I THINK CHARLIE BROWNS DOPING...
EKG Rounds
SVT

David Stultz, MD
Cardiology Fellow, PGY 4
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Broad Classification of SVT

- AV node dependent
- AV node independent
## Classification of Supraventricular Tachycardias

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*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

Sinus Rhythm

Common Atrioventricular Nodal Reentrant Tachycardia

Uncommon Atrioventricular Nodal Reentrant Tachycardia

Slow
Fast

Atrioventricular node

Lead II

Ganz
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
AVNRT with pseudo S wave

Chauhan
AVNRT with pseudo R waves

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 antiarrythmics, autonomic tone

• Retrograde conduction path (25%)
  – Concealed pathways, not apparent on normal EKG
Accessory Path

Left lateral accessory pathway with antegrade conduction

Chauhan
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

Chauhan
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

Chauhan
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 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)
Locus of Atrial Tachycardia

- Positive P in V1 = Left atrial focus
- Positive or biphasic P in aVL = Right atrial focus
- Inferior leads
  - Positive = superior focus
  - Negative = inferior focus

- Atach has isoelectric baseline, unlike Afib
Atrial Tachycardia

Atrial tachycardia initiating from superior right atrium

Chauhan
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
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
SVT

Regular

No P waves
AF
JT

P waves
MAT
AFL

Irregular

No AV dissociation

RP<PR

typical AVNRT (s/f)
AVRT

RP>PR

AT
atypical AVNRT (f/s)
PJRT

AV dissociation

AT
AVNRT (2:1)
AFL

Vagal Maneuvers / Adenosine

No Termination
AV Block
(AV node-independent)

AT

Termination
(AV node-dependent)

Termination with P wave
AVNRT

Termination with QRS
(not discriminatory)
AVNRT
AVRT
AT
JT
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
