

EKG Rounds SVT

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Broad Classification of SVT

- AV node dependent
- AV node independent

Classification of Supraventricular Tachycardias

AV Node Independent	AV Node Dependent
<i>Sinus tachycardia</i>	<i>AV node reentry</i>
Appropriate	Slow-fast variant
Inappropriate	Fast-slow variant
Sinus node reentry	
<i>Atrial tachycardia</i>	<i>AV reentrant</i>
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.	

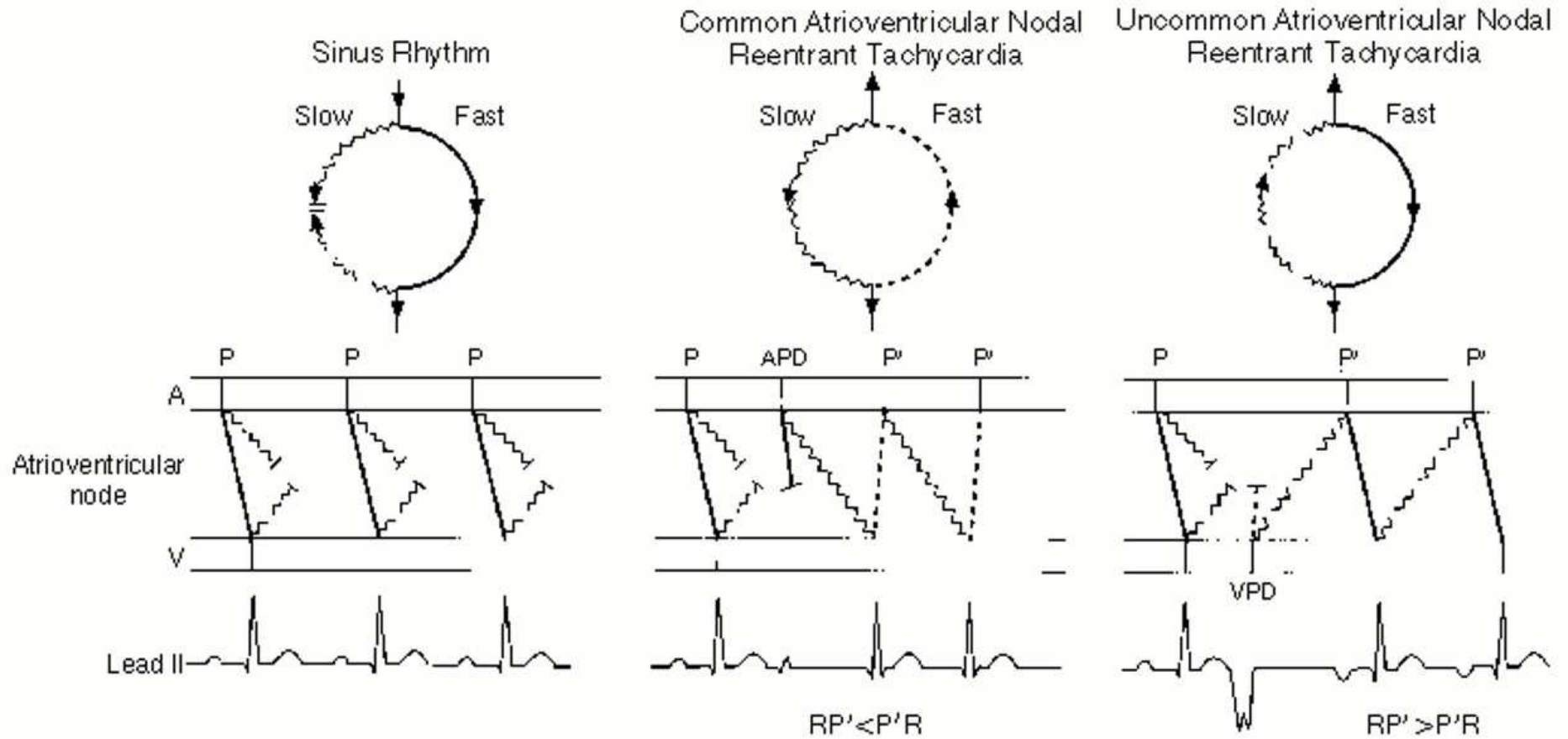
General Mechanism of Nodal Dependent SVT

- 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 Reentrant Tachycardia AVNRT

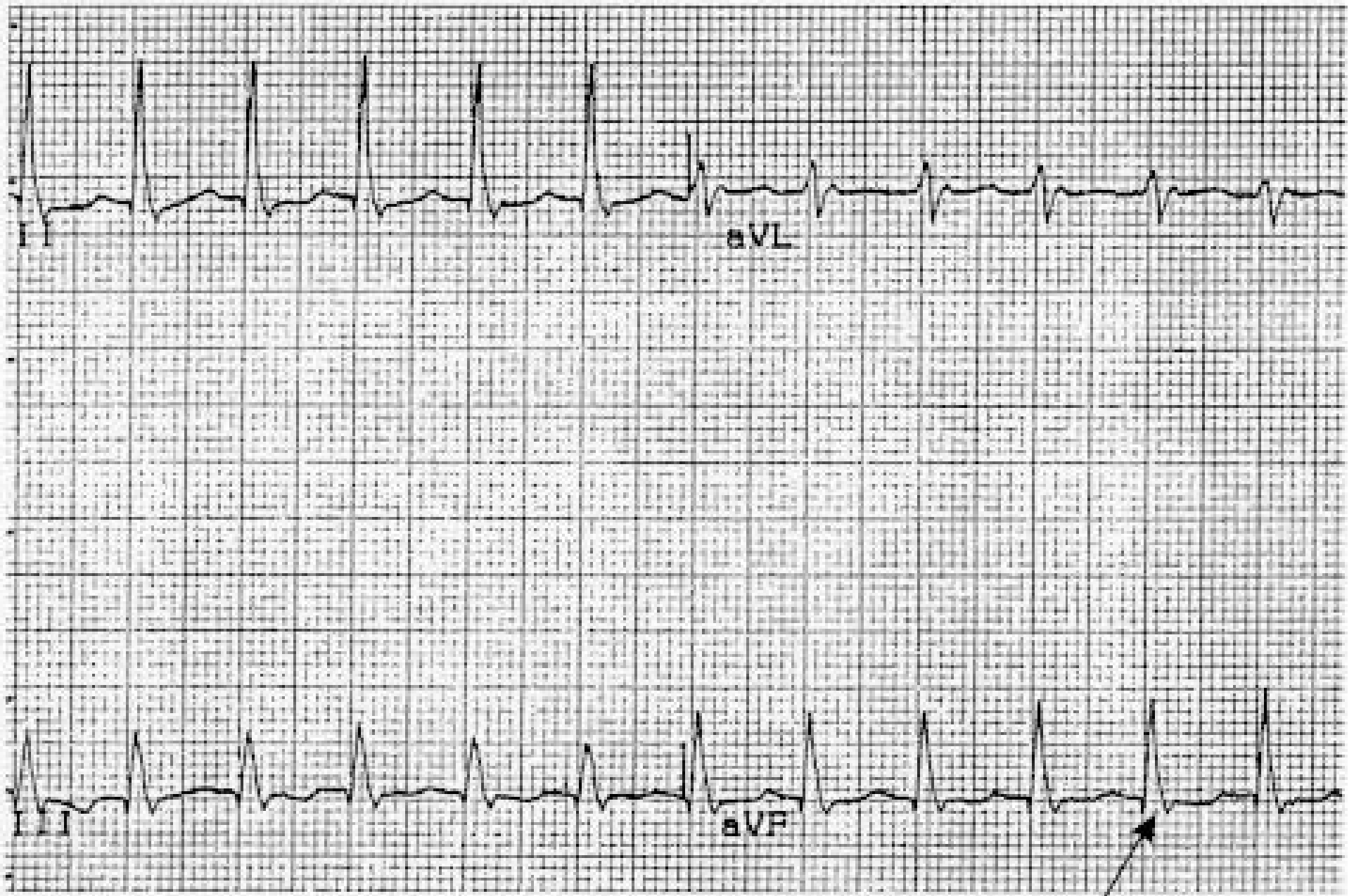
- 60% of all SVT's (most common)
- 70% are female
- Mostly patients age 30-40's
- 90% Typical (Slow-Fast)
 - Antegrade limb has slow conduction, retrograde is fast
- 10% Atypical
 - Fast-Slow
 - Slow-Slow
 - Fast-Fast

AVNRT

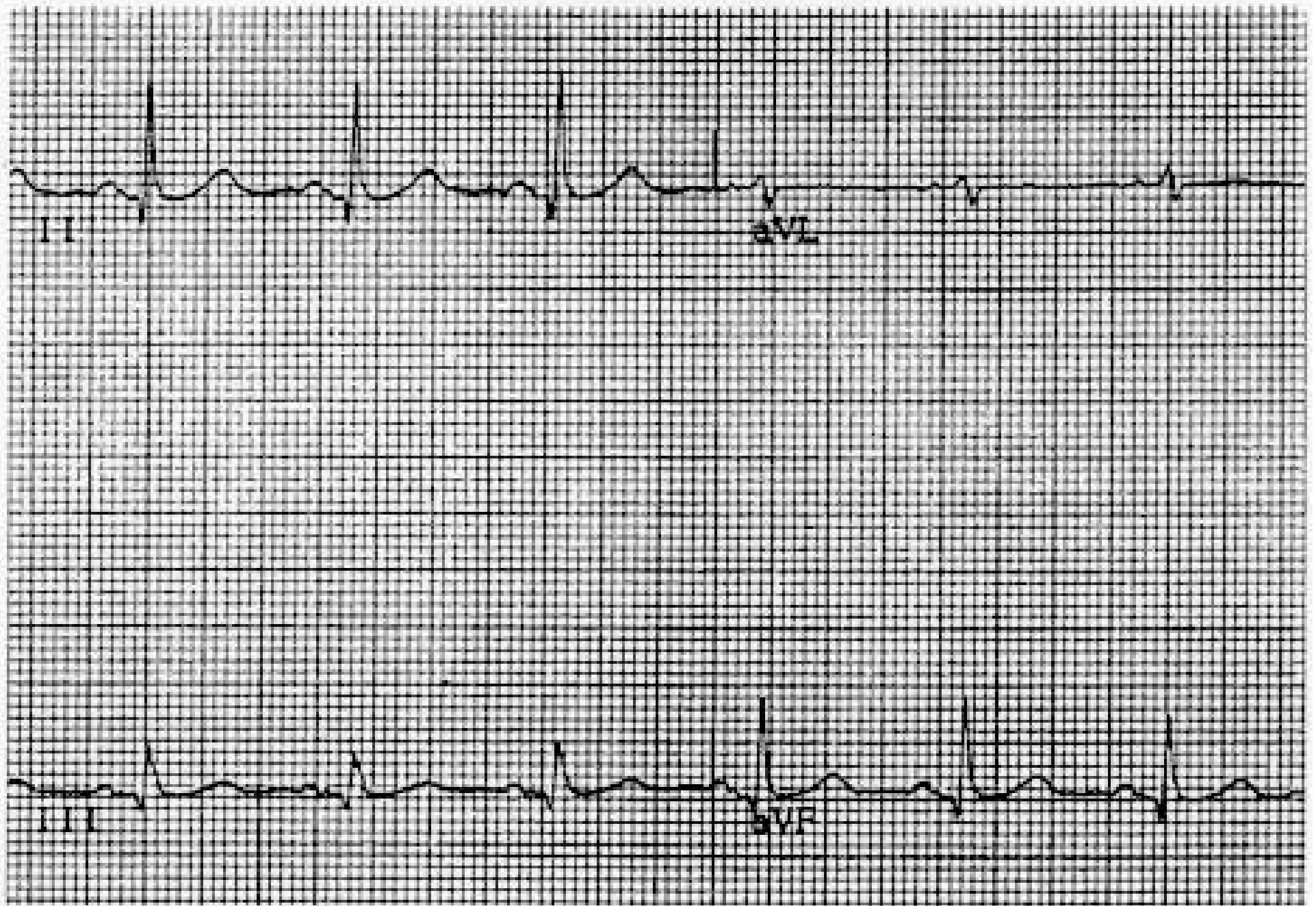


Typical AVNRT

- 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

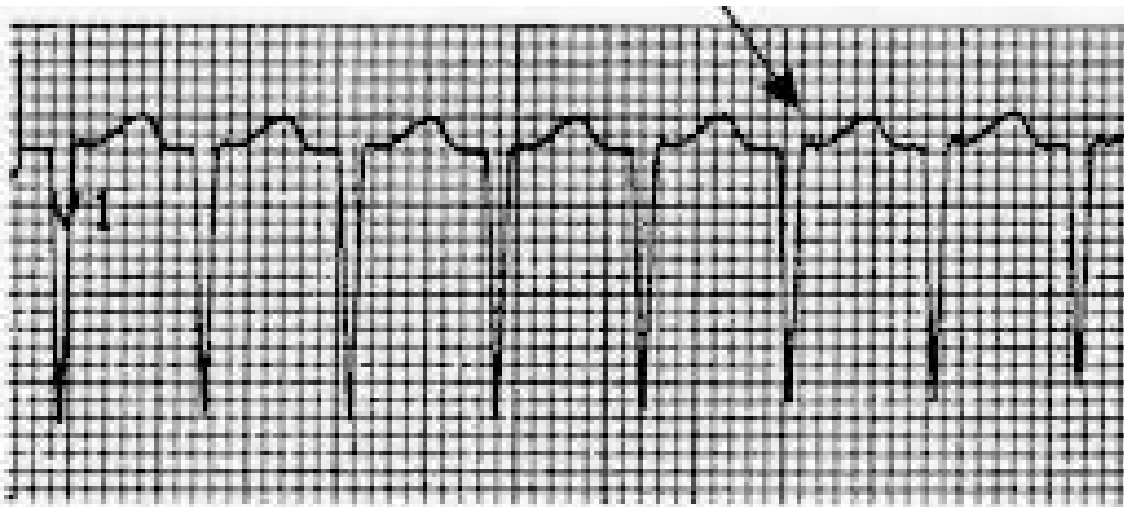


AVNRT with pseudo S wave



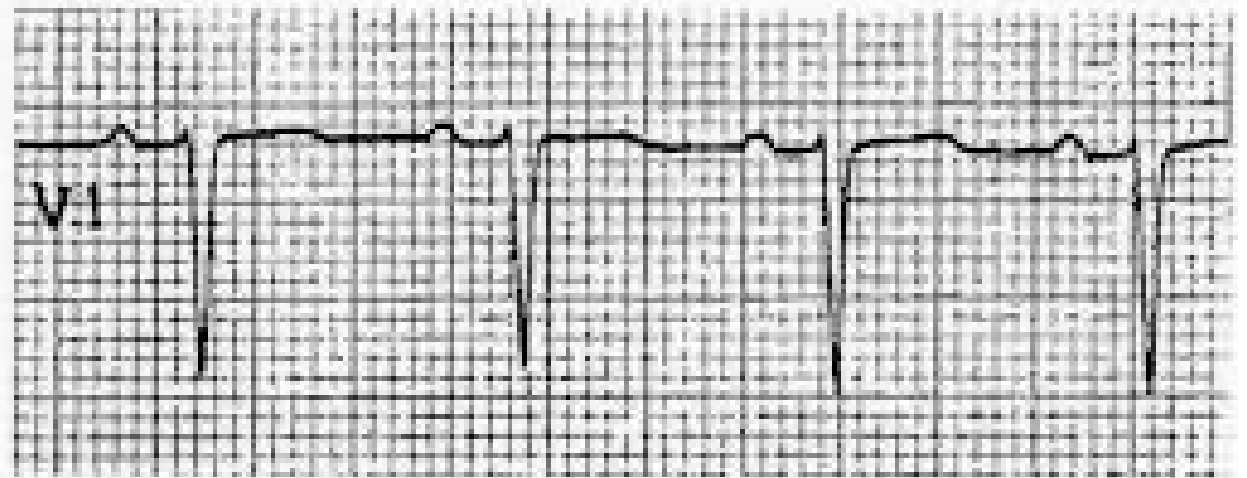
Chauhan

NSR



AVNRT with pseudo R waves

B AVNRT



Sinus Rhythm

AV Reentrant Tachycardia

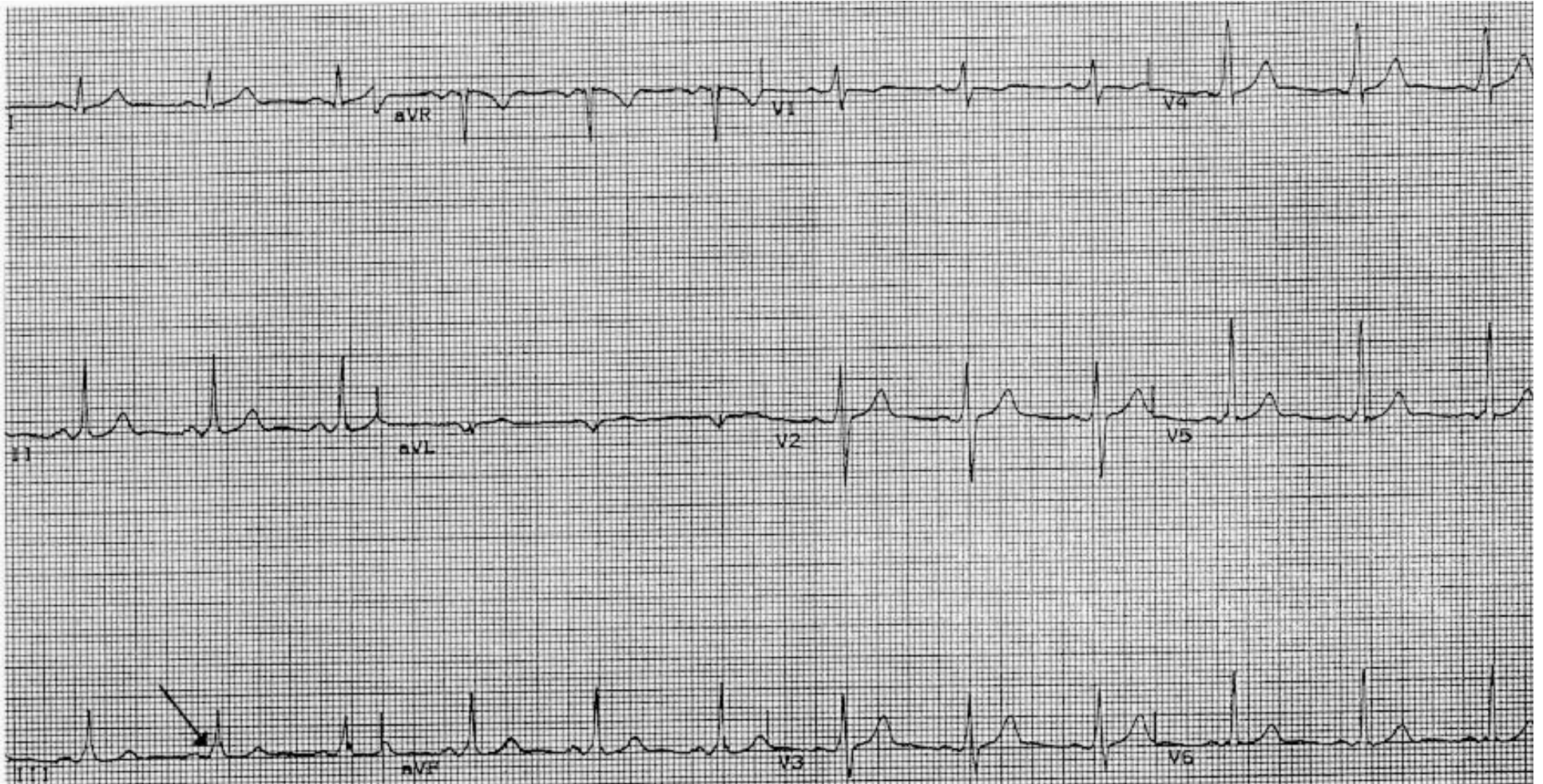
AVRT

- 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 individuals
 - Preexcitation can be modulated by antiarrhythmics, autonomic tone
- Retrograde conduction path (25%)
 - Concealed pathways, not apparent on normal EKG

Accessory Path

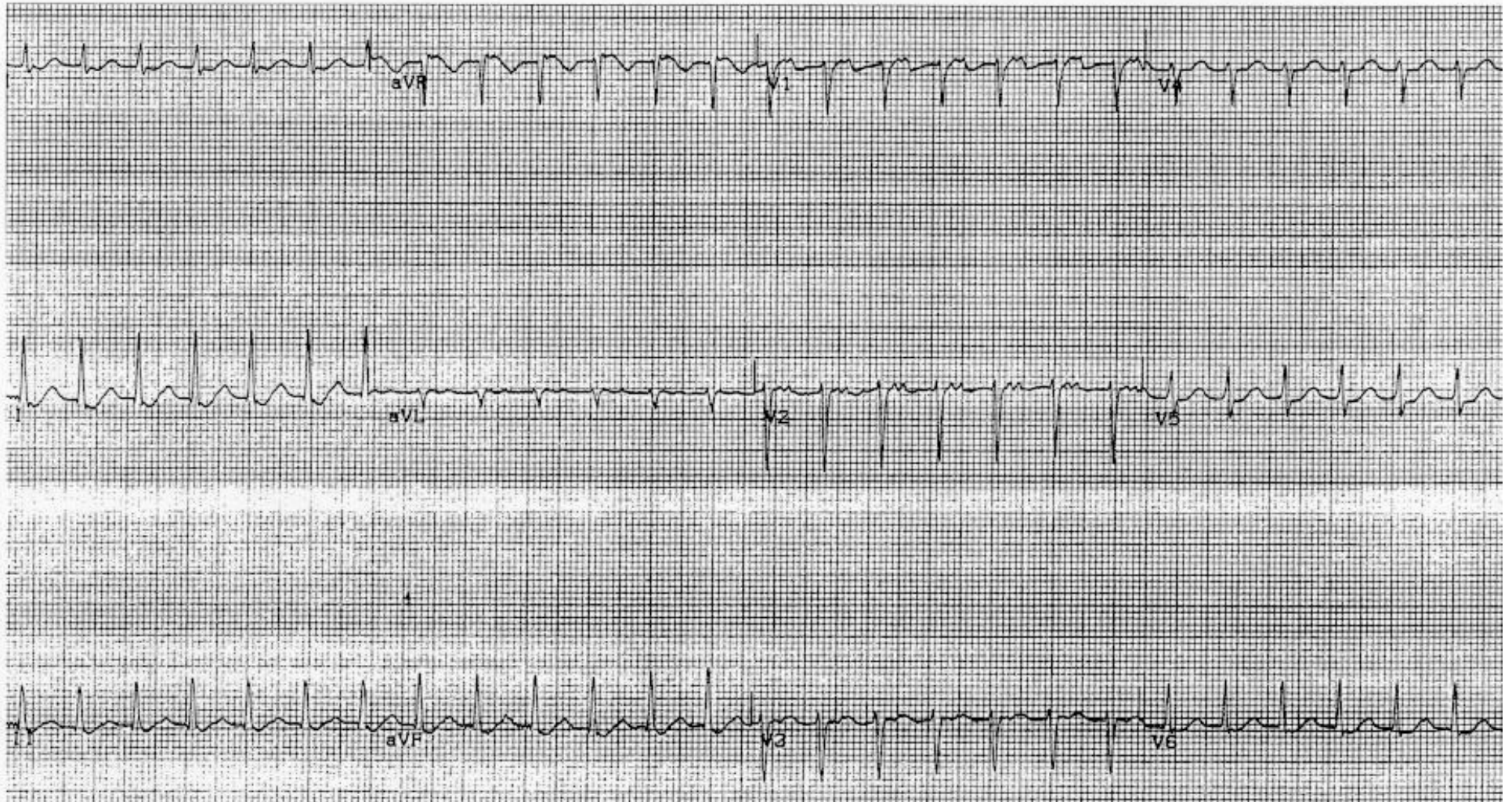


Left lateral accessory pathway with antegrade conduction

Types of AVRT

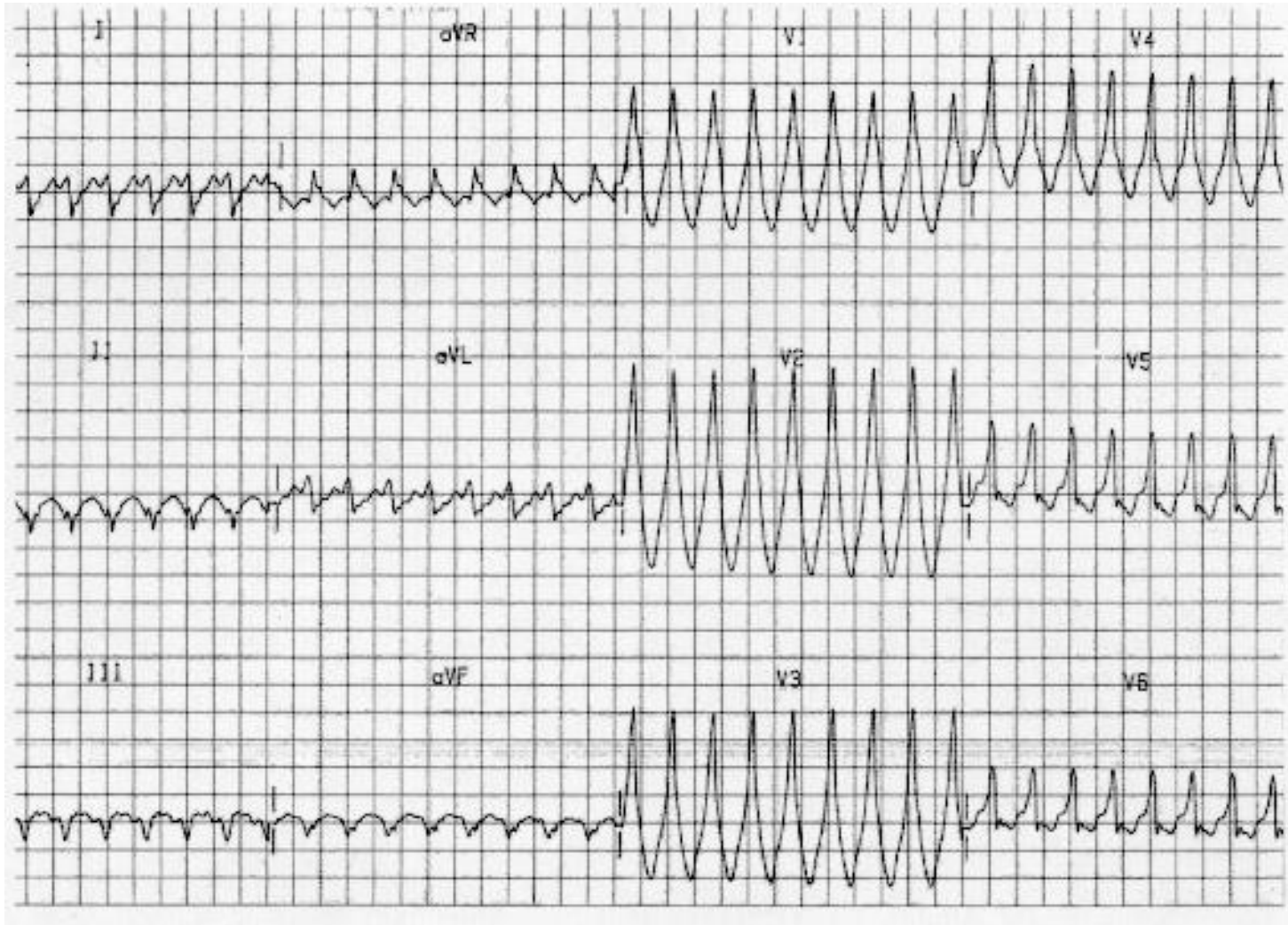
- SVT initiated by PAC or PVC
- Orthodromic AVRT
 - Uses AV node as antegrade limb, accessory path conducts retrograde
 - Common
 - EKG shows no delta wave
- Antidromic AVRT
 - Accessory path is antegrade, AV node retrograde
 - Uncommon
 - EKG shows preexcitation
 - May involve multiple bypass tracts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

Orthodromic AVRT



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

Antidromic AVRT

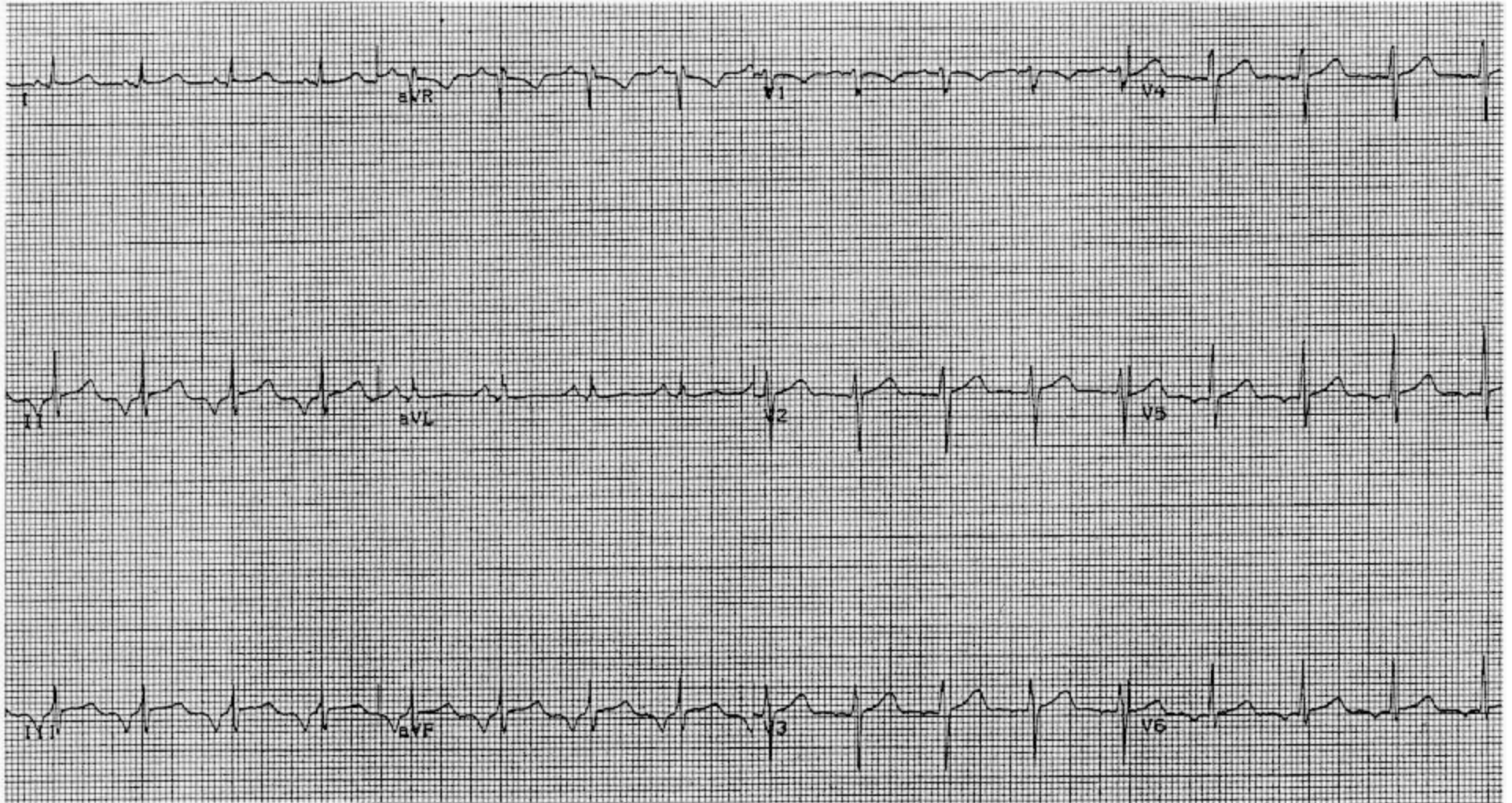


Antegrade conduction from left paraseptal bypass tract,
retrograde conduction through AV node

EKG features

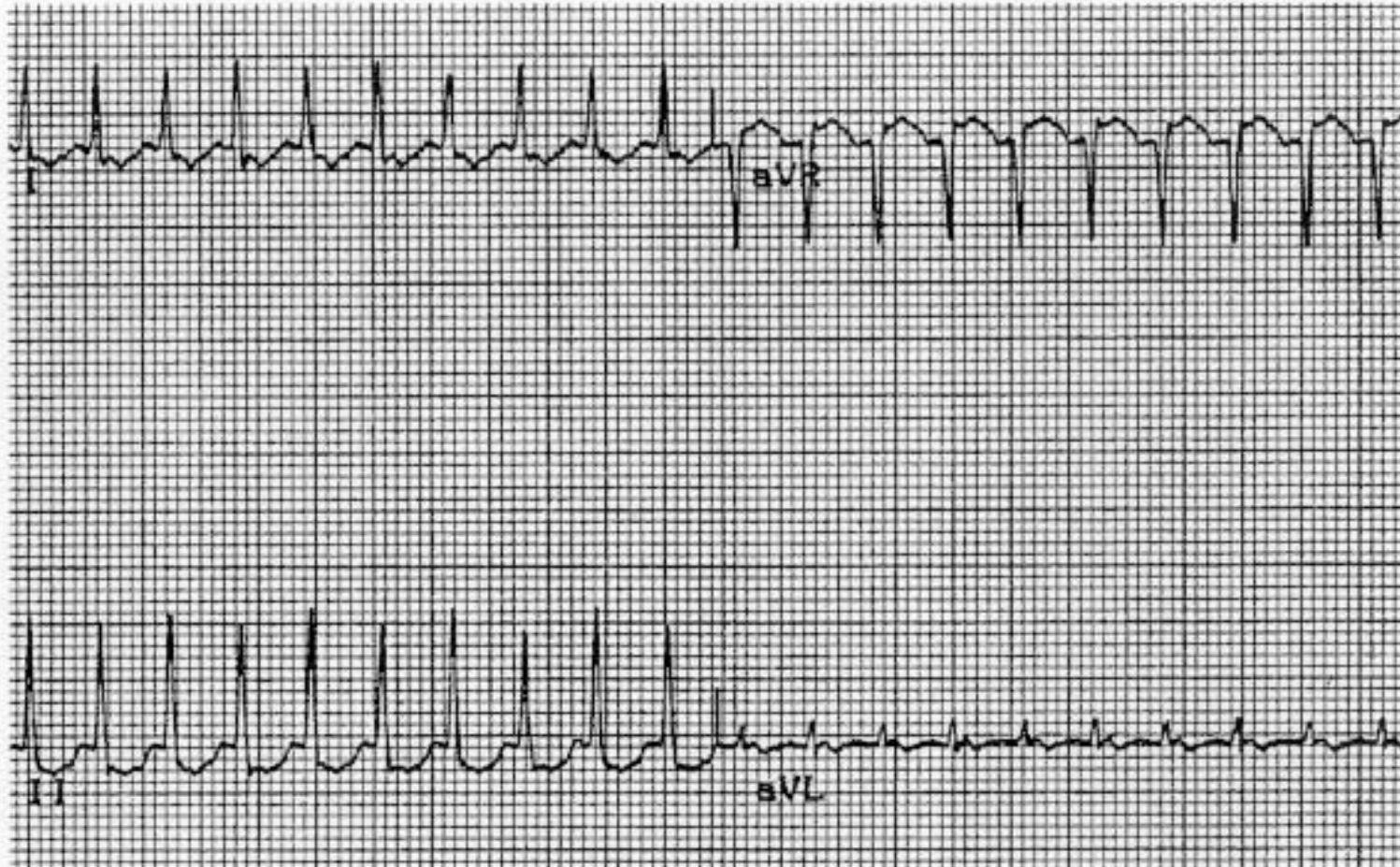
- Orthodromic AVRT
 - Narrow complex
 - P wave appears after QRS ($R-P < P-R$)
 - If slow retrograde accessory path used, then $R-P > P-R$
 - May start spontaneously, termed Permanent Junctional Reciprocating Tachycardia (PJRT)
 - P wave morphology dependent on location of accessory path
 - Negative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

Permanent Junctional Reciprocating Tachycardia



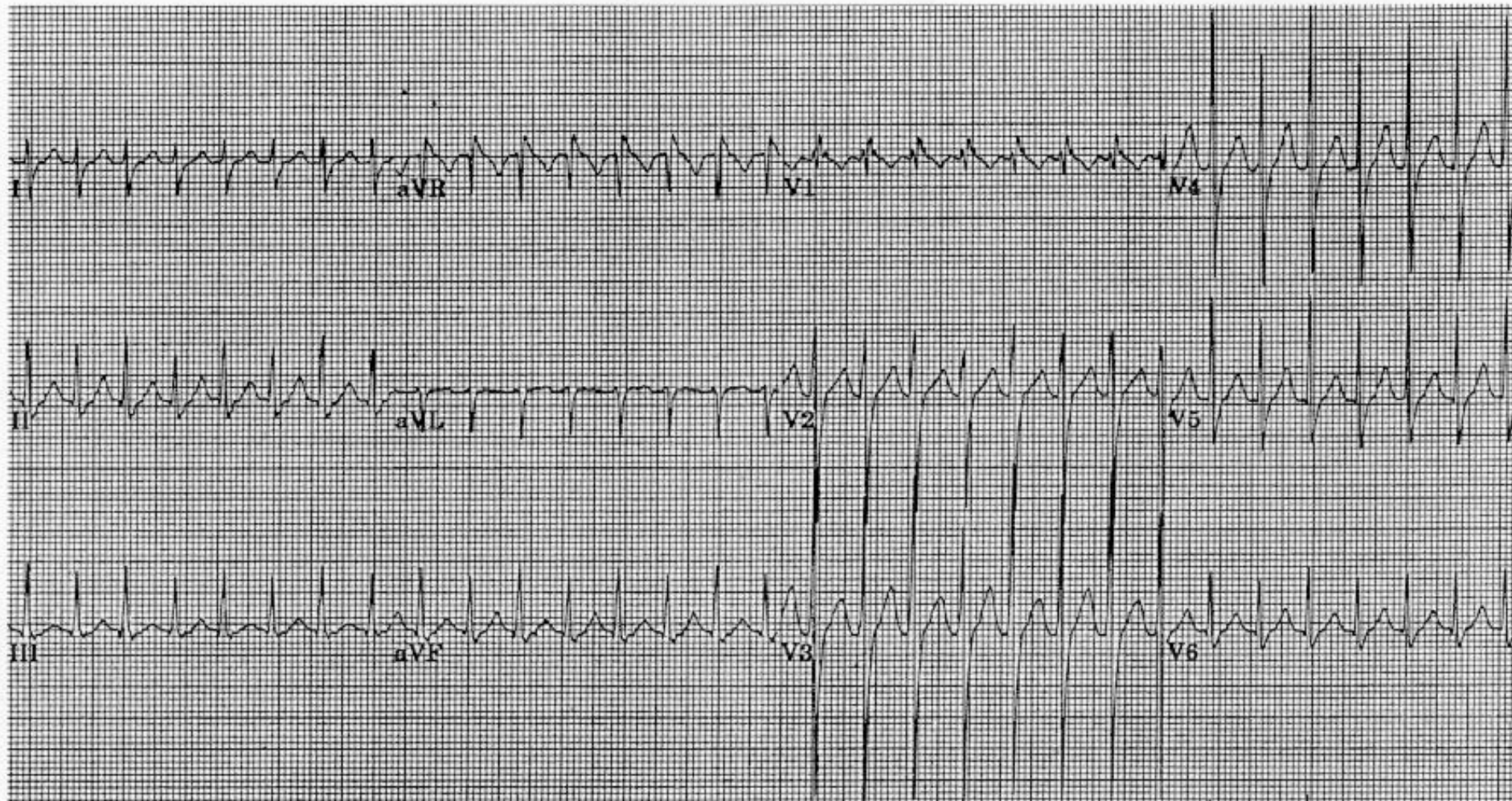
Slowly conducting posteroseptal accessory path creating R-P > P-R
P waves inverted in inferior leads

Orthodromic AVRT with left sided accessory path



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

Orthodromic AVRT with QRS alternans



QRS alternans in lead II and V4

Junctional Tachycardia

- In infants <6 months, poor prognosis
- In adults, generally benign prognosis
- Enhanced automaticity or triggered activity
 - Acute phase of myocardial infarction
 - Digitalis toxicity
 - Acute myocarditis
 - Post cardiac surgery (peri-nodal trauma)
- Irregular rate
- Retrograde atrial activation

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

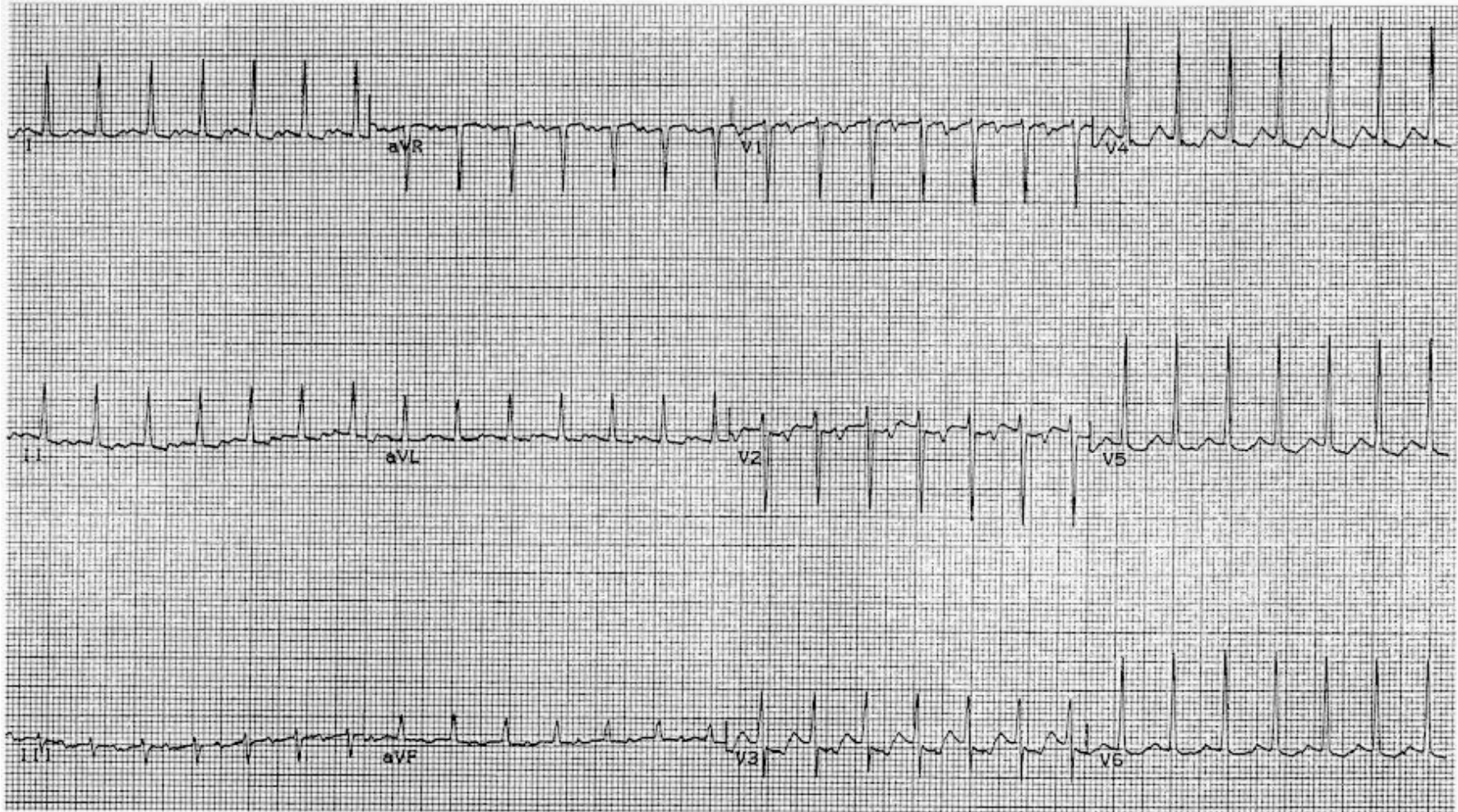
Atrial Tachycardia

- About 15% of SVT's
- Usually single tachycardic focus
 - Local reentry common with atrial dilatation 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)

Locus of Atrial Tachycardia

- Positive P in V1 = Left atrial focus
- Positive or biphasic P in aVL = Right atrial
- Inferior leads
 - Positive = superior focus
 - Negative = inferior focus
- Atrial tachycardia has isoelectric baseline, unlike Atrial Fibrillation

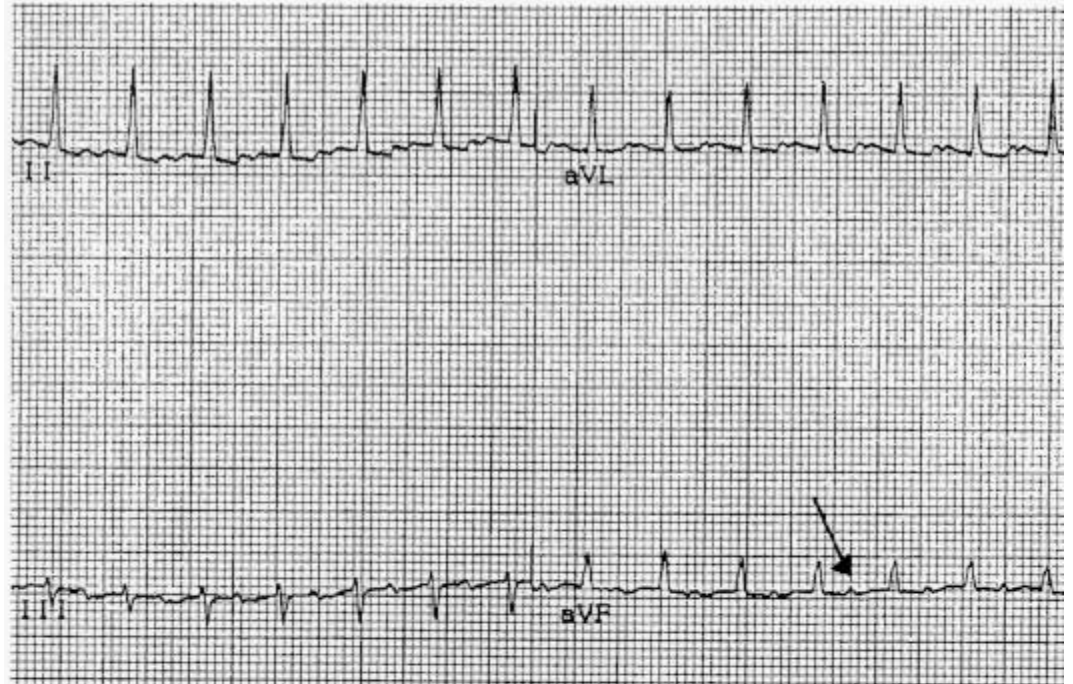
Atrial Tachycardia



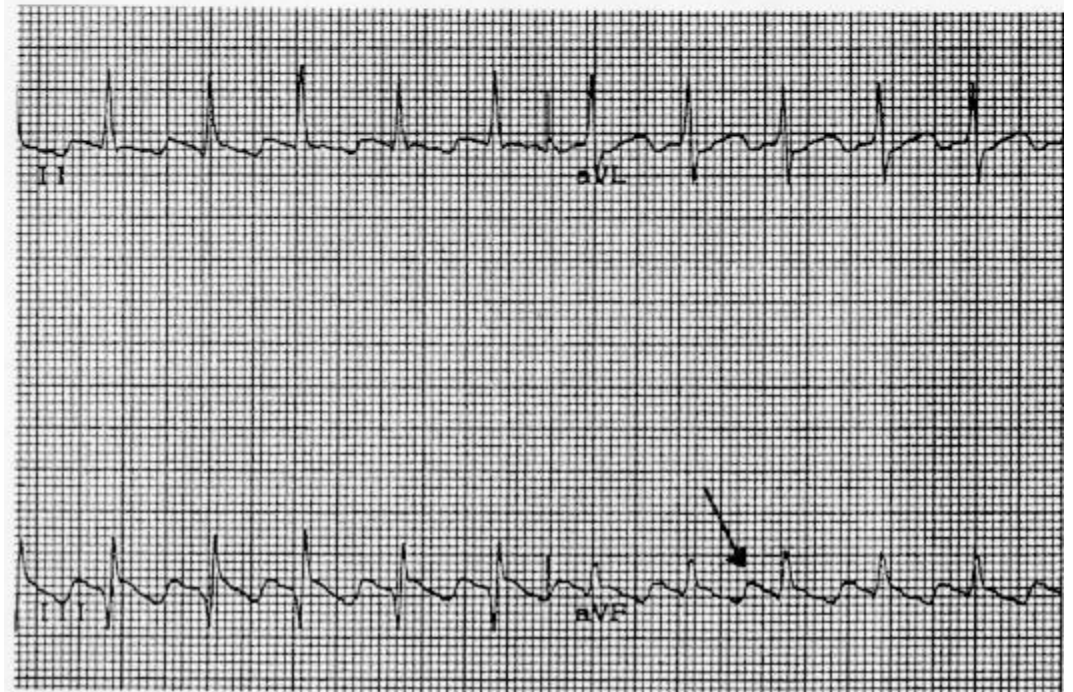
Atrial tachycardia initiating from superior right atrium

ATach vs AFlutter

Atrial tachycardia with
isoelectric baseline



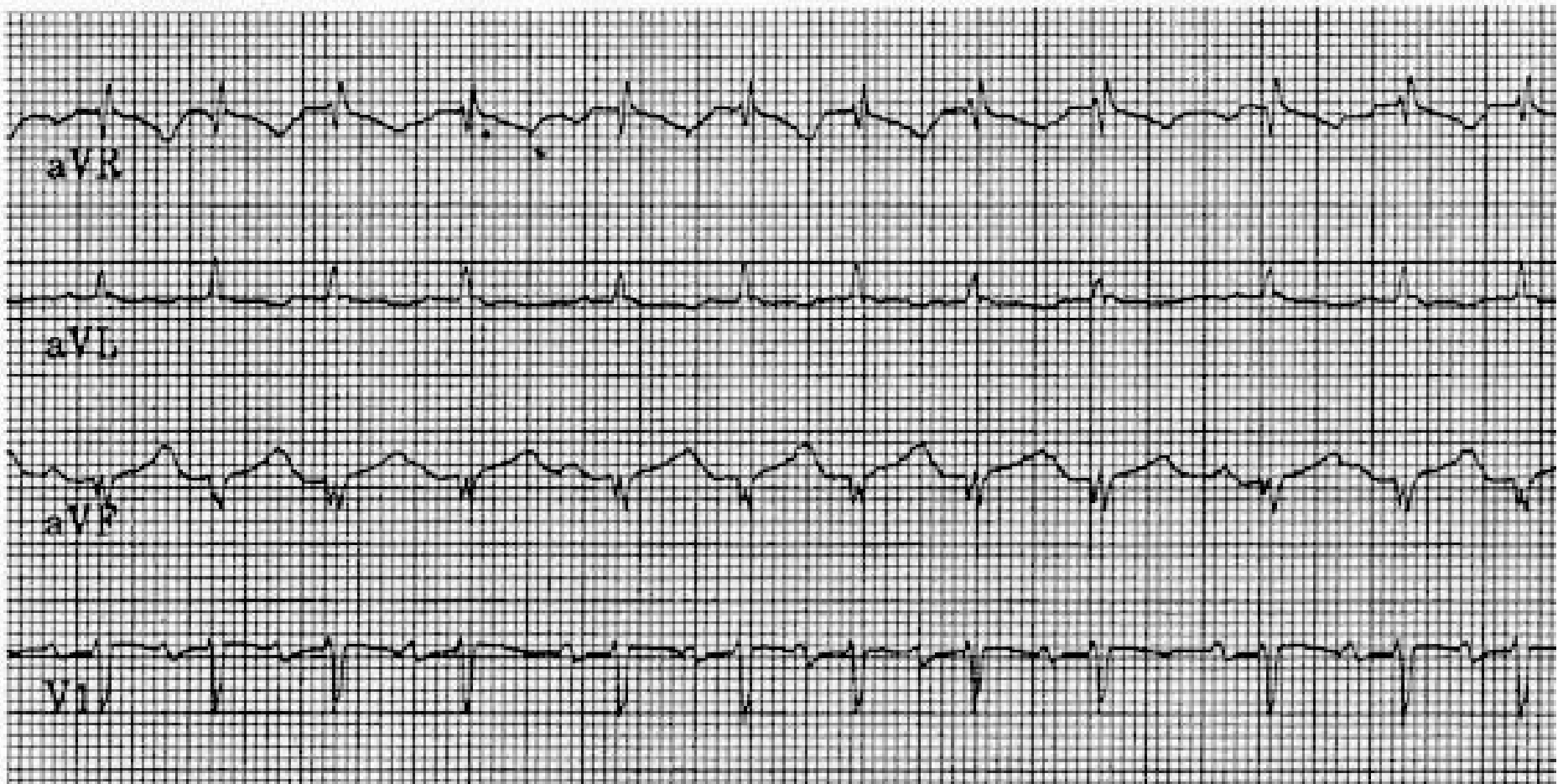
Atrial Flutter with F
waves, no baseline



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

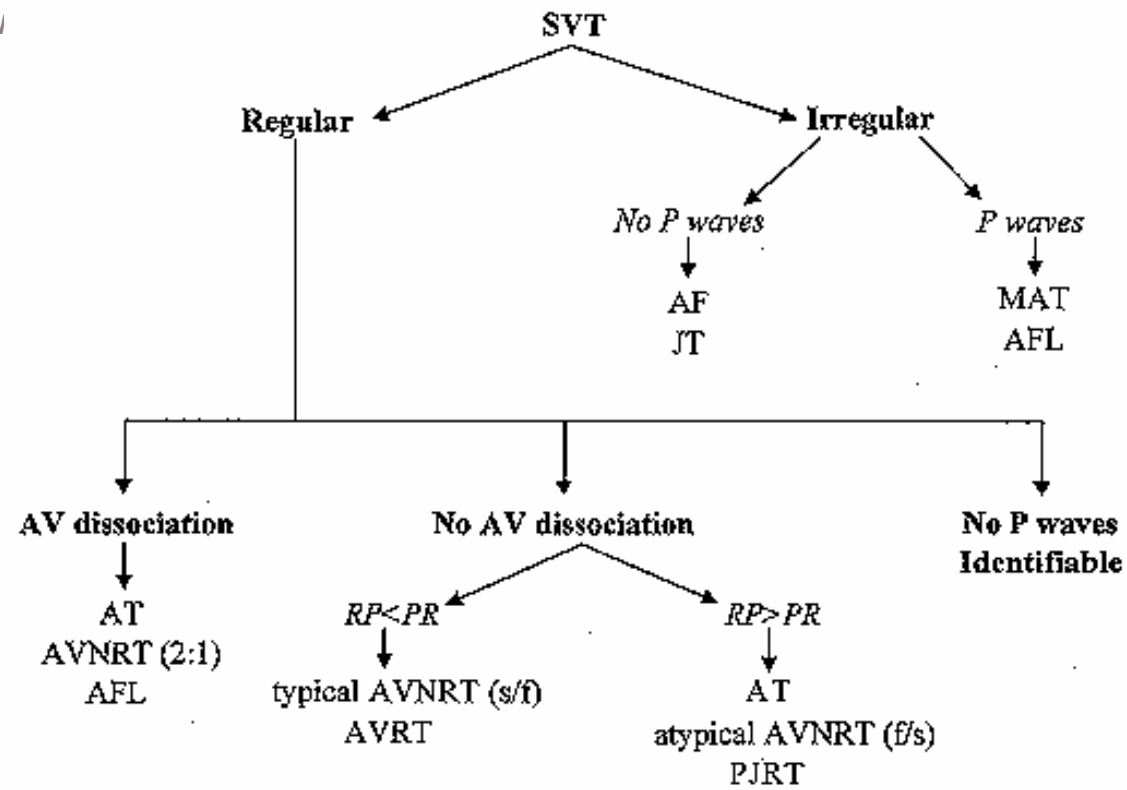


Sinus Tachycardia

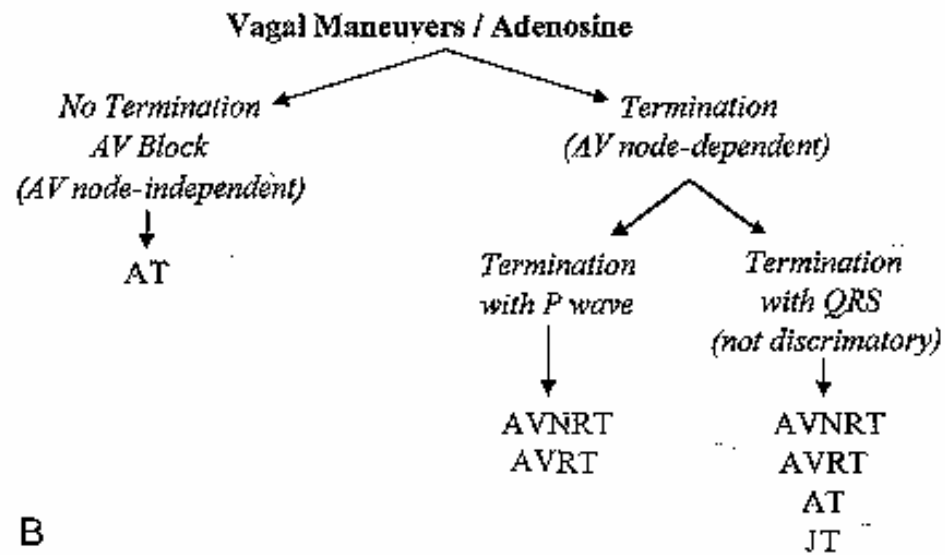
- Sinus node reentry
 - Caused by PAC
 - Abrupt onset and cessation
 - Usually nonsustained and slower than inappropriate sinus tachycardia
 - Breaks with adenosine
- Inappropriate sinus tachycardia
 - Rule out causes of tachycardia
 - Anemia
 - Hyperthyroidism
 - Pheochromocytoma
 - Diabetes with autonomic 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



A



B

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

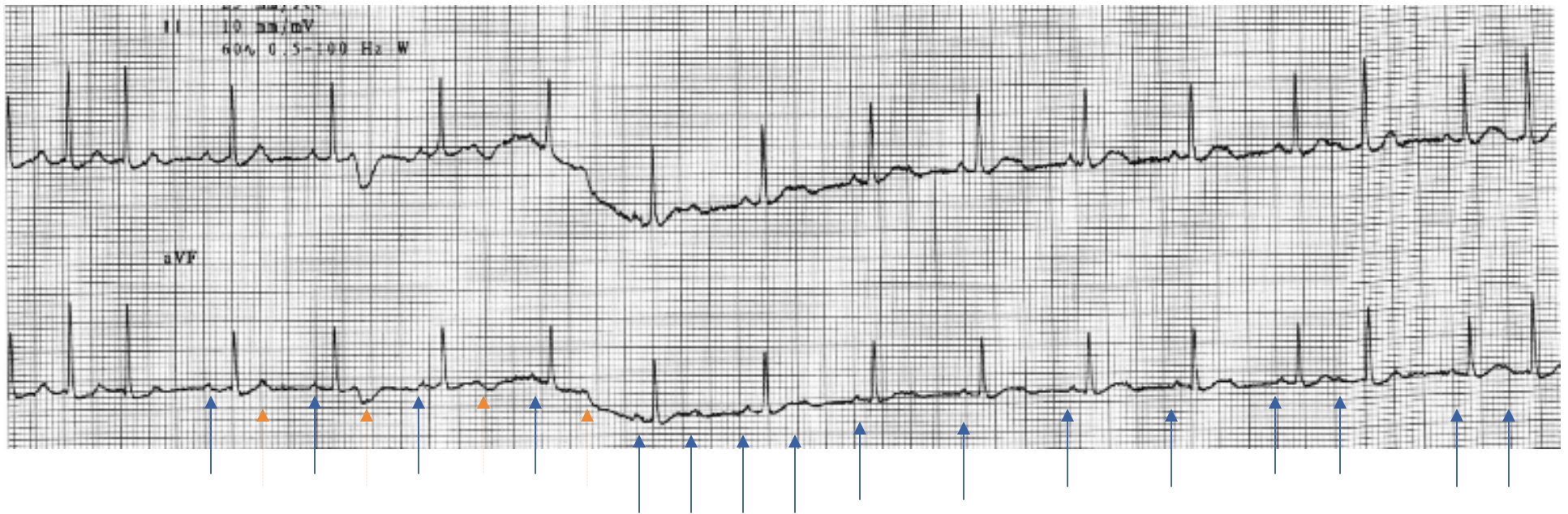
- Vagal Maneuvers (Valsalva, Carotid Massage)
- AV blocking drugs (Adenosine, Verapamil)
- AV node dependent tachycardias will break
 - If SVT terminates with a P wave then it is AVNRT or AVRT
 - If it terminates with a QRS, this is not discriminatory
- If it doesn't break with above maneuvers it is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