EKG Rounds
SVT

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Classification of Supraventricular Tachycardias

AV Node Independent	**AV Node Dependent**
Sinus tachycardia	*AV node reentry*
Appropriate	Slow-fast variant
Inappropriate	Fast-slow variant
Sinus node reentry	
Atrial tachycardia	*AV reentrant*
Unifocal	Orthodromic (concealed AP)
Multifocal	Antidromic (manifest AP)
	PJRT (concealed slowly conducting AP)
Atrial flutter	Junctional tachycardia
Atrial fibrillation	
AV = Atrioventricular; AP = accessory pathway; PJRT = permanent form of junctional reciprocating tachycardia.	

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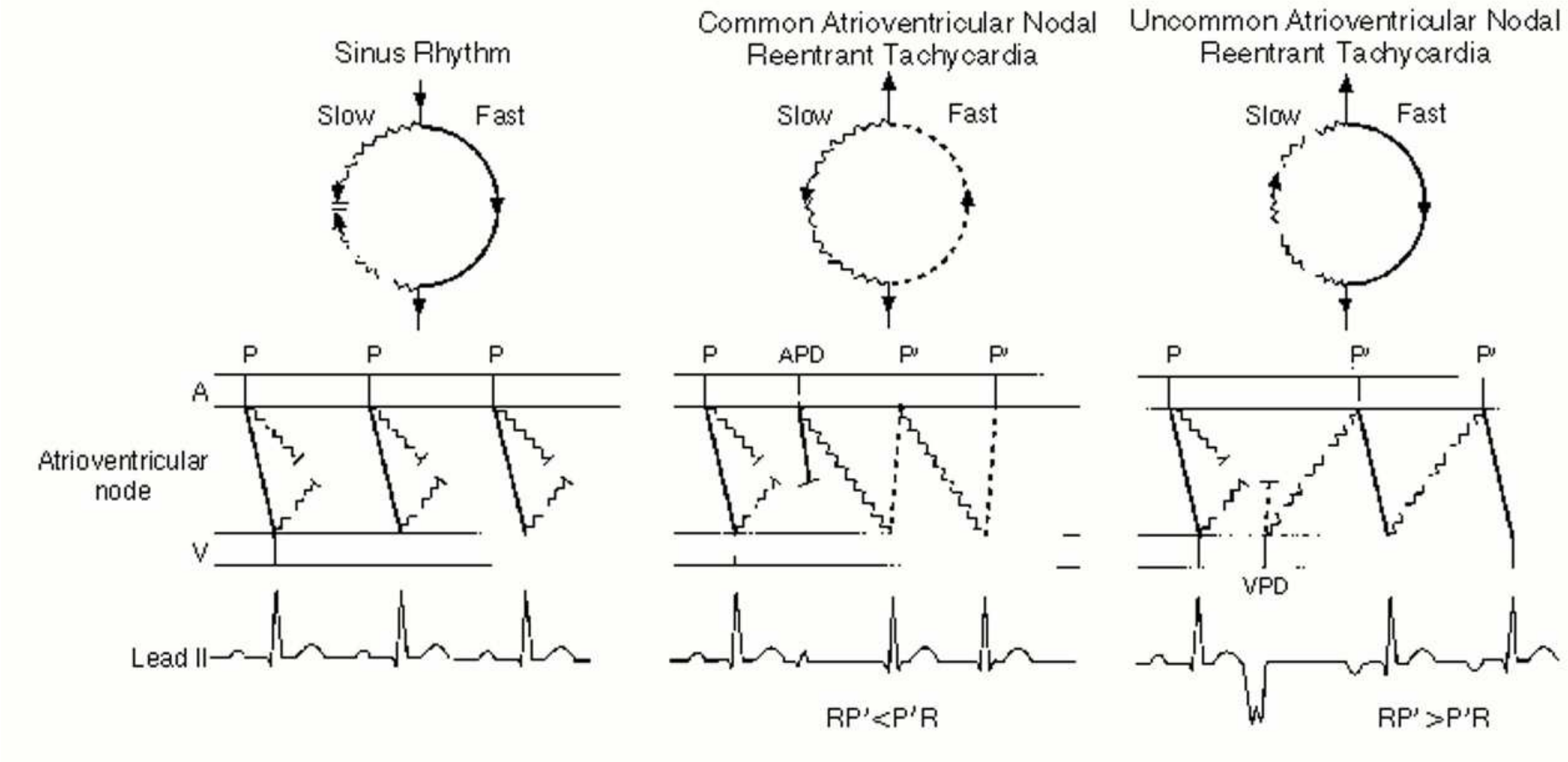
General Mechanism of Nodal Dependent SVT

- 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

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

AVNRT



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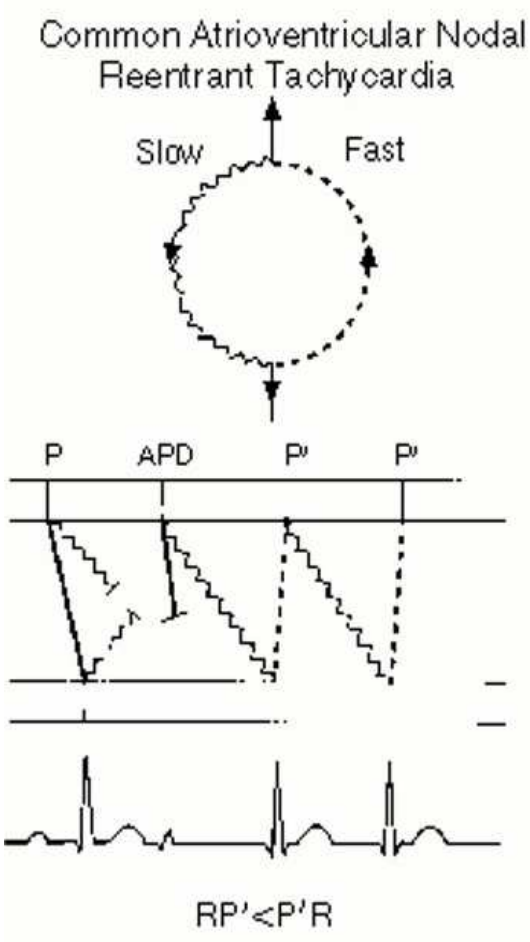
Typical AVNRT

- 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



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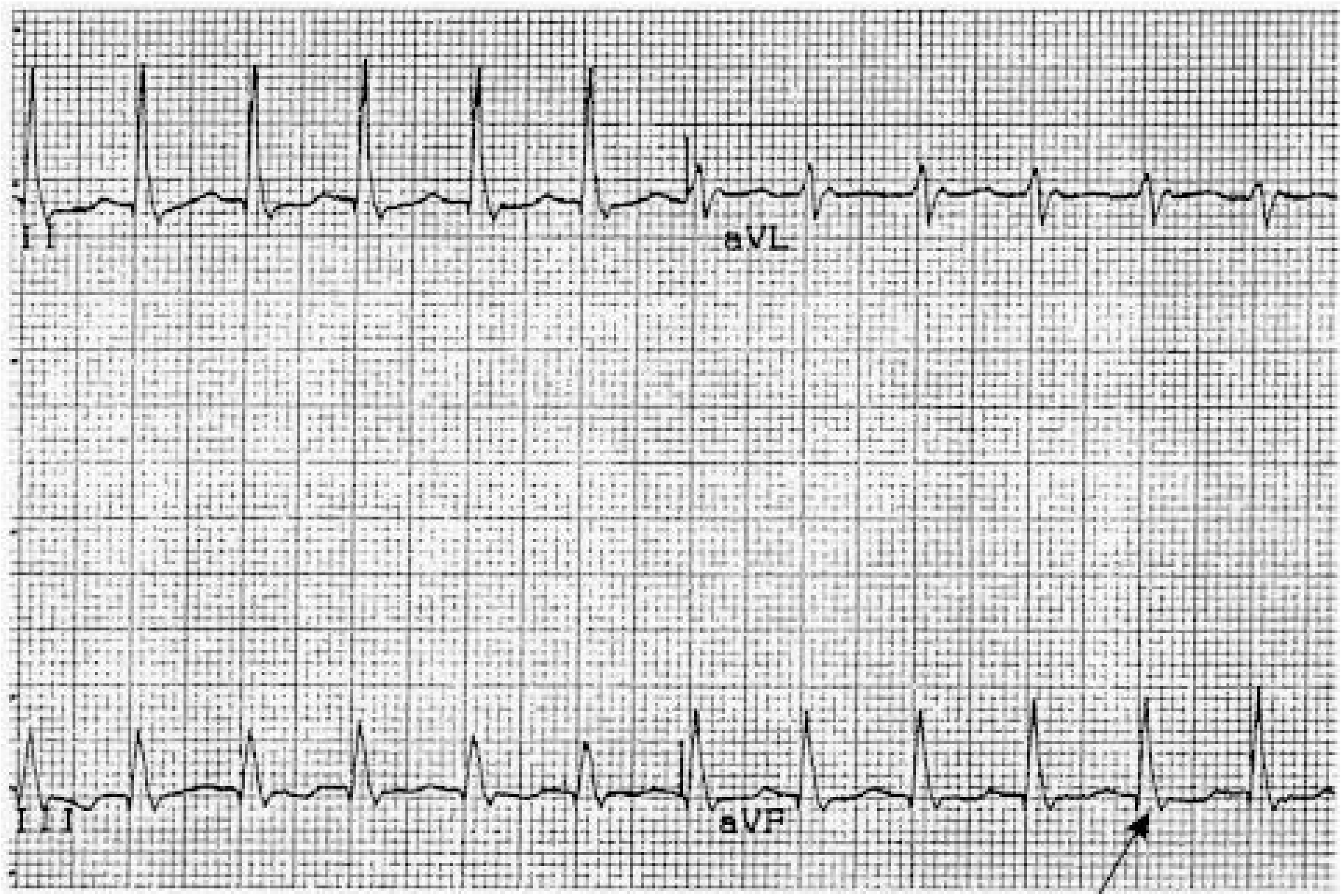

AVNRT with pseudo S wave

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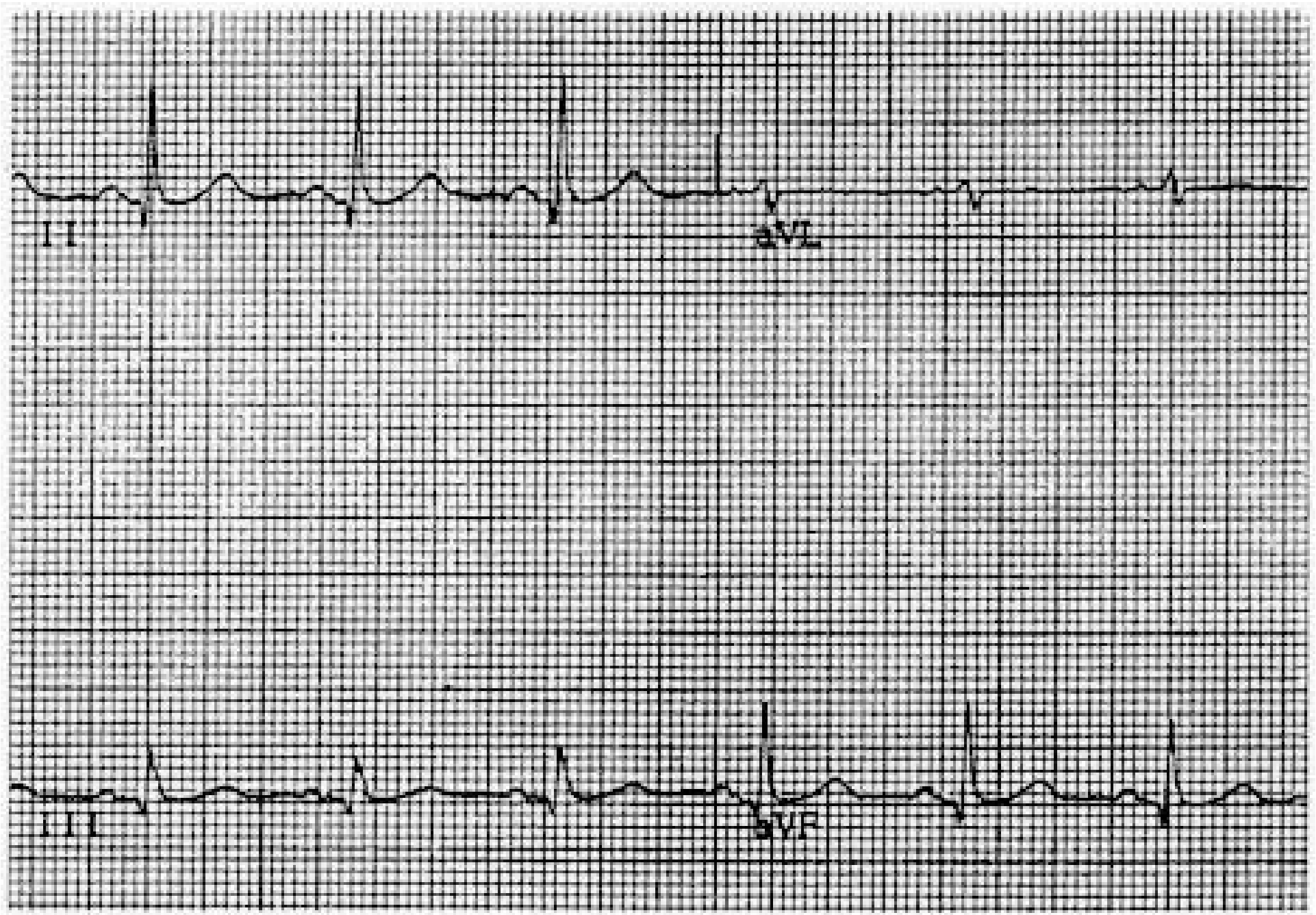

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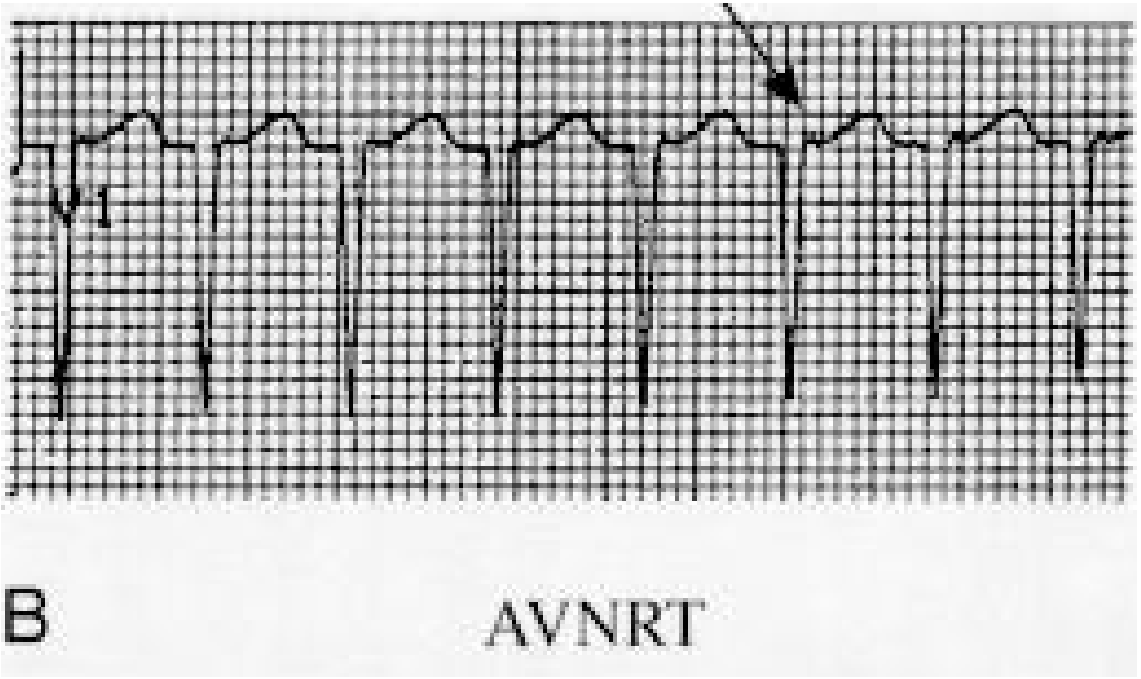
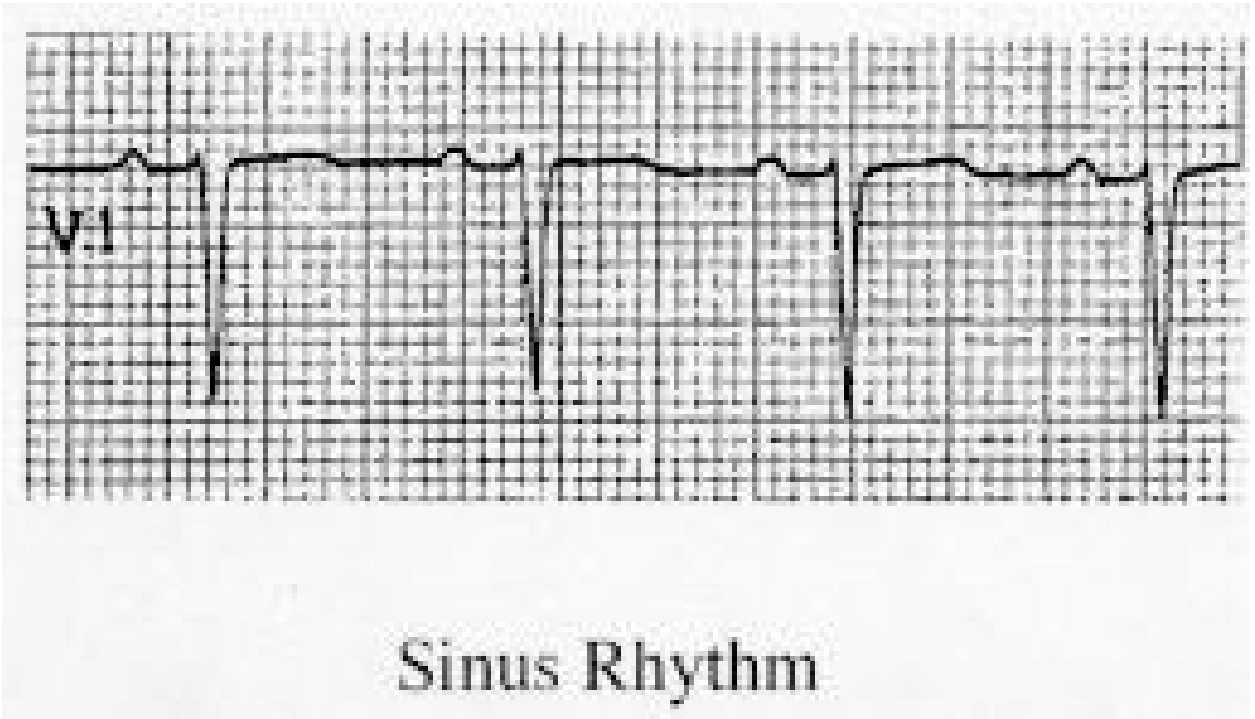
NSR



AVNRT with pseudo R waves



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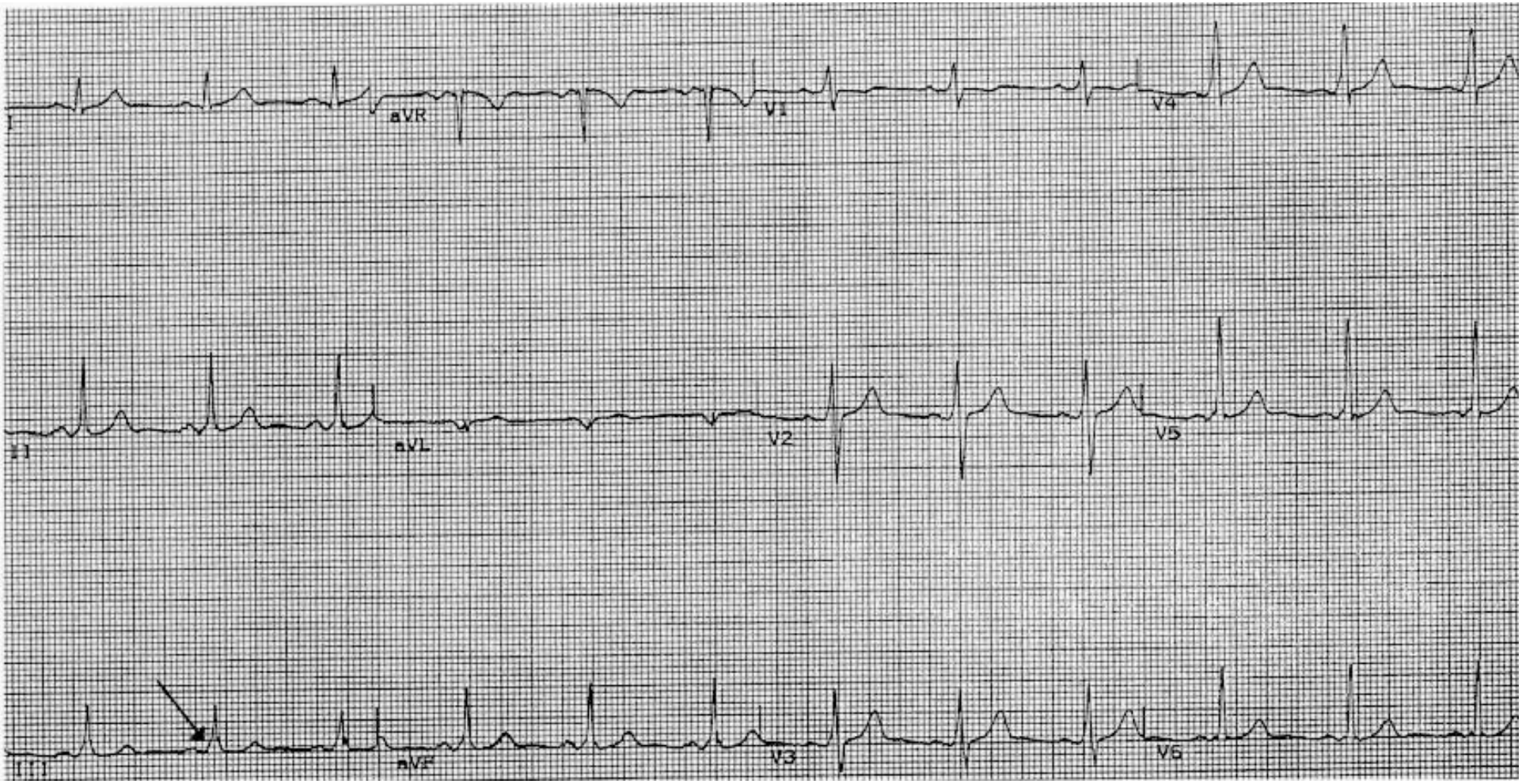
AV Reentrant Tachycardia AVRT

- 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

Accessory Path



Left lateral accessory pathway with antegrade conduction

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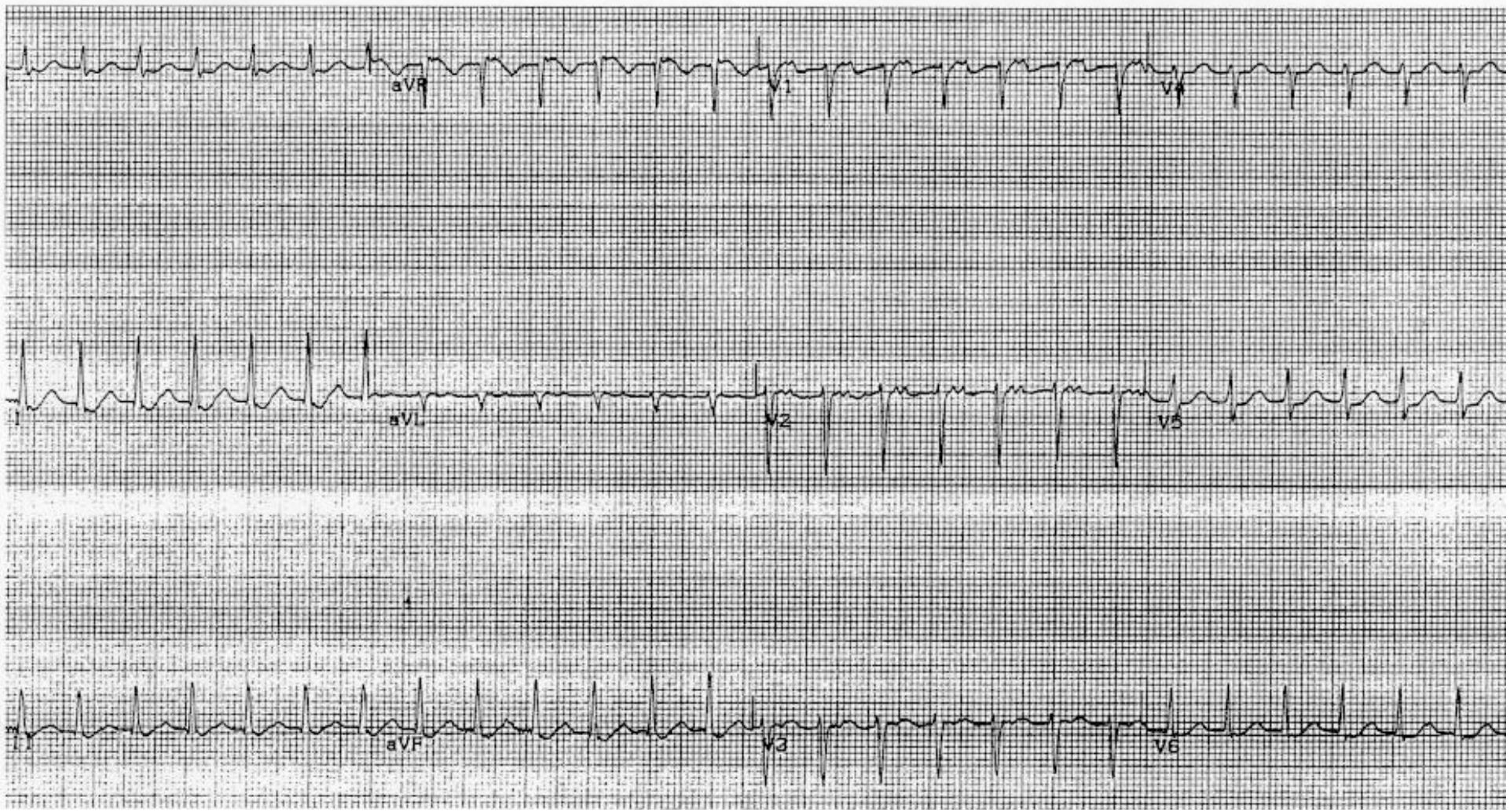
Types of AVRT

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

Orthodromic AVRT



Antegrade conduction from AV node, retrograde conduction by left sided accessory path

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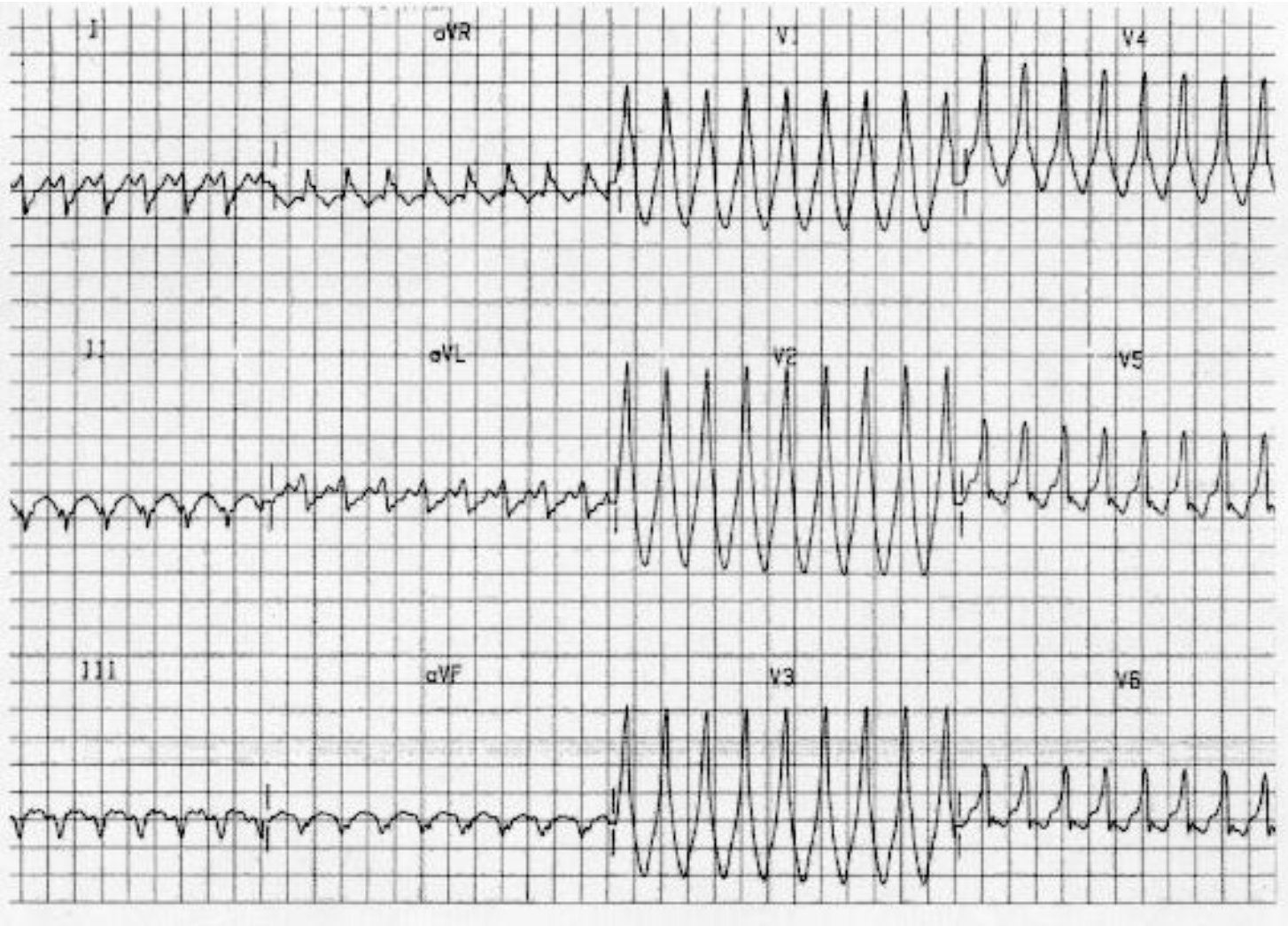
Antidromic AVRT



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

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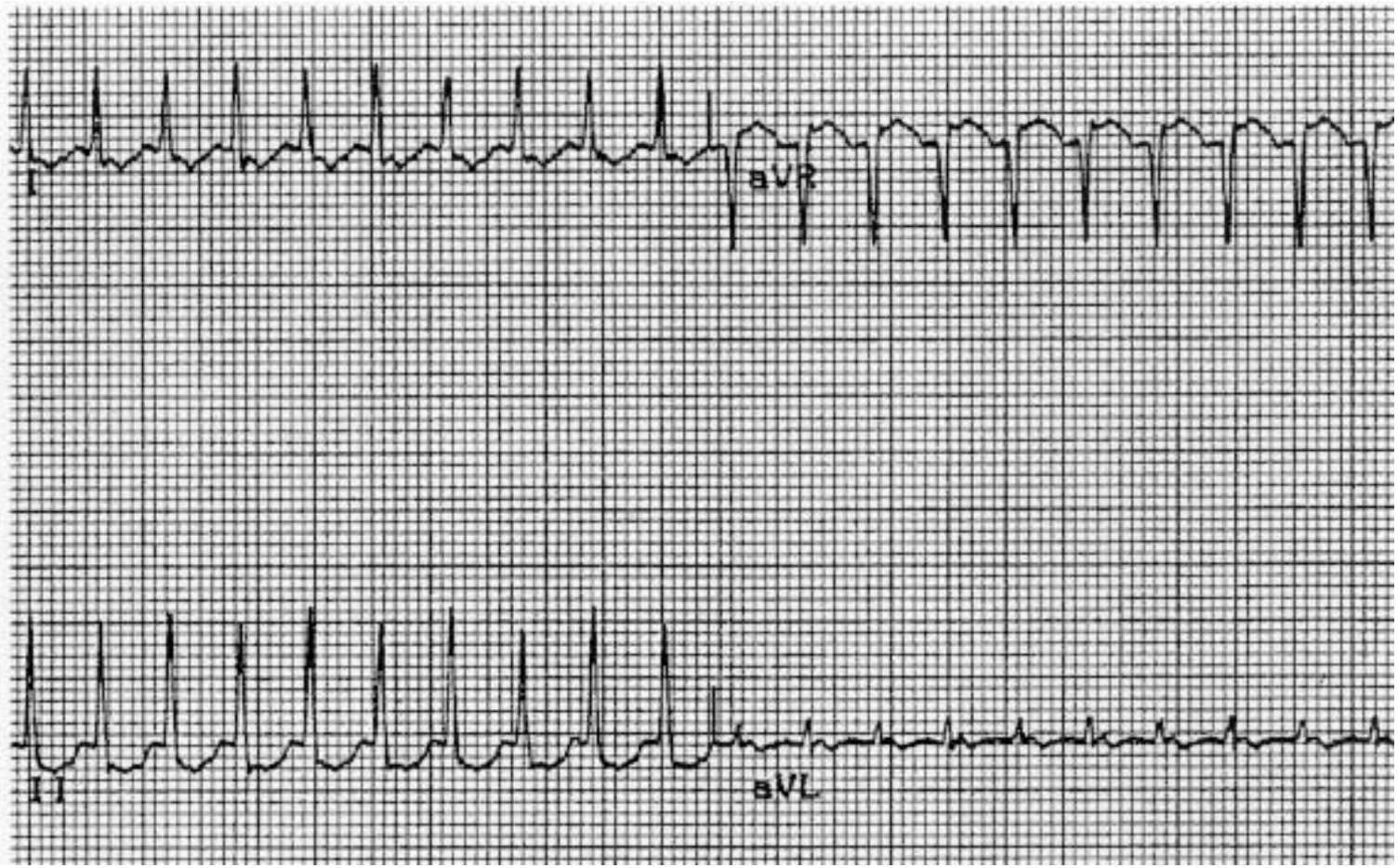
EKG features

- Orthodromic AVRT
  - Narrow complex
  - P wave appears after QRS (R-P<P-R)
  - If slow retrograde accessory path used, then R-P>P-R
    - May start spontaneously, termed Permanent Junctional Reciprocating Tachycardia (PJRT)
  - P wave morphology dependent on location of accessory path
    - Negative in I = left atrial
    - Positive in inferior leads = posteroseptal
  - May see QRS alternans with fast rate

Orthdromic AVRT with left sided accessory path



Negative P wave in I, aVL; R-P<P-R

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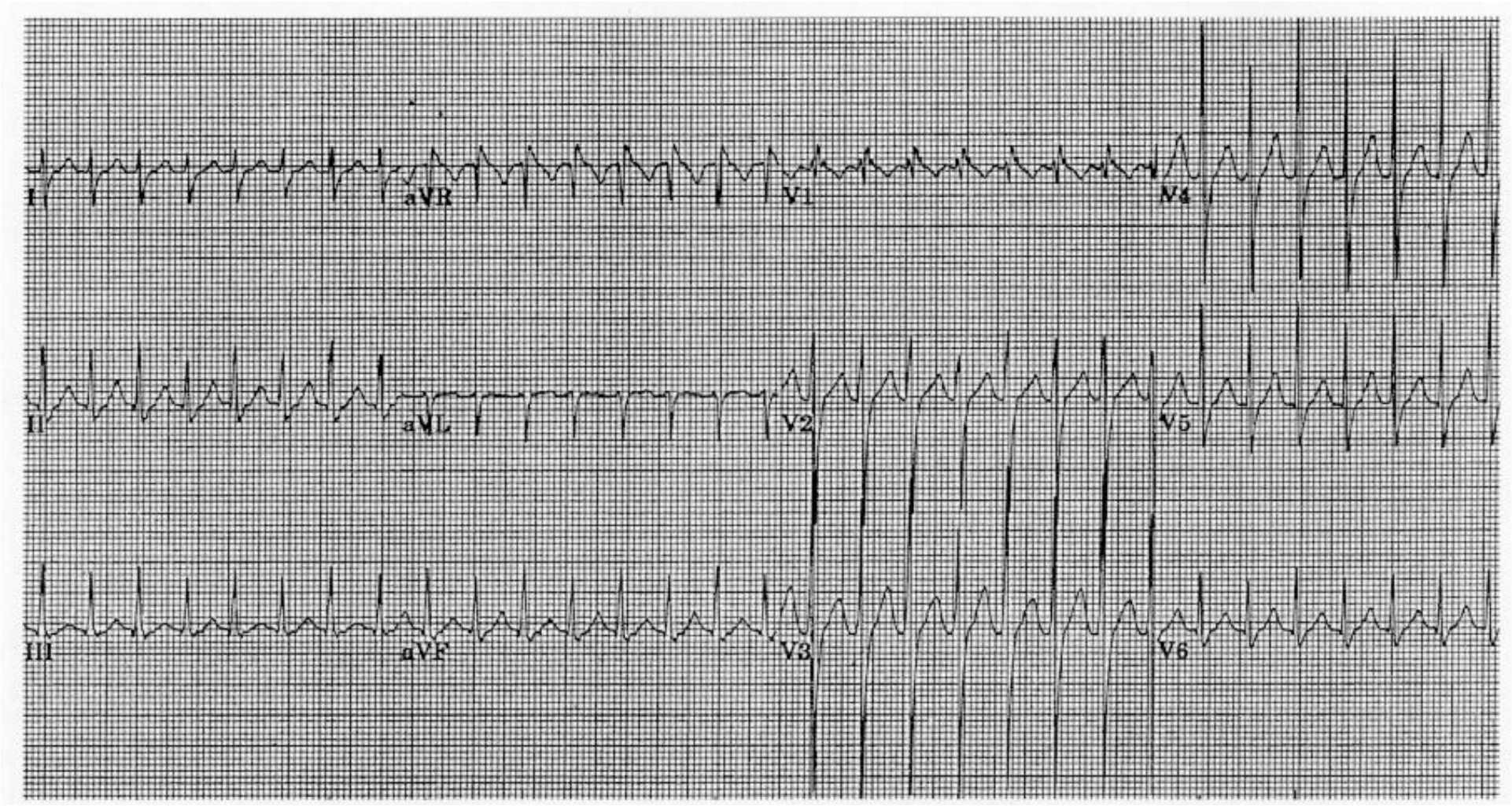
Orthdromic AVRT with QRS alternans



QRS alternans in lead II and V4

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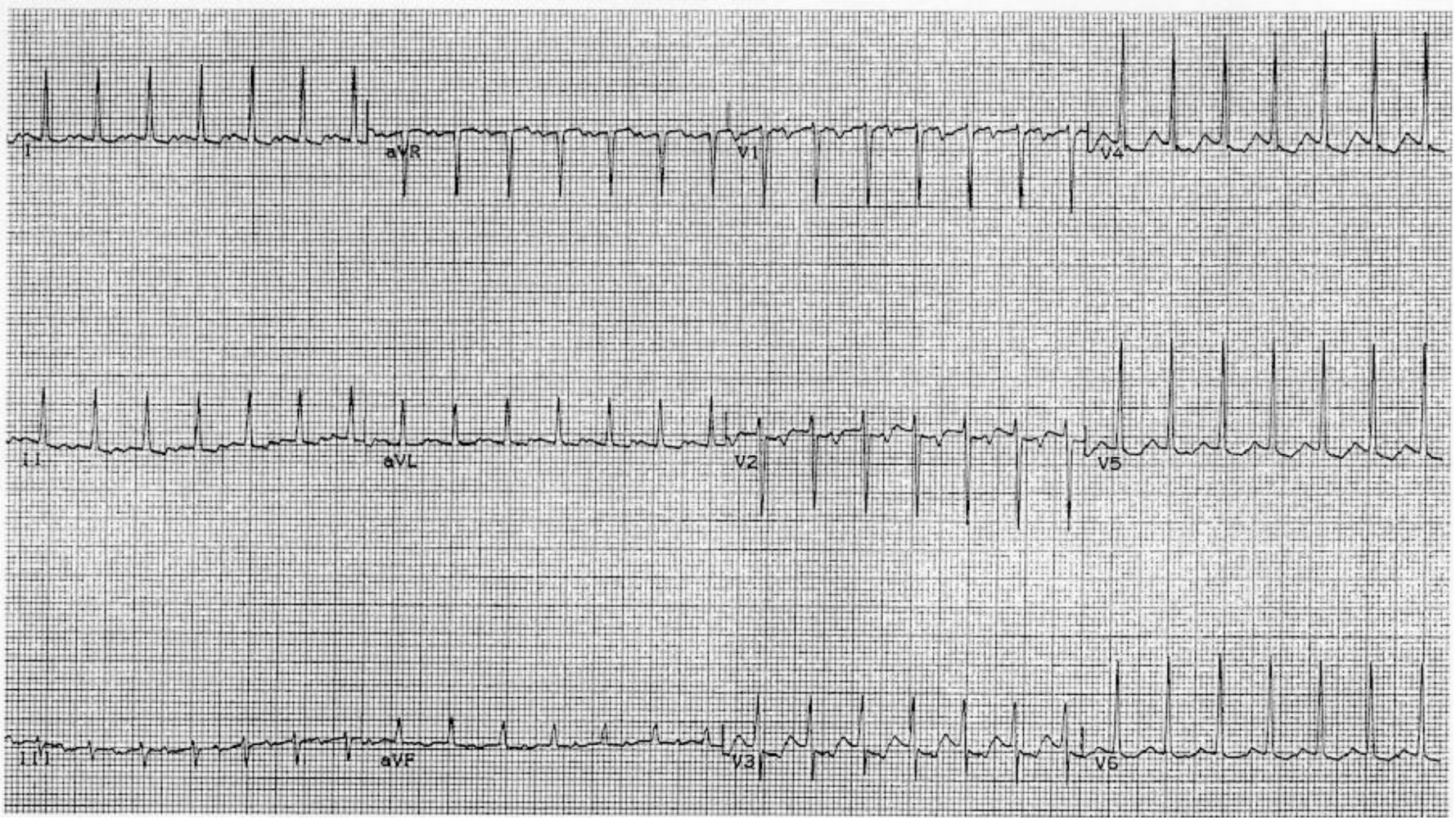
Pearls of Node dependent SVT

- AVNRT
  - Most common SVT (60%), most are female
  - 90% are typical Slow-Fast variety
  - P typically buried in QRS creating pseudo R/S
- AVRT
  - Most bypass tracts conduct bidirectionally
  - Orthodromic AVRT most common
    - Narrow QRS
    - P usually follows QRS
  - Antidromic AVRT rare
    - Delta wave evident
  - Concealed conduction due to retrograde only bypass tracts, not evident on resting EKG

Atrial Tachycardia

- About 15% of SVT's
- Usually single tachycardic focus
  - Local reentry common with atrial dilitation or surgery
    - Starts with PAC
  - Enhanced automaticity or triggered activity
    - Heart without structural disease
    - Shows warm up and cool down phase (not abrupt onset)
    - Mechanism of digoxin (usually with variable A:V block)

Atrial Tachycardia



Atrial tachycardia initiating from superior right atrium

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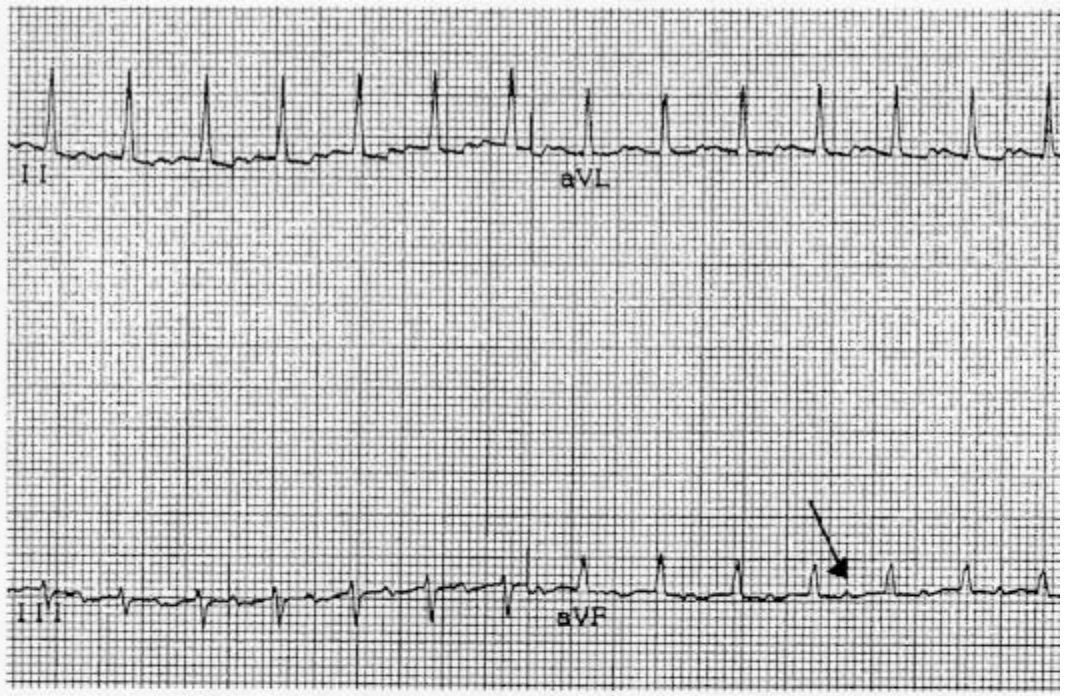
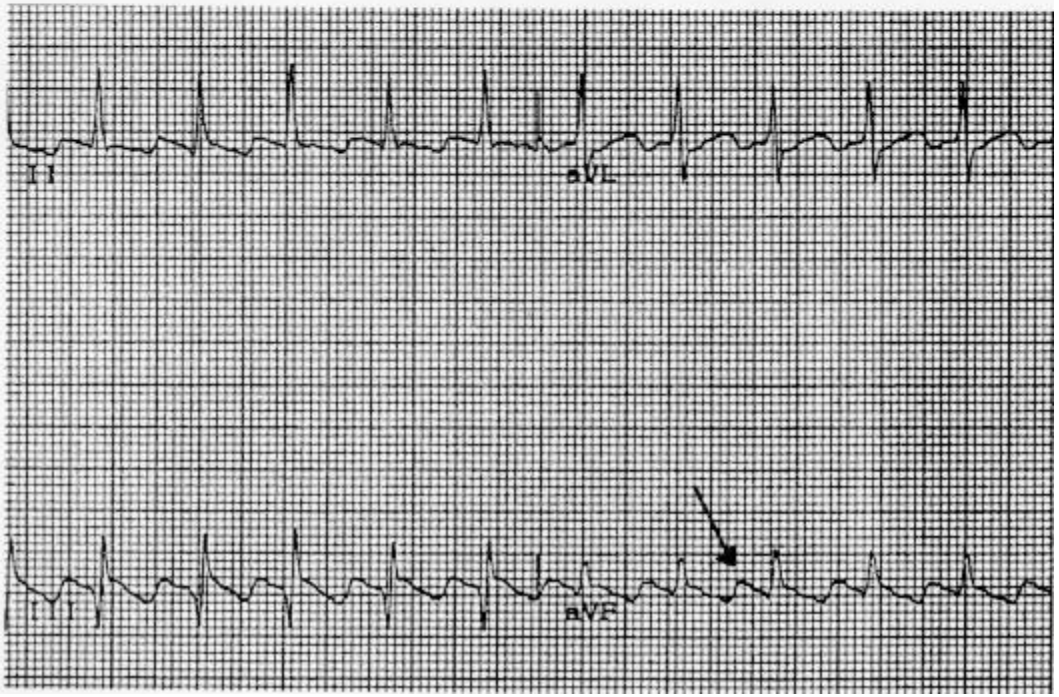
ATach vs AFlutter

Atrial tachycardia with isoelectric baseline



Atrial Flutter with F waves, no baseline



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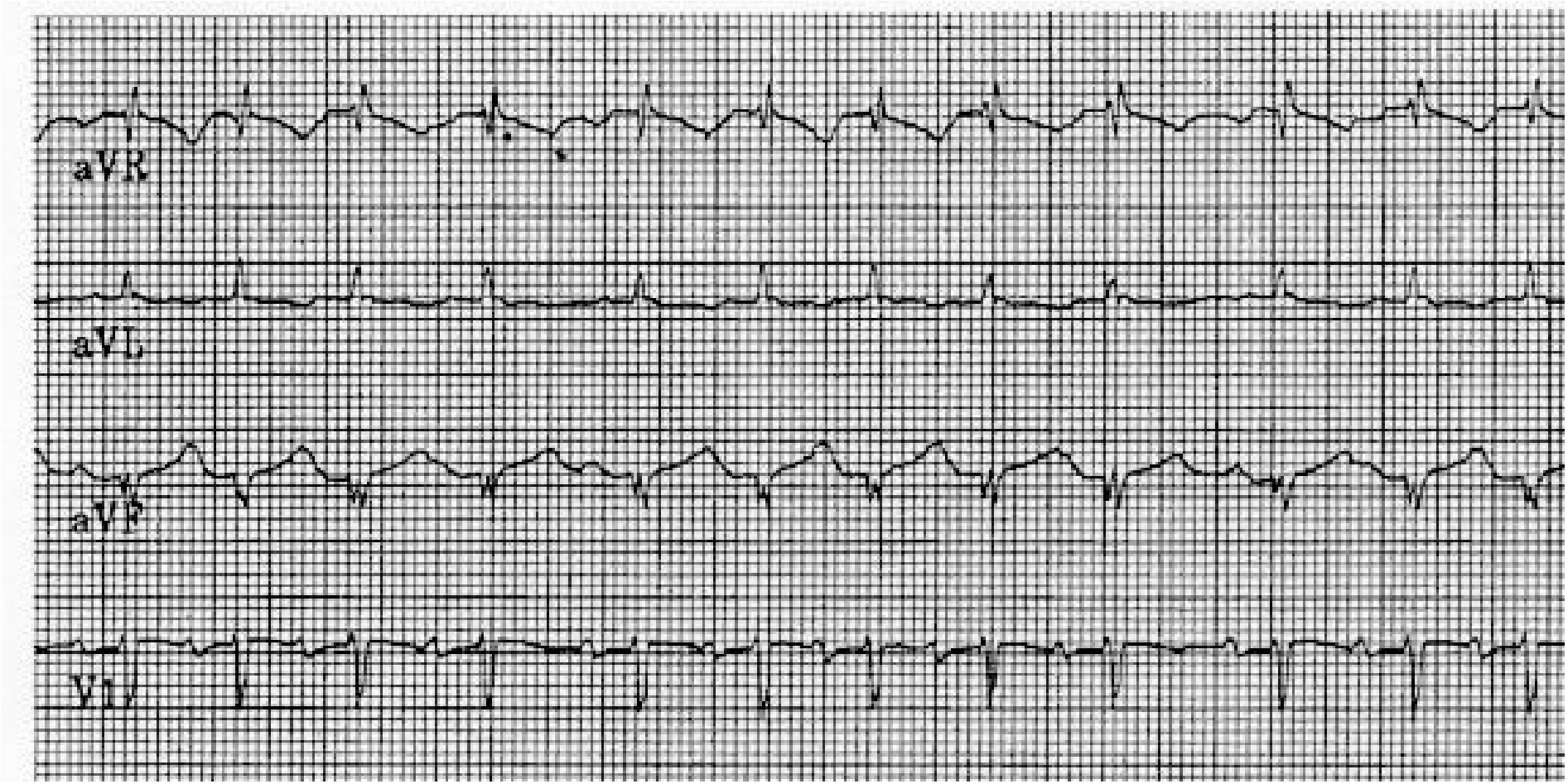
Multifocal Atrial Tachycardia

- Variable atrial foci
- Usually associated with hypoxia or pulmonary disease
- Due to enhanced automaticity or triggered activity
- 3 P wave morphologies with variable P-R intervals, rate >100

MAT



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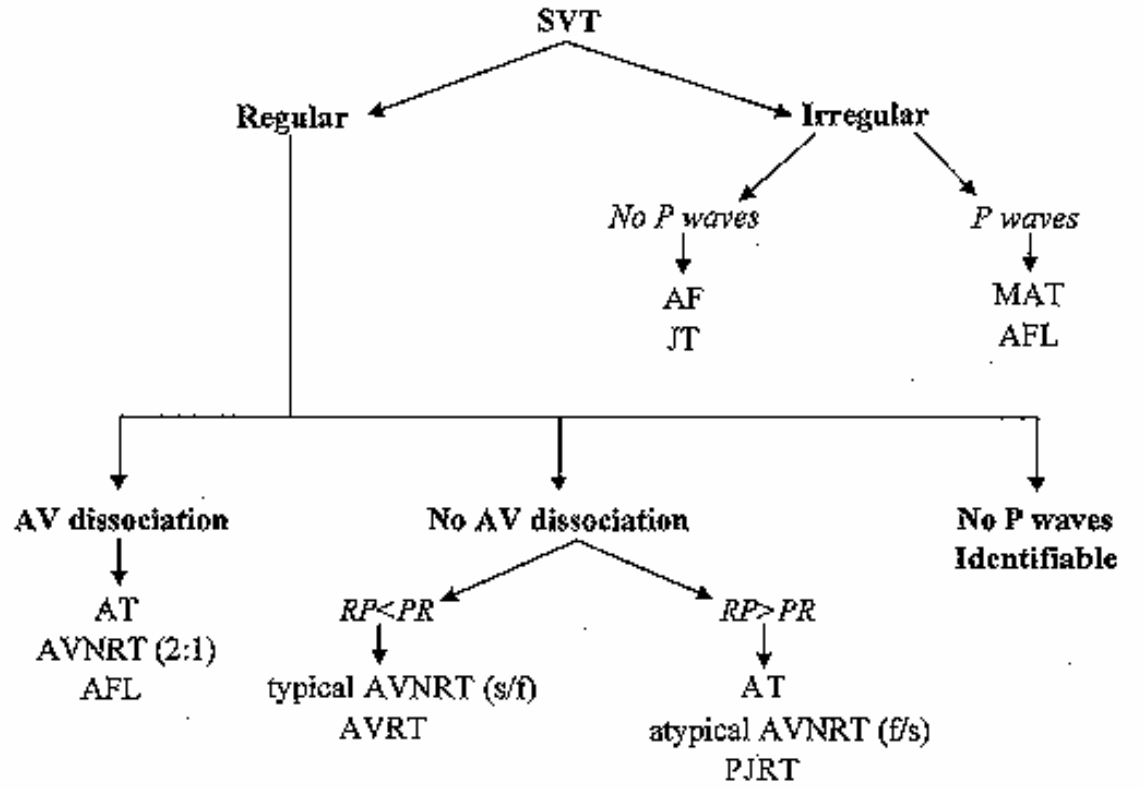
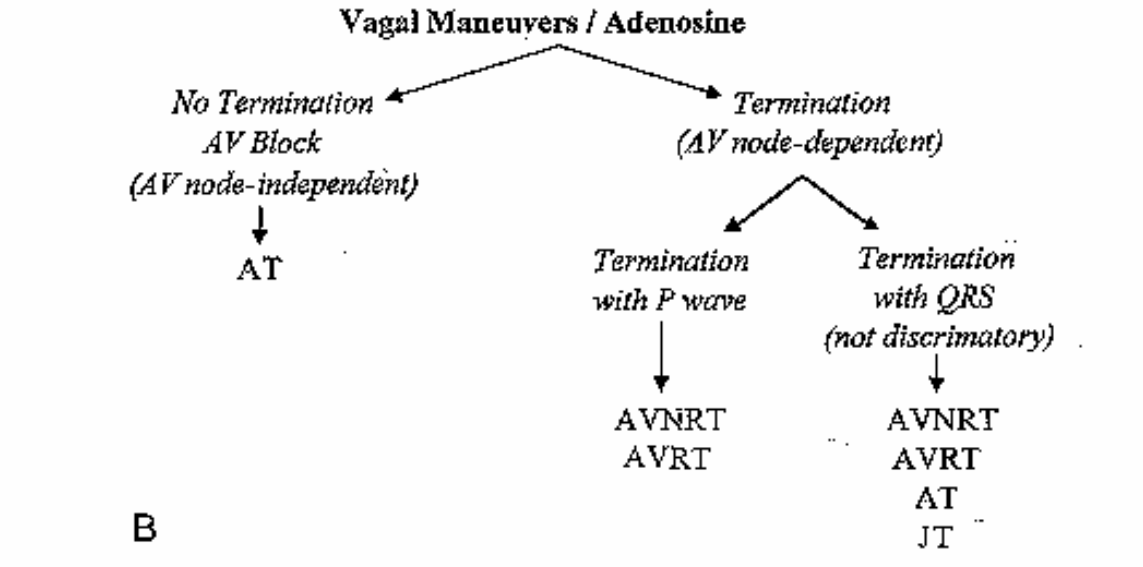
Sinus Tachycardia

- Sinus node reentry
  - Caused by PAC
  - Abrupt onset and cessation
  - Usually nonsustained and slower than inappropriate sinus tachycardia
  - Breaks with adenosine
- Inappropriate sinus tachycardia
  - Rule out causes of tachycardia
    - Anemia
    - Hyperthyroidism
    - Pheochromocytoma
    - Diabetes with autonomic dysfunction
    - Fever
  - Thought to be due to hyperadrenergic sensitivity or depressed vagal tone

Diagnosis of SVT

- 12-lead EKG
- Adenosine/Verapamil
  - Does it break with a terminal P wave?
- Compare R-P interval to P-R interval





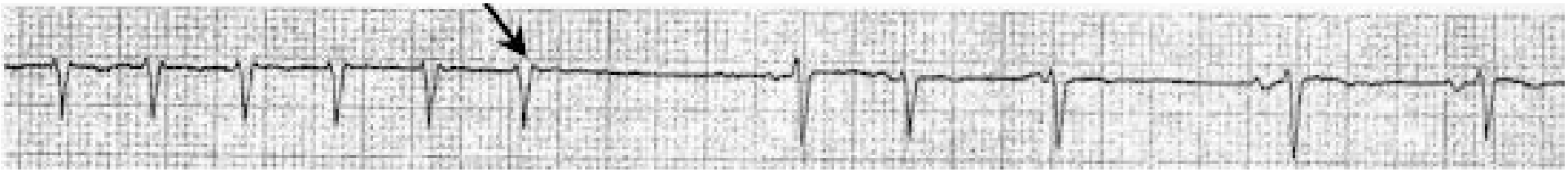
R-P Interval

- R-P > P-R (“Long R-P tachycardia”)
  - Atrial Tachycardia (most common)
  - Atypical AVNRT (Fast-Slow)
  - Permanent Junctional Reentrant Tachycardia
- R-P < P-R (“Short R-P tachycardia”)
  - typical AVNRT (slow-fast variant)
  - AVRT

Breaking a tachycardia

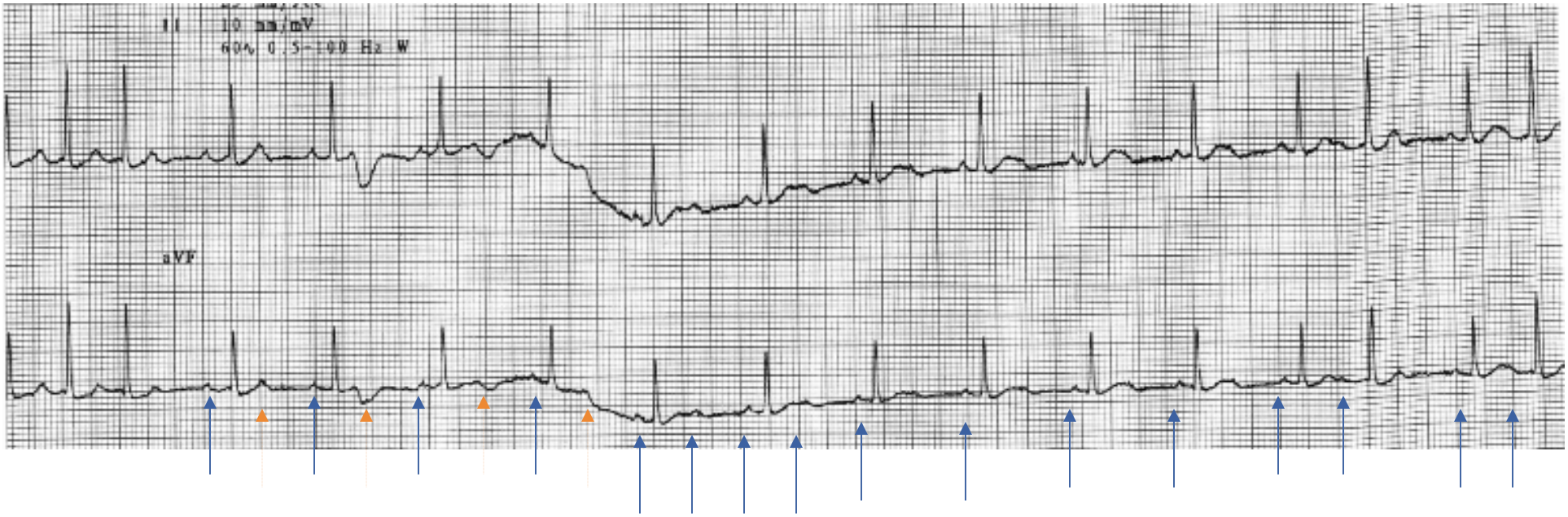
- Vagal Maneuvers (Valsalva, Carotid Massage)
- AV blocking drugs (Adenosine, Verapamil)
- AV node dependent tachycardias will break
  - If SVT terminates with a P wave then it is AVNRT or AVRT
  - If it terminates with a QRS, this is not discriminatory
- If it doesn't break with above maneuvers it is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

Adenosine Terminating AVNRT



Note terminal P as a pseudo R wave

Adenosine not terminating Sinus Tachycardia



Note AV block followed by a warm up phase

Caveats

- Never assume that a wide complex tachycardia is SVT with aberration
  - Verapamil is disastrous with Ventricular tachycardia
- In Atrial fibrillation with RVR using accessory tract (ie WPW), avoid node blocking agents such as verapamil, B-blockers
- Adenosine is useful and safe in almost every tachycardic situation
  - May precipitate atrial fibrillation though

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)

Medical Management of SVT

- No therapy if limited symptoms or infrequent episodes
- AV node dependent tachycardias (AVNRT)
  - Verapamil, Beta Blockers
  - Class I antiarrhythmics
    - IA - procainamide, quinidine, and disopyramide
    - IC - flecainide and propafenone
  - Class 3 antiarrhythmics (sotalol, amiodarone)

Medical Management of SVT

- Atrial Tachycardia – not very amenable to medical therapy
  - B-blockers
  - Trial of IA or IC antiarrhythmic
- Junctional Tachycardia/MAT
  - Correct underlying metabolic condition/hypoxia
  - Metoprolol, verapamil

Medical Management of WPW

- Antegrade accessory paths with long refractory period pose little risk of life threatening arrhythmia
  - Intermittent Delta wave, disappears with exercise
- Short refractory period more likely to develop rapid arrhythmias
  - Class IC or III antiarrhythmics (prolongs refractory period)
  - May add B-blocker
  - Avoid long term digoxin and calcium channel blocker

Catheter Ablation for SVT

- 1% to 2% incidence of complications
  - stroke, myocardial infarction, cardiac or aortic perforation, aortic valve injury, femoral vein or artery injury, and AV node conduction block
- 1st line therapy for symptomatic patients with accessory pathway
- 2nd line for AVNRT failing Ca-channel and/or B-blocker therapy
- AVNRT – slow path ablation preferred
- Atrial tachycardia difficult to ablate due to variable focus
- Junctional tachycardia, SA node reentrant tachycardia not easily amenable to ablation

Accessory path without symptoms

- Incidental delta wave on EKG
- Low risk of sudden death (1/1000 patient-years)
- No specific therapy unless symptoms develop
  - Exception may be for airline pilots, police officers, and firefighters, high level competitive athletes; may prefer catheter ablation

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.