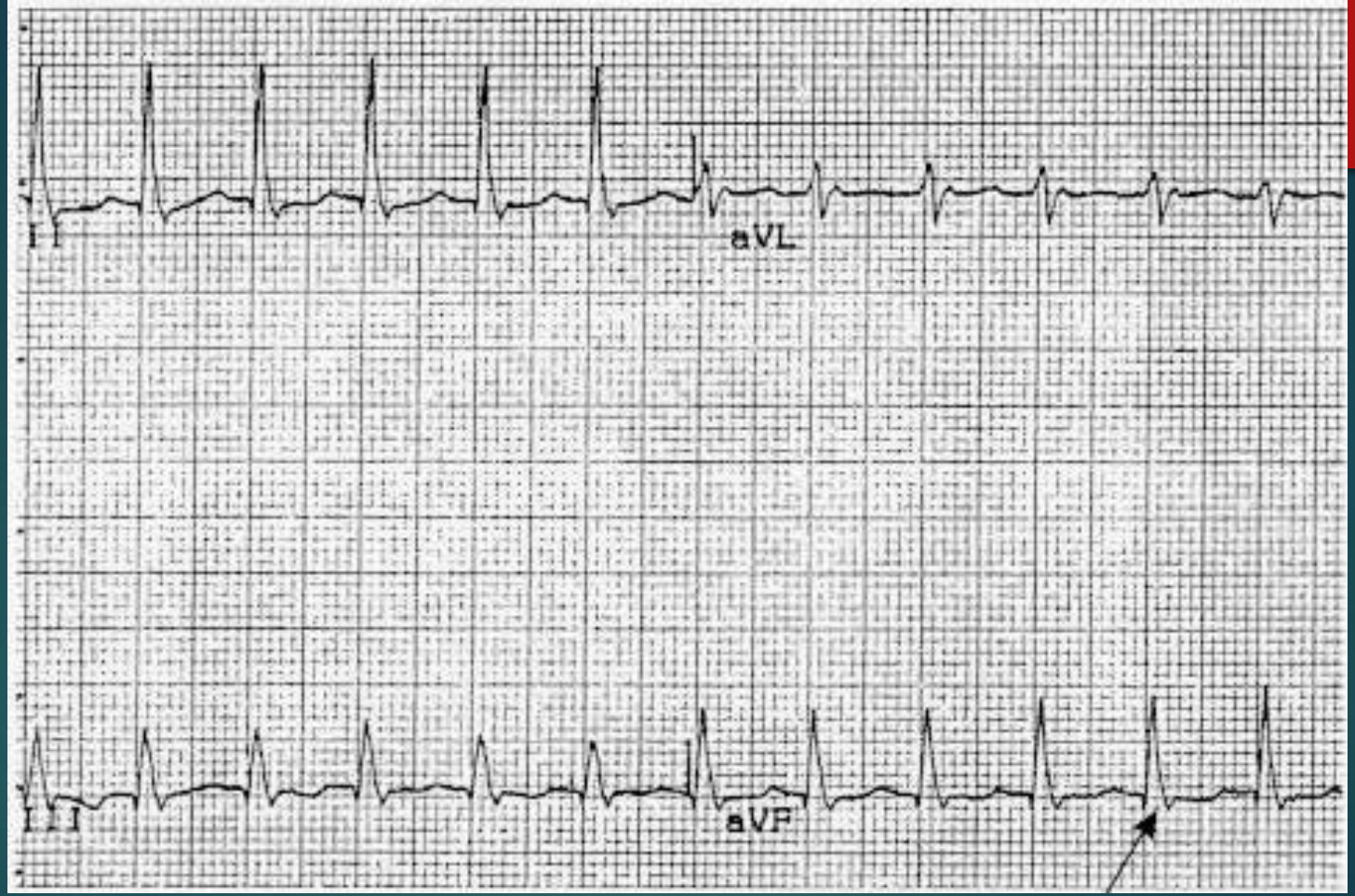
- Starts with PAC
  - Fast path is refractory, so PAC is blocked
  - Slow path (short refractory period) is able to conduct
- PAC impulse conducted to ventricles by slow path
- PAC impulse simultaneously conducted up fast path (no longer refractory) in a retrograde fashion
- Atrial depolarization occurs simultaneous with Ventricular depolarization

EKG Features of AVNRT

- P waves either hidden in QRS or appear as part of QRS
  - Pseudo R in V1
  - Pseudo S in II, III, avF
  - P waves negative in inferior leads

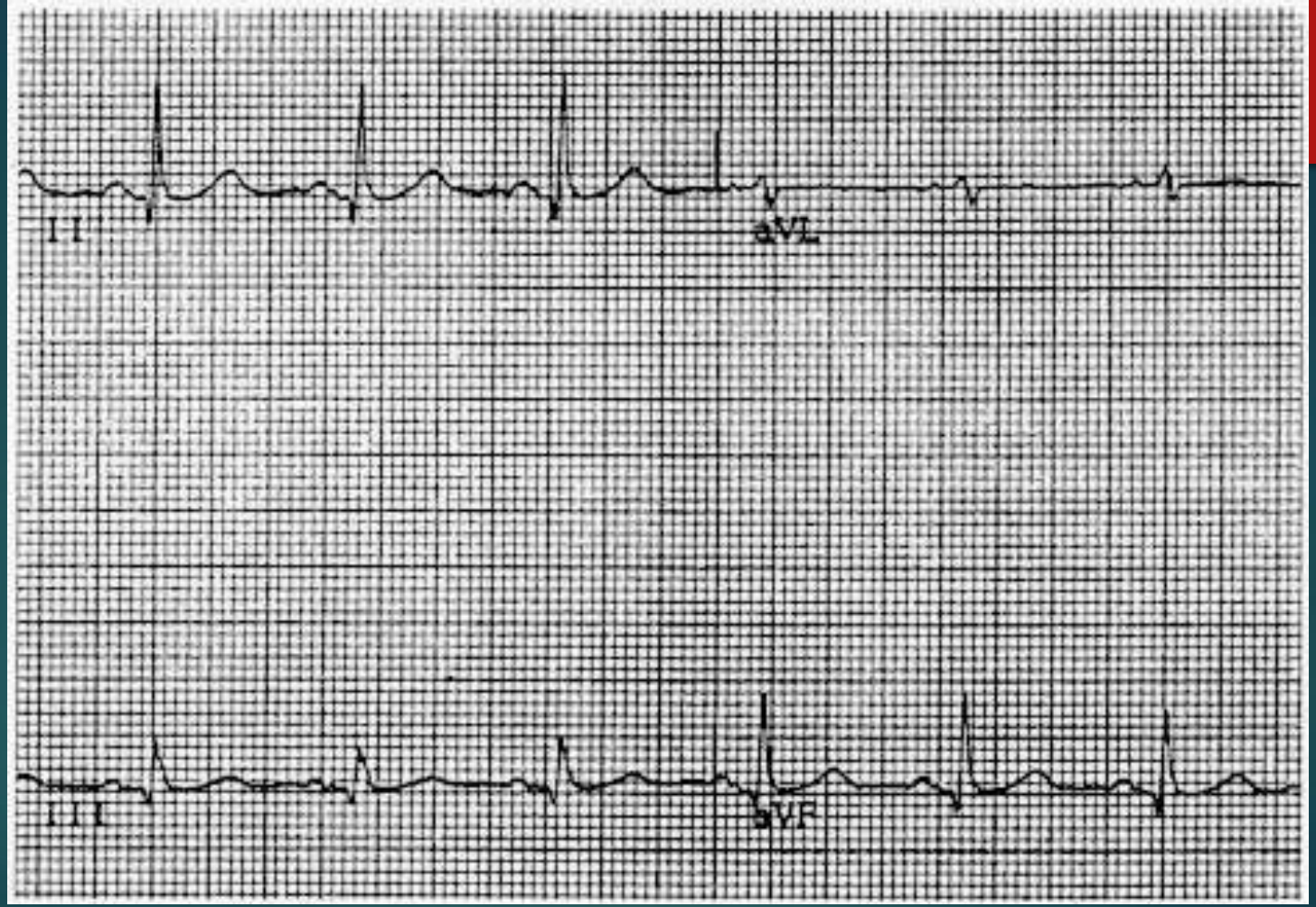


Chauhan
Ganz



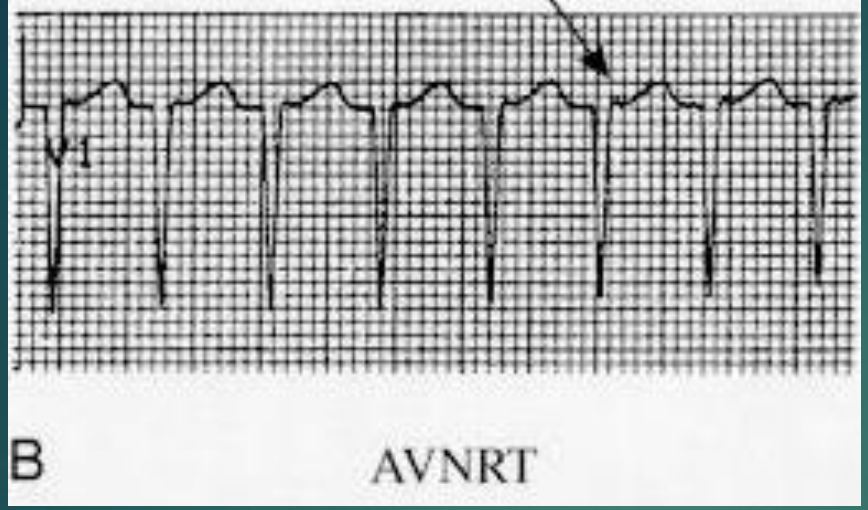
AVNRT with pseudo S wave

Chauhan

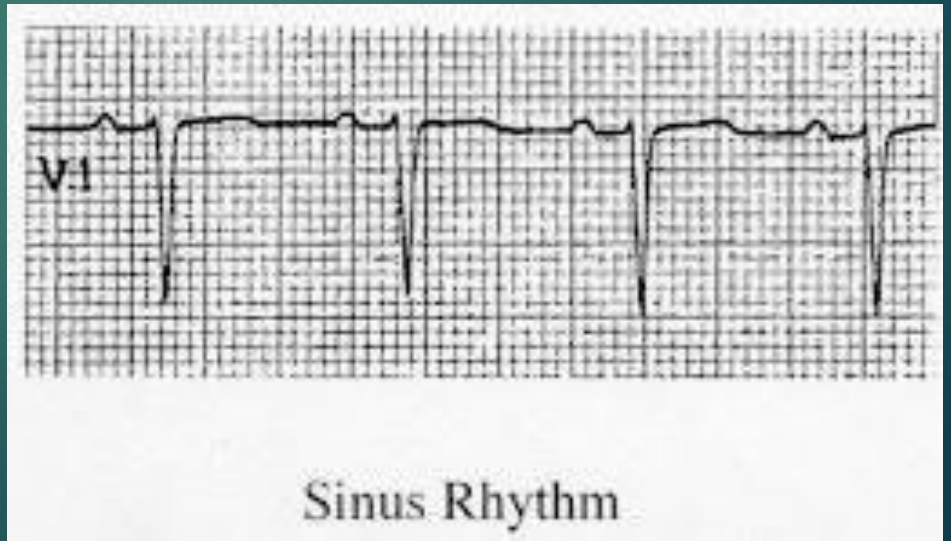


Chauhan

NSR



AVNRT with pseudo R waves



Chauhan

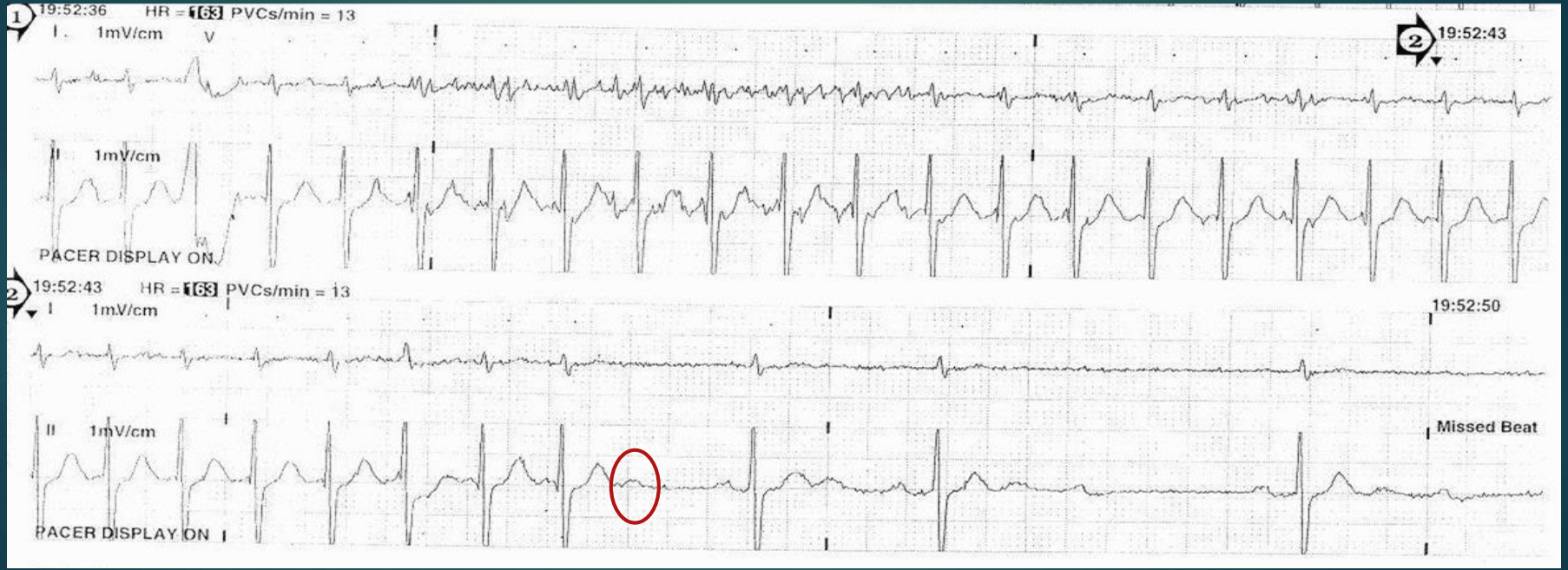
Breaking a tachycardia

- Vagal Maneuvers (Valsalva, Carotid Massage)
- AV blocking drugs (Adenosine, Verapamil)
- AV node dependent tachycardias will break
  - If SVT terminates with a P wave then it is AVNRT or AVRT
  - If it terminates with a QRS, this is not discriminatory
- If it doesn't break with above maneuvers it is most likely atrial tachycardia

Acute Management of SVT

- Vagal Maneuvers
  - Carotid Massage
  - Valsalva
  - Cold water immersion
  - Gag reflex
- Adenosine 6mg IV/12mg IV
- Verapamil 5-10mg IV / Diltiazem 10-20mg IV
  - Use digoxin 0.25-0.5mg IV instead if CHF is known
- Procainamide 1g IV / Amiodarone 150-300mg IV
- Synchronized cardioversion (start at 50J)

SVT Breaking with adenosine



Longterm Management of AVNRT

- No therapy if limited symptoms or infrequent episodes
  - Lifestyle modification – avoid caffeine/stimulants
  - Vagal maneuvers prn
- AV node dependent tachycardias (AVNRT)
  - Verapamil, Beta Blockers
  - Antiarrhythmics rarely used
- Ablation therapy

Another case…

- 25 year old male with palpitations
- 1 episode of syncope in teens
- No other significant past medical history
- No medications

Wide complex tachycardia

After Intervention

AV Reentrant Tachycardia
AVRT

- Second most common SVT
- Uses accessory path of Myocardial tissue connecting atrium and ventricle
  - **>50 % left free wall**
  - 20-30% posteroseptal
  - 10-20% right free wall
  - 5-10% anteroseptal
- Paths most commonly conduct bidirectionally but may be solely antegrade or retrograde
- Accessory paths are usually fast conduction

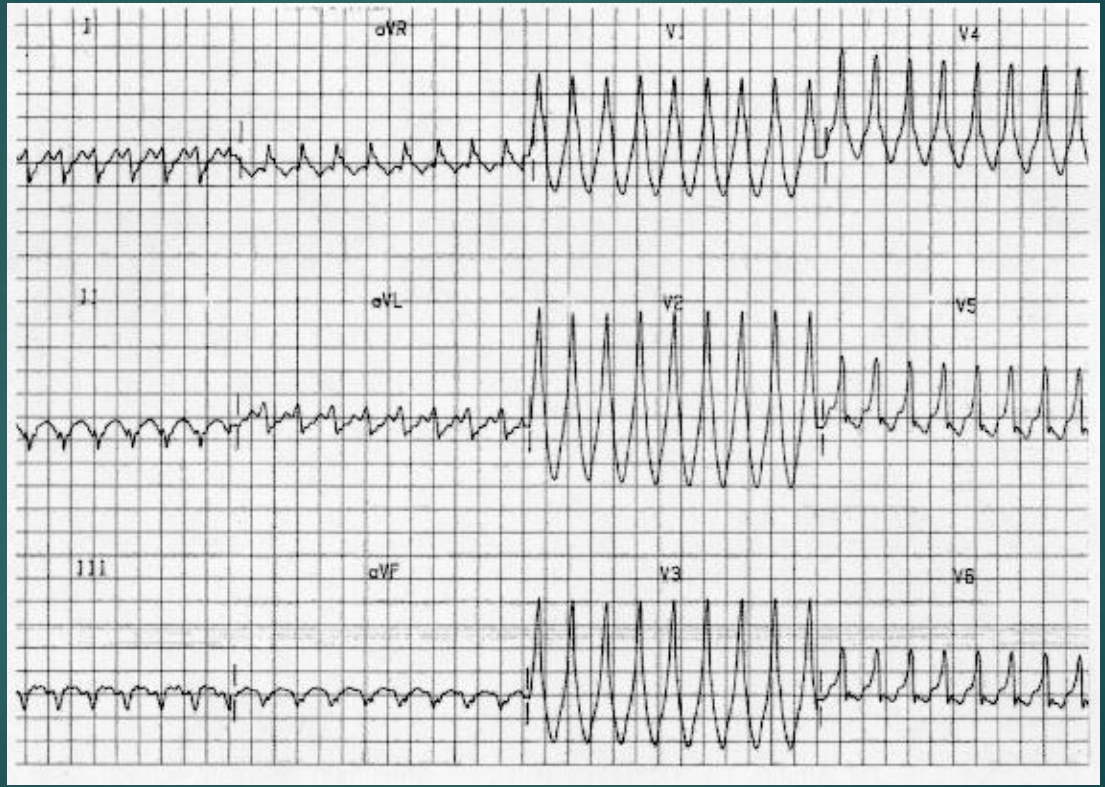
Accessory Pathways

- Antegrade conduction path
  - In normal conduction, ventricles activated 1st by accessory path and 2nd by normal AV-His conduction
    - Preexcited ventricle, short P-R interval, delta wave
    - Variable degree of preexcitation amongst indivuiduals
    - Preexcitation can me modulated by antiarrythmics, autonomic tone
- Retrograde conduction path (25%)
  - Concealed pathways, not apparent on normal EKG
- Large electrical loop, slower rates than AVNRT

Types of AVRT

- SVT initiated by PAC or PVC
- Orthodromic AVRT
  - Uses AV node as antegrade limb, accessory path conducts retrograde
  - Common
  - EKG shows no delta wave
    - (**Typically Narrow Complex**)
- Antidromic AVRT
  - Accessory path is antegrade, AV node retrograde
  - Uncommon
  - EKG shows preexcitation (**Wide Complex**)
  - May involve multiple bypass tracts (rare)

Antidromic AVRT



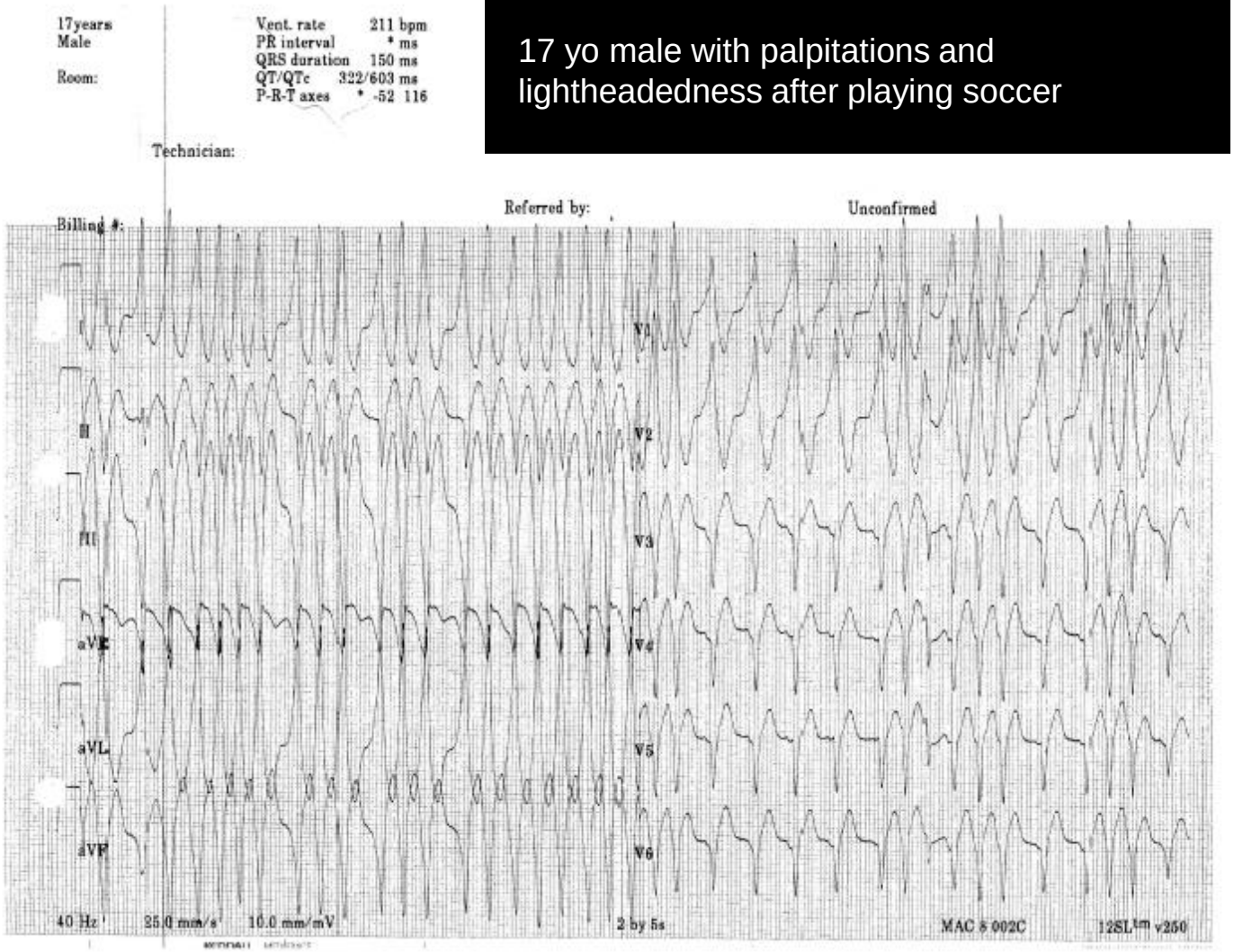
Antegrade conduction from left paraseptal bypass tract, retrograde conduction through AV node

Chauhan

Acute management of WPW

- If narrow complex, regular tachycardia, management identical to AVNRT
- If wide complex and **regular**
  - Consider VT
  - Avoid calcium channel blockers (verapamil)
  - Vagal maneuvers, adenosine, beta blockers, cardioversion

17 yo male with palpitations and lightheadedness after playing soccer



Acute management of WPW

- If narrow complex, regular tachycardia, management identical to AVNRT
- If wide complex and **regular**
  - Consider VT
  - Avoid calcium channel blockers (verapamil)
  - Vagal maneuvers, adenosine, beta blockers, cardioversion
- If wide complex and **irregular** (Atrial fibrillation with WPW)
  - Procainamide
  - Cardioversion
  - Avoid all negative chronotropes!!

Therapy for WPW

- Catheter ablation of the accessory pathway for symptomatic patients
- Asymptomatic patients with delta wave
  - No palpitations, syncope, family history of sudden death
  - No specific therapy unless symptoms develop
  - Exception may be for airline pilots, police officers, and firefighters, high level competitive athletes; may prefer catheter ablation

Ventricular tachycardia

- Wide complex, regular tachycardia
- May be “stable” or unstable
- A word on wide complex tachycardias
  - For any regular, wide complex tachycardia, assume VT until proven otherwise!
  - Look for old Bundle Branch Block
  - Consider “SVT with aberrency”
  - WPW?

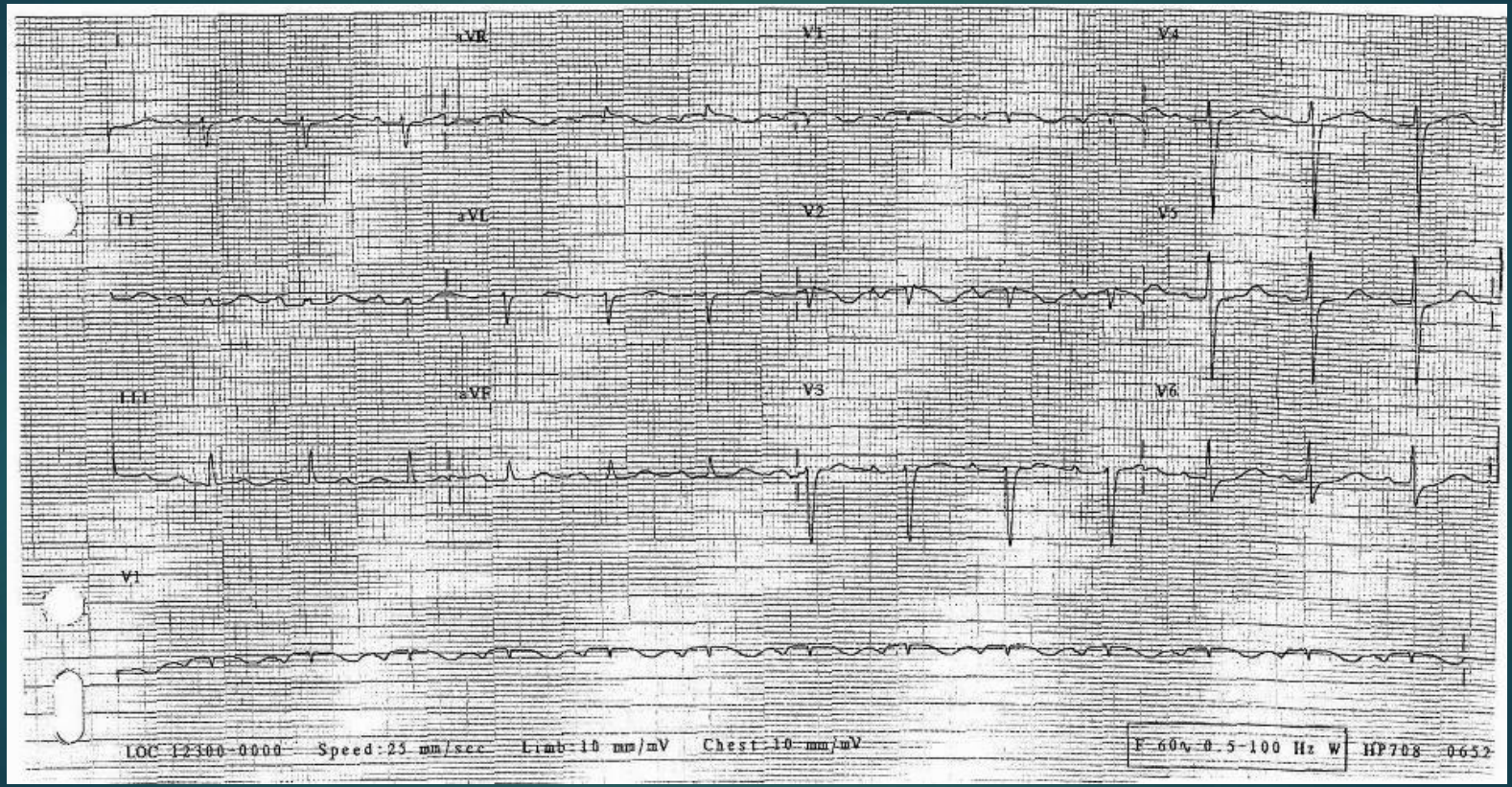
Etiology of symptomatic recurrent VT

- Ischemic heart disease (>50%)
- Cardiomyopathy (both congestive and hypertrophic)
- Primary electrical disease
  - hypo/hyperkalemia
  - hypomagnesemia
- Mitral valve prolapse
- Valvular heart disease
- Congenital heart disease
- Miscellaneous causes

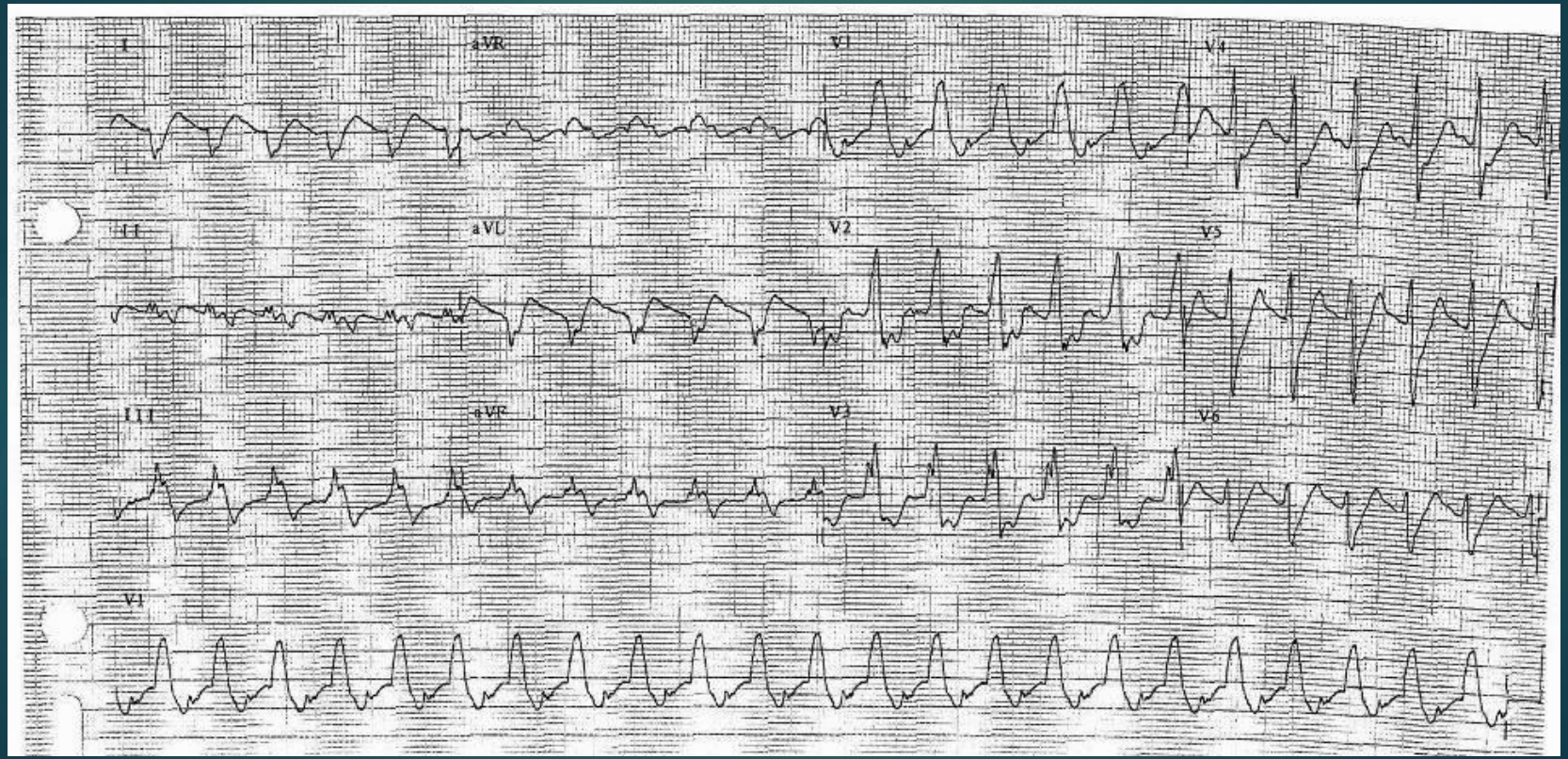
Case VT

- 54 yo AAM admitted with chest pain,SOB
  - Multiple admissions for same over past several years
- ESRD, HD
- Hx CABG 2 years ago; recent EF 38%
  - Recent cath showed patent grafts
- Code Blue
  - VT, defibrillated, bradycardia
- CTSP following code

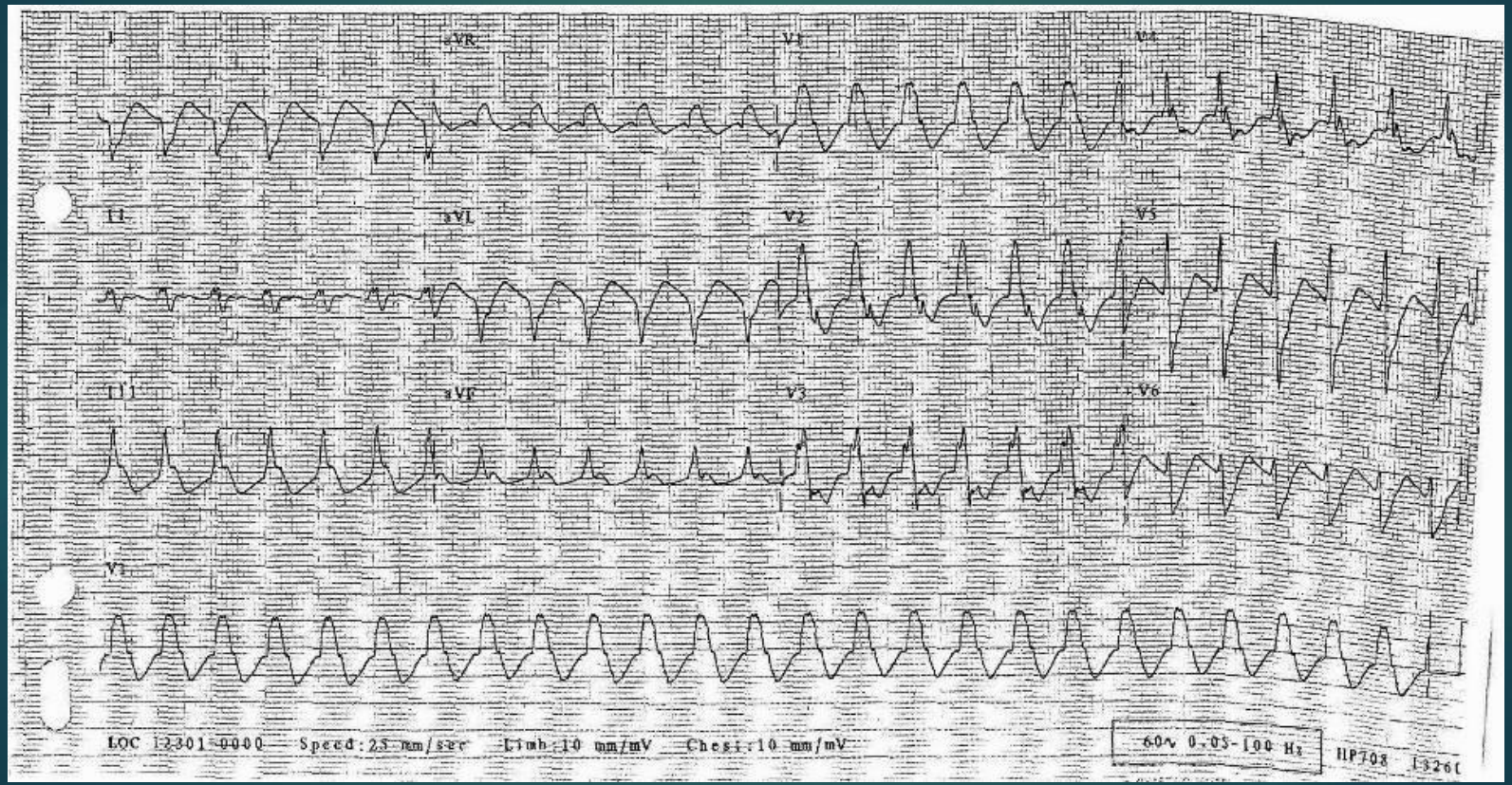
Baseline EKG



EKG following code

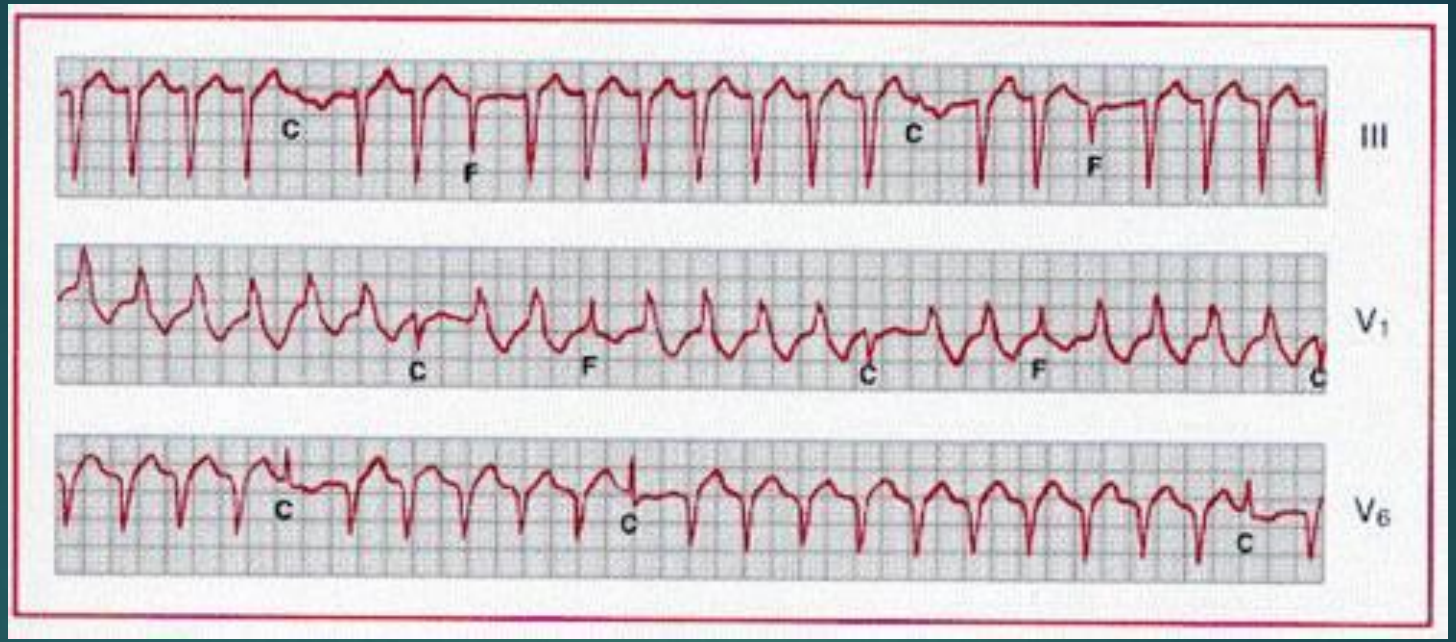


EKG next evening…



Rhythm Strip

Fusion and Capture Beats



During the course of a tachycardia characterized by widespread, abnormal QRS complexes, the presence of fusion beats and capture beats provides maximum support for the diagnosis of VT

Braunwald

Acute management of VT

- Pulseless
  - ACLS protocol
    - 360J unsynchronized shock
    - Amiodarone
    - Epinephrine
- Hypotensive/unstable (but with pulse)
  - 50J synchronized shock
- Stable (No VT is really stable)
  - Amiodarone or lidocaine or other antiarrhymic
  - 50J synchronized shock

Rate	237
PR	76
QRSD	130
QT	235
QTc	467
--AXIS--	
P	76
QRS	263
T	94

52 year old female with 1.5 hours of chest pressure, palpitations, shortness of breath, lightheadedness, +/- diaphoresis

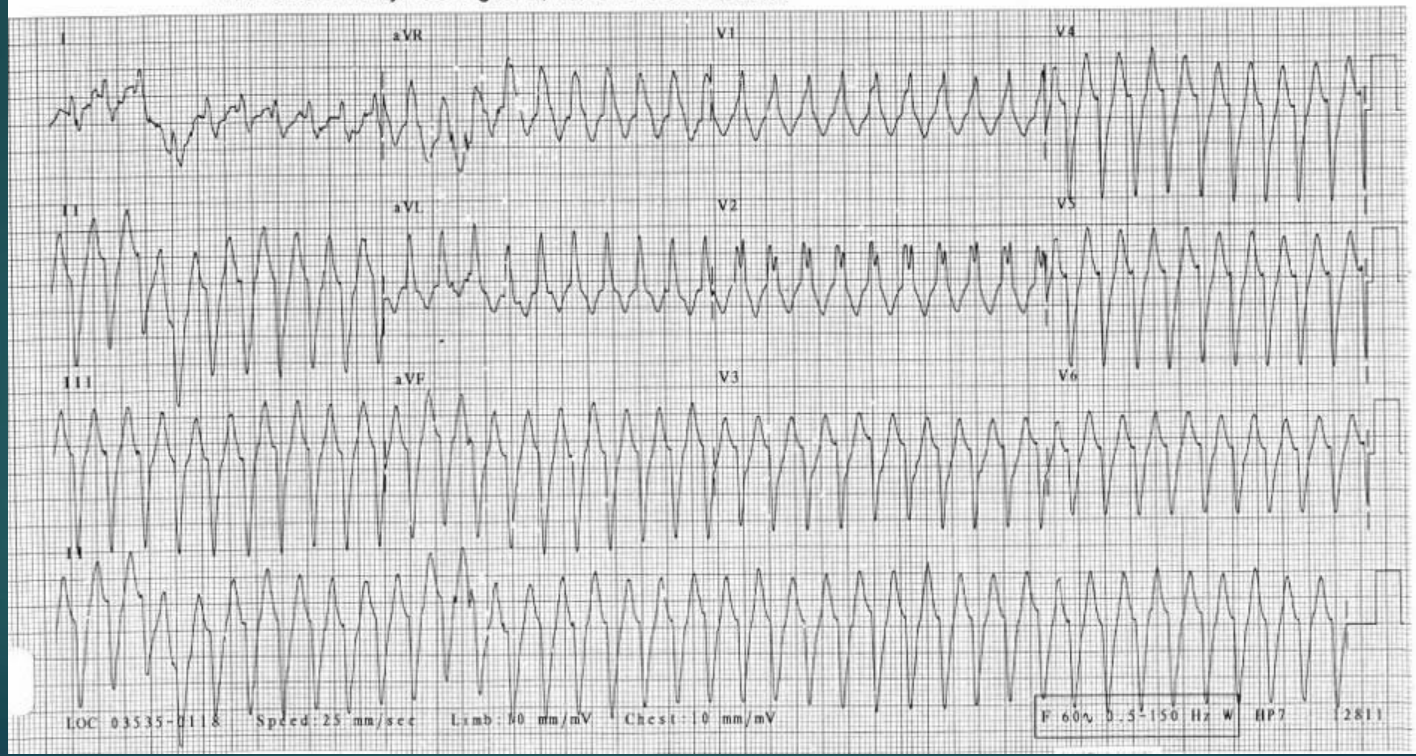
No significant past medical history, no significant medications, nonsmoker, no DM or HTN Requested by:

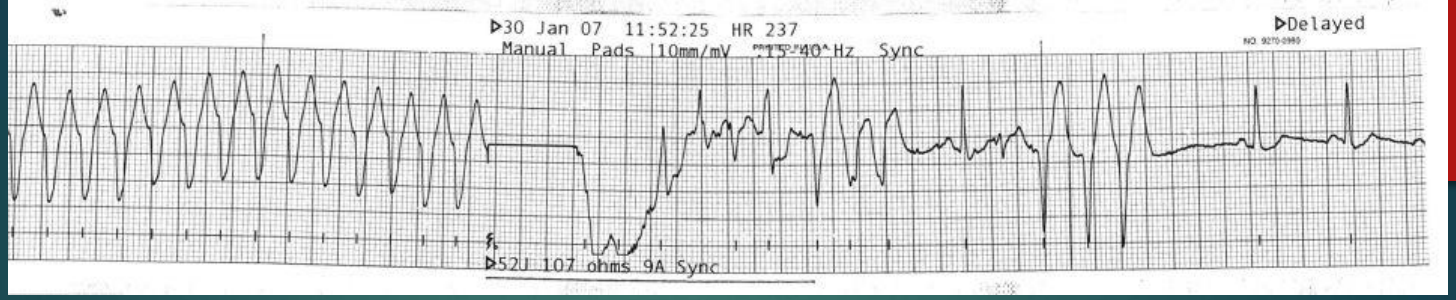
No family history of atherosclerosis or sudden cardiac death

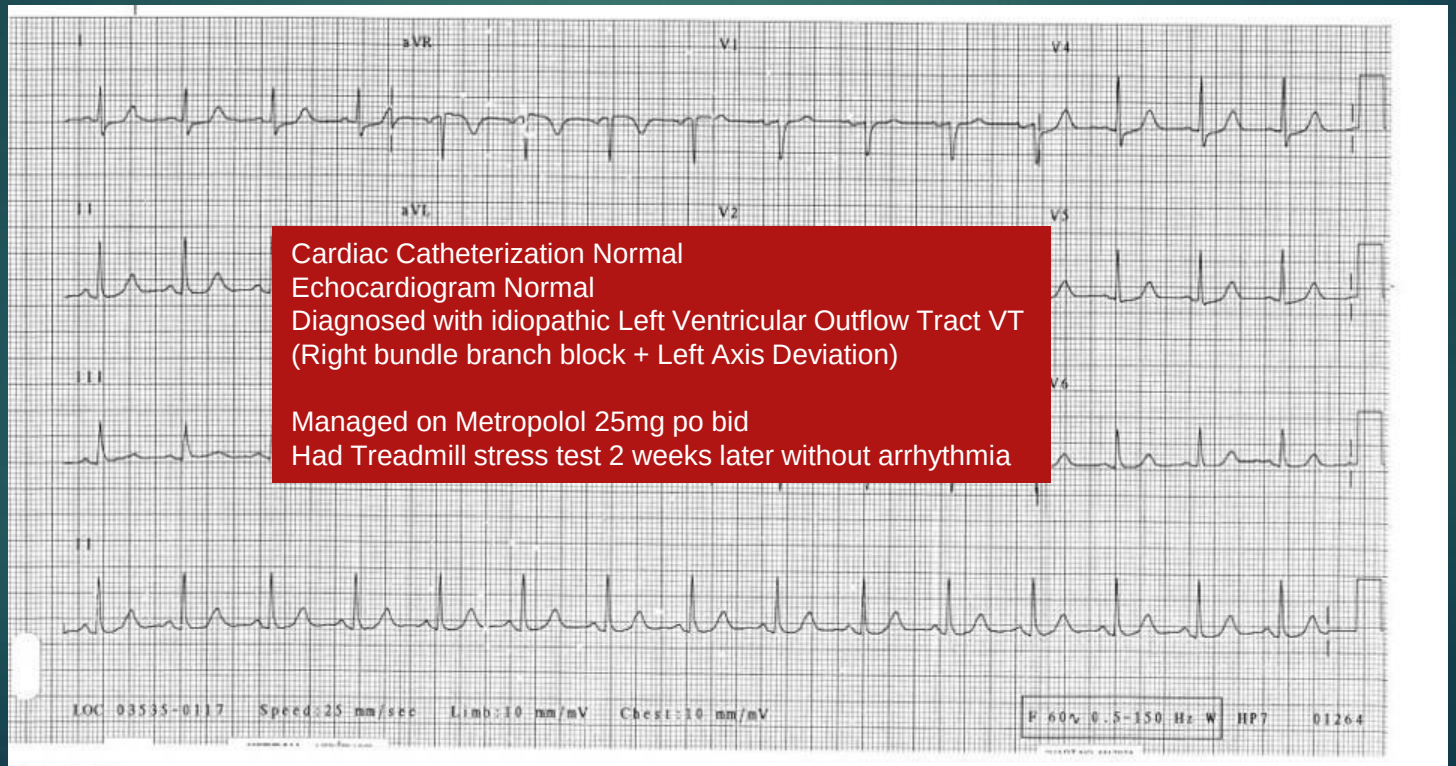
drinks about 4 glasses of wine daily, under a lot of stress recently; denies illicits/OTC's

Typically walks several miles, no dyspnea, no chest pain; never had syncope or symptoms like this

Initial cardiac enzymes negative, no other labs available





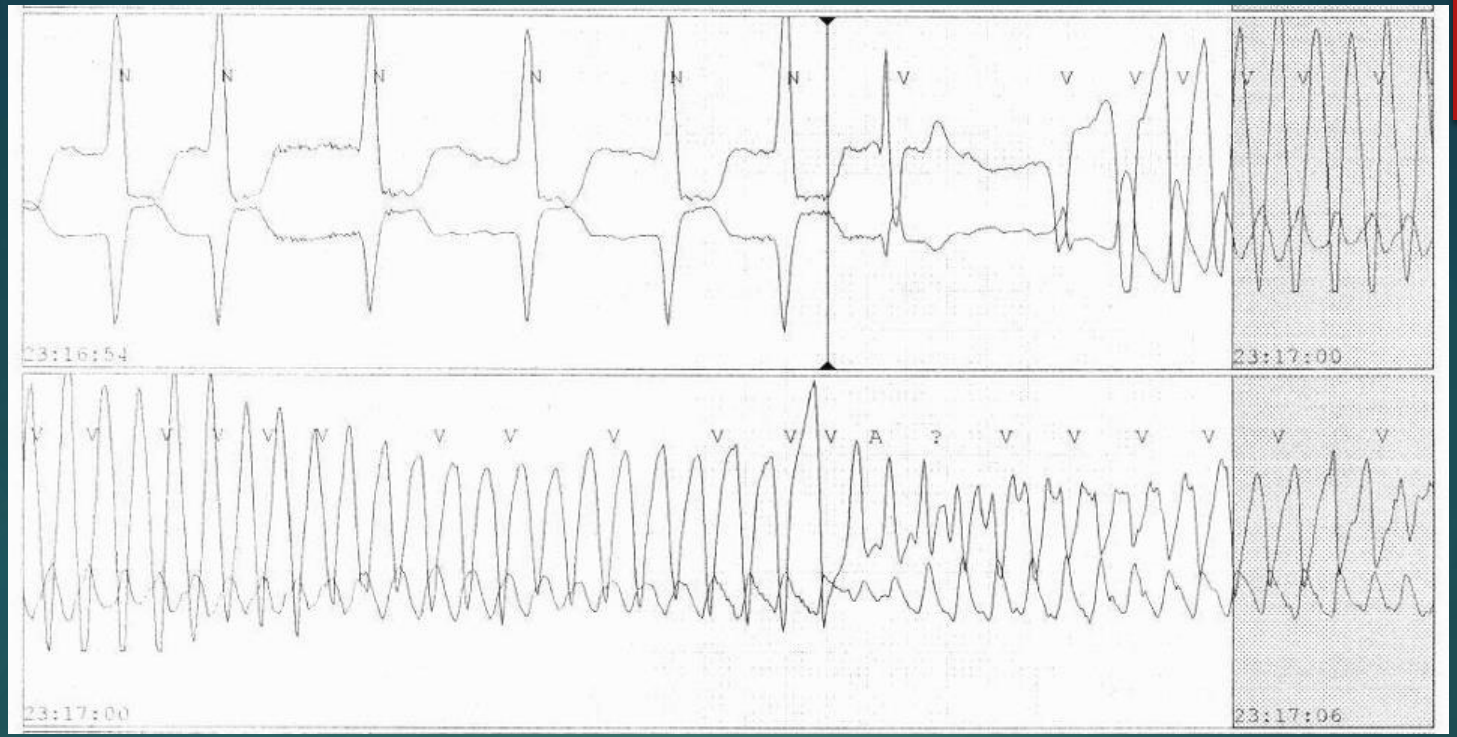


Cardiac Catheterization Normal
Echocardiogram Normal
Diagnosed with idiopathic Left Ventricular Outflow Tract VT
(Right bundle branch block + Left Axis Deviation)

Managed on Metropolol 25mg po bid
Had Treadmill stress test 2 weeks later without arrhythmia

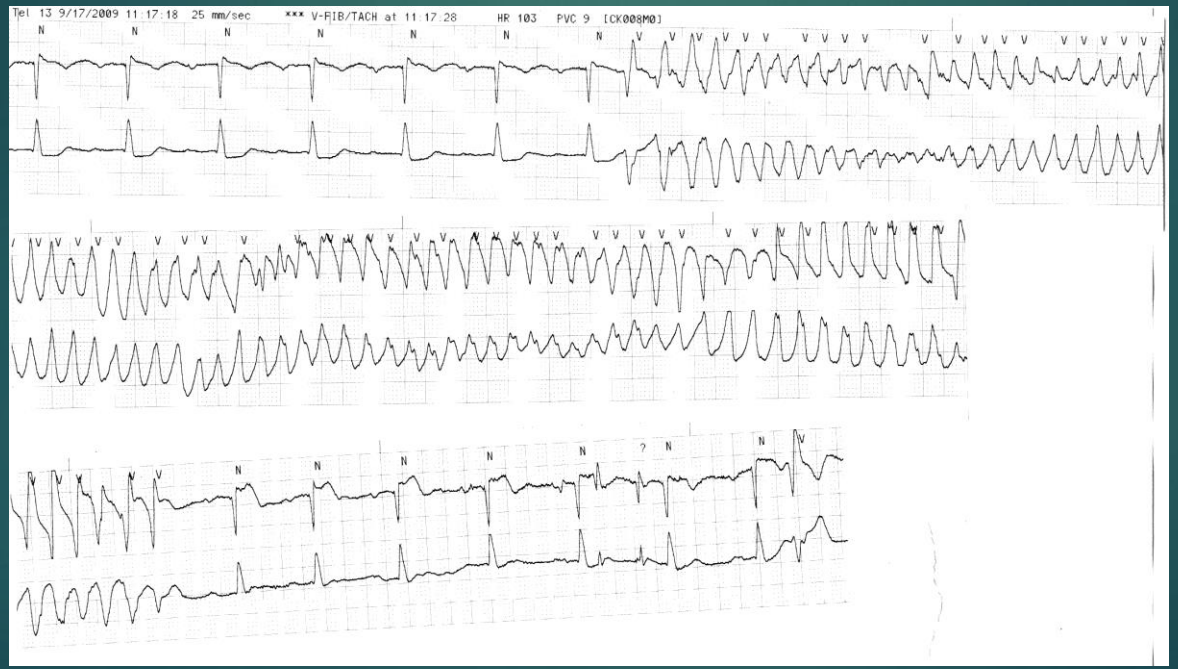
Torsades de Pointes

- Twisting of Points
- Management similar to monomorphic VT
- More often associated with Long Q-T syndrome
  - Medication induced or congenital
  - Think Tikosyn (dofetilide)
- Remember hypokalemia/hypomagnesemia as causes!



Initiation of polymorphic VT
Long-short-long cycle of QRS with R on T

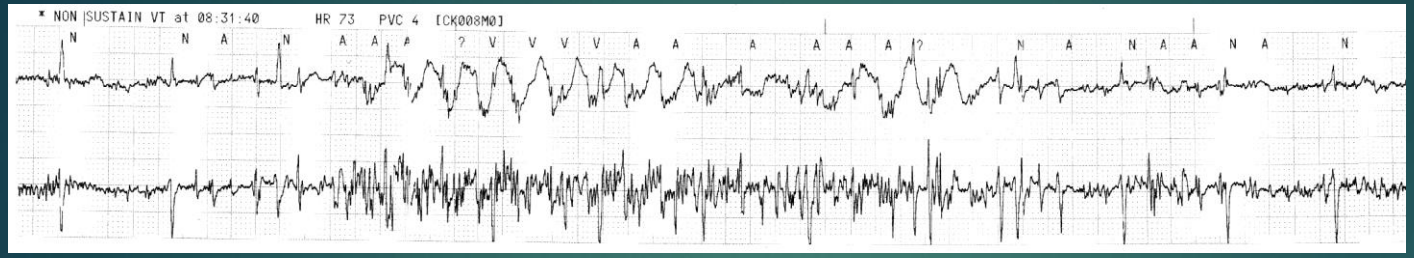
Another Torsades…

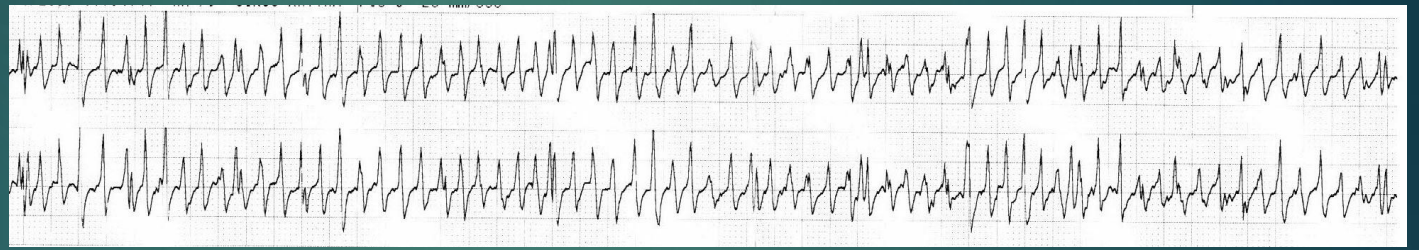


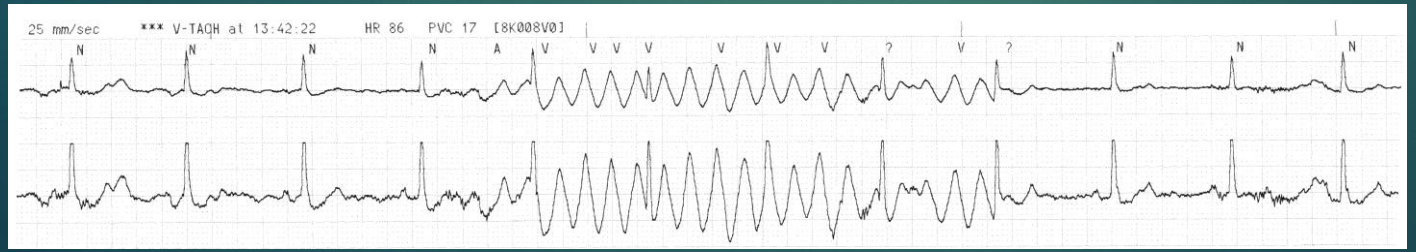
Acute treatment of Torsades

- Acquired Long QT (ie medication induced)
  - IV Magnesium
  - Temporary pacing (high rate)
  - Isoproterenol (to increase heart rate)
  - IV Lidocaine
  - Mexiletine
  - Phenytoin
- Congenital Long QT
  - Beta Blocker
  - Pacemaker/ICD

You are called from 3N…







Pseudo-Ventricular Tachycardia (artifact)

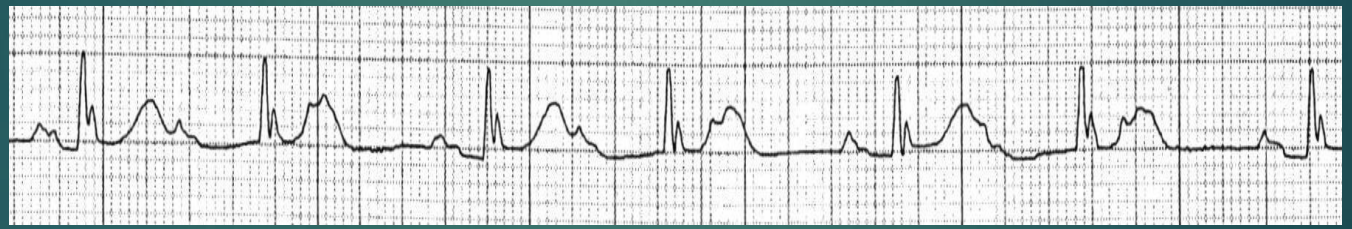
And now to Slow it down….

1st Degree AV Block

- >200 ms from onset of P wave to onset of QRS

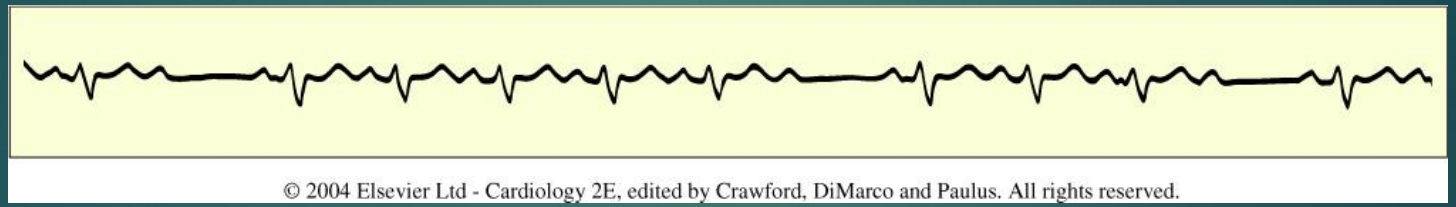
2nd Degree AV Block Type 1 - Wenkebach

- P-R interval prolongs until QRS is dropped



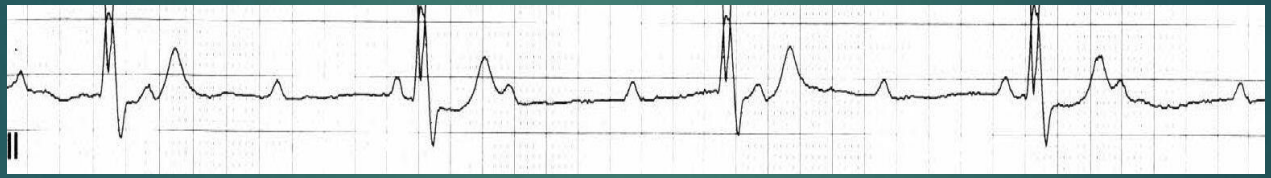
2nd Degree Heart Block Type 2

- PR interval remains constant, QRS drops unexpectedly



3rd degree Heart Block

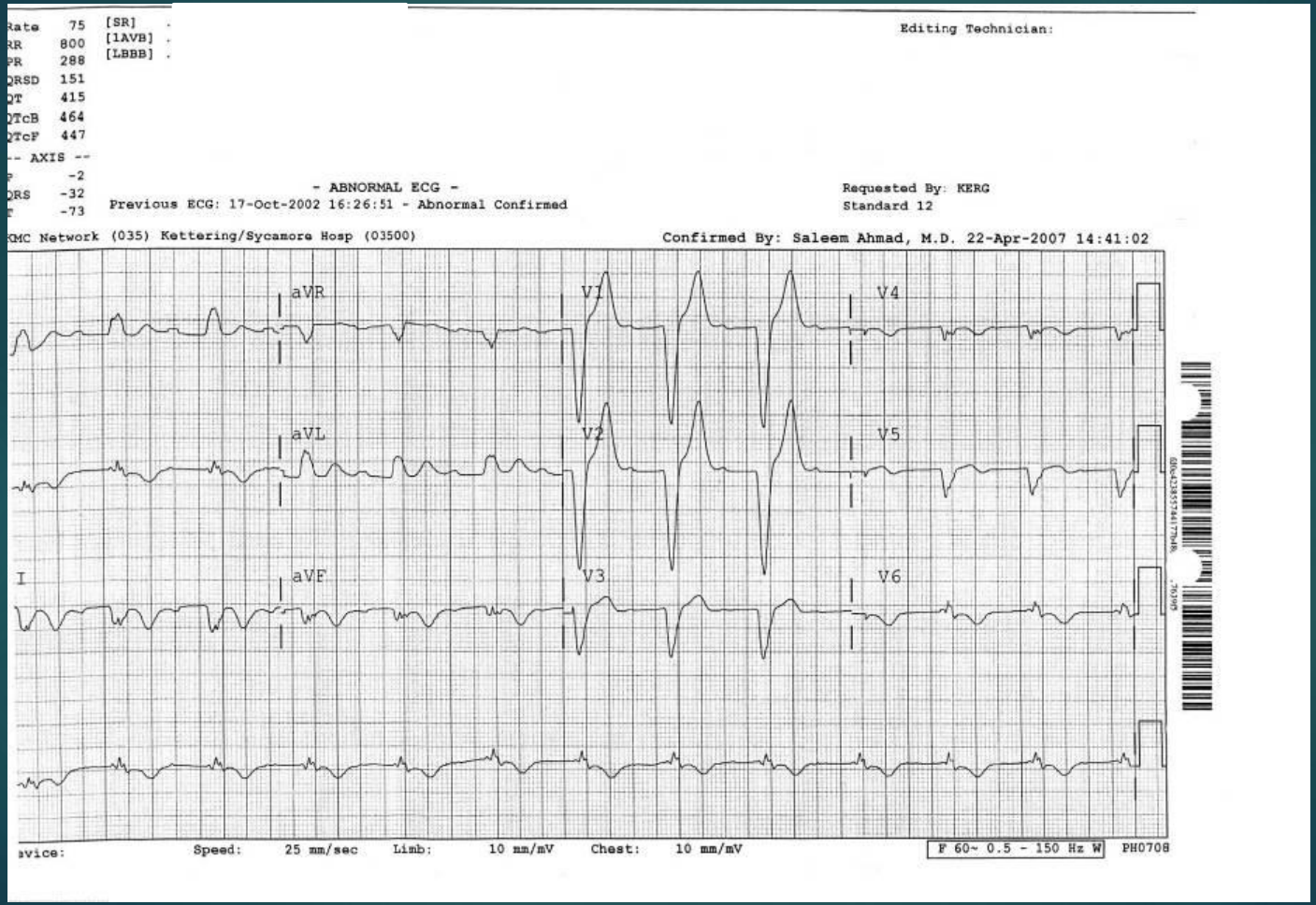
- P rate faster than QRS rate
- No correlation between P's and QRS



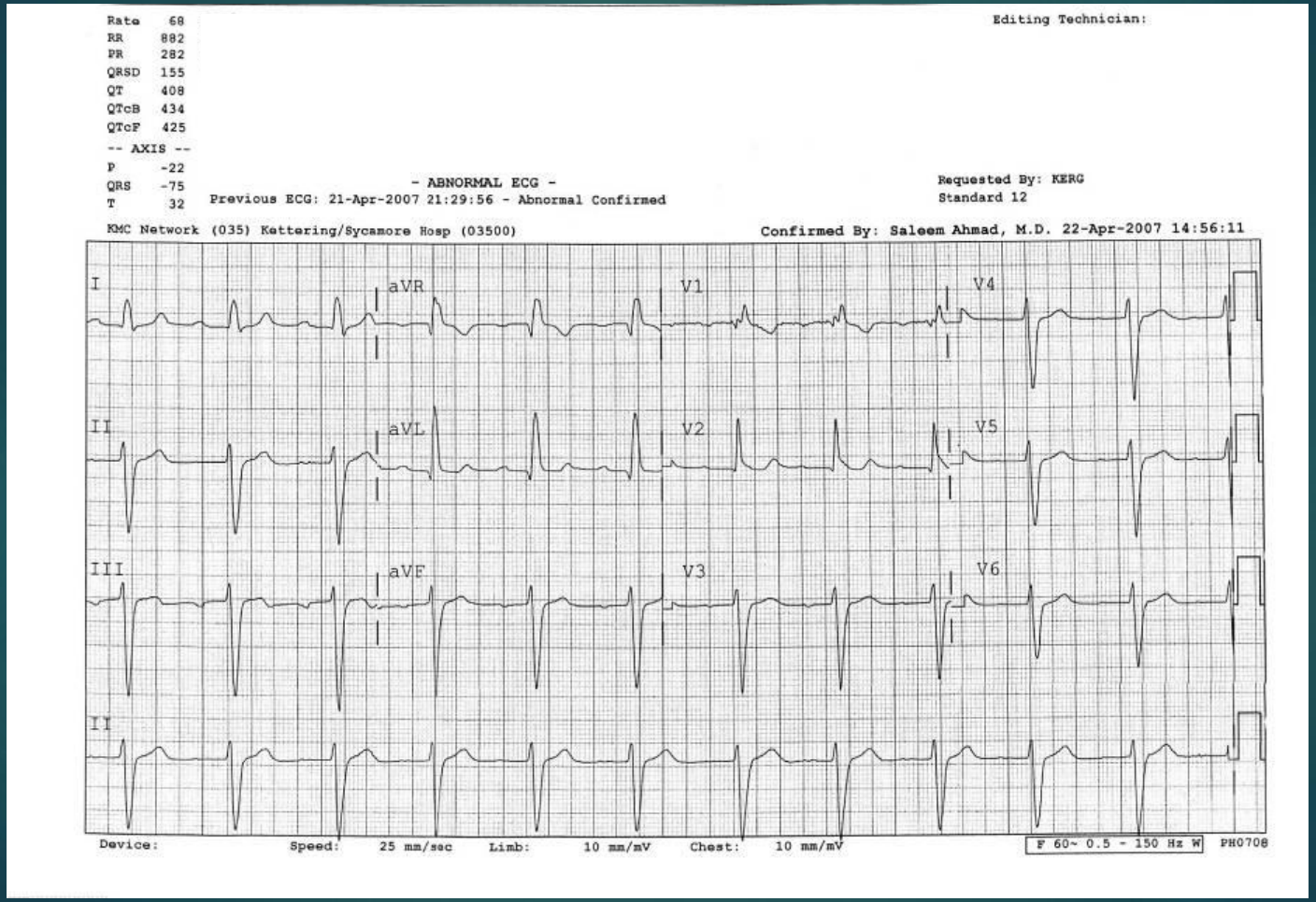
Case Presentation

- 50ish year old white female
- No cardiac history
- Admitted 2 weeks ago at outside hospital for syncope
- Watched for 2 days, diagnosed with possible seizures, had "negative" echo
- Recurrent syncope, admitted to KMC

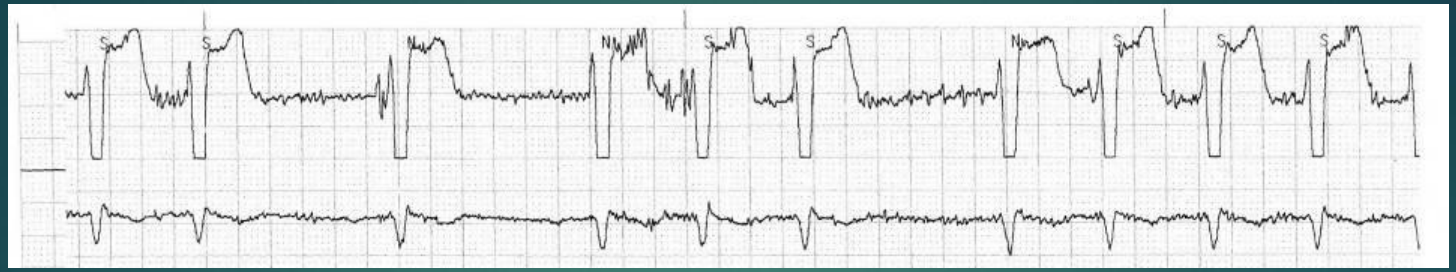
4/21/07 21:30

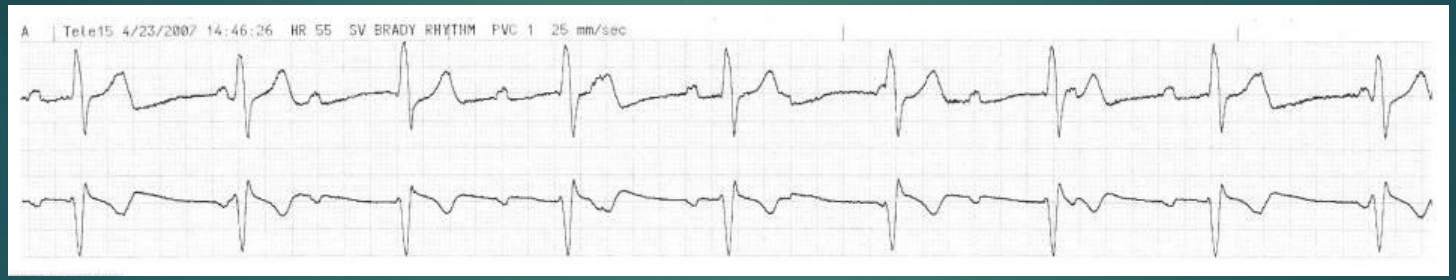

Rate 75
RR 800
PR 288
QRSD 151
QT 415
QTcB 464
QTcF 447
-- AXIS --
P -2
QRS -32
T -73
[SR]
[1AVB]
[LBBB]
Editing Technician:
- ABNORMAL ECG -
Previous ECG: 17-Oct-2002 16:26:51 - Abnormal Confirmed
Requested By: KERG
Standard 12
KMC Network (035) Kettering/Sycamore Hosp (03500)
Confirmed By: Saleem Ahmad, M.D. 22-Apr-2007 14:41:02
aVR
V1
V4
aVL
V2
V5
I
aVF
V3
V6
Speed: 25 mm/sec
Limb: 10 mm/mV
Chest: 10 mm/mV
F 60~ 0.5 - 150 Hz W
PH0708

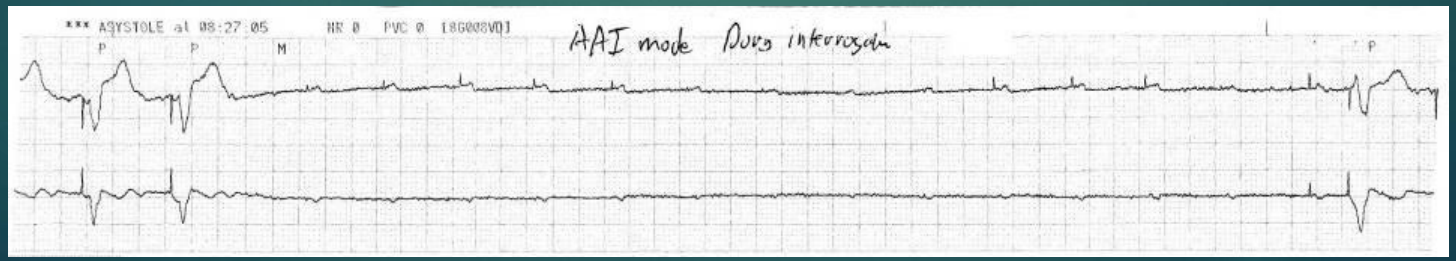
4/21/07 23:45


Rate 68
RR 882
PR 282
QRSD 155
QT 408
QTcB 434
QTcF 425
-- AXIS --
P -22
QRS -75
T 32
Editing Technician:
- ABNORMAL ECG -
Previous ECG: 21-Apr-2007 21:29:56 - Abnormal Confirmed
Requested By: KERG
Standard 12
KMC Network (035) Kettering/Sycamore Hosp (03500)
Confirmed By: Saleem Ahmad, M.D. 22-Apr-2007 14:56:11
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
Device:
Speed: 25 mm/sec
Limb: 10 mm/mV
Chest: 10 mm/mV
F 60~ 0.5 - 150 Hz W
PH0708

Later that night…..







Board Pearls for Heart Block

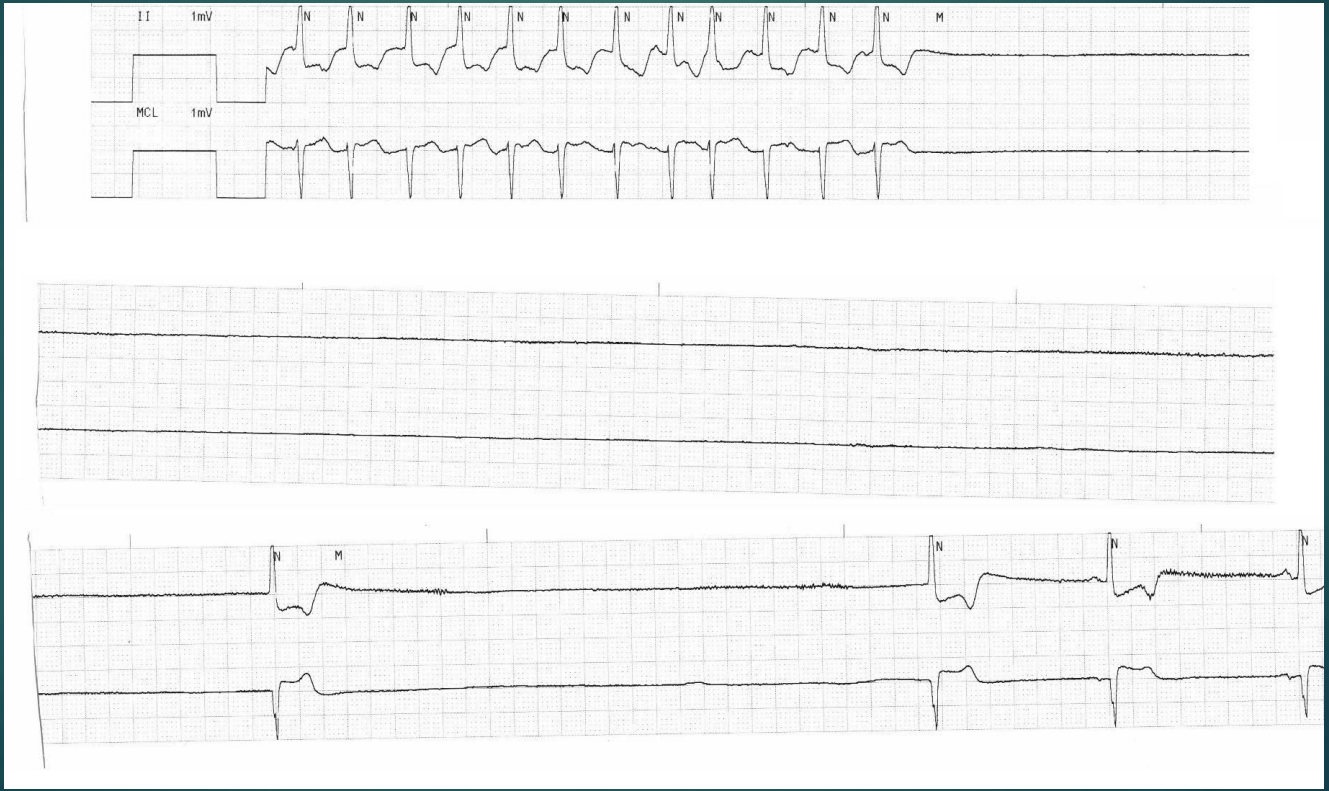
- Think of potential causes of heart block
  - Lyme disease
  - Sarcoidosis
  - Drug overdose
  - Hyperkalemia
  - Hypothyroidism

Another case…

- 75 year old male admitted with syncope
- No significant past medical history or medications
- Nothing on telemetry overnight…

NSR → 20 second asystole

Atrial fibrillation → Asystole



References

- Chauhan VS, Krahn AD, Klein GJ, Skanes AC, Yee R. Supraventricular tachycardia. Med Clin North Am. 2001 Mar;85(2):193-223, ix.
- Ganz LI, Friedman PL. Supraventricular tachycardia. N Engl J Med. 1995 Jan 19;332(3):162-73.