Supraventricular Tachycardia

Topics in Cardiovascular Care
Lancaster General Health

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Disclosures

• Honoraria for Educational Programs:
  – Medtronic
  – St. Jude Medical
  – Biotronik
  – Aurora Health Care

Tachycardia

• Heart rate > 100 bpm
• Narrow Complex = QRS < 120ms
• Wide Complex = QRS ≥ 120ms

24 year old woman with recurrent palpitations. You should give:
A. IV Metoprolol
B. IV Adenosine
C. Reassurance
D. IV fluids
E. DC cardioversion

SVT

• Narrow Complex Tachycardia (NCT)
  – Mechanisms
  – Diagnostic approach
  – Management

Normal Cardiac Conduction System
Normal Sinus Rhythm

Narrow Complex Tachycardia
- Must involve the atrium or AV node (supraventricular)
- Must use normal conduction system of the heart
- Can arise from:
  - Abnormal automaticity
  - Triggered activity
  - Re-entry circuit

Mechanisms of NCT

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Inappropriate Sinus Tachycardia
- Accelerated baseline sinus rate in the absence of a physiological stressor
- Most commonly in young women without structural heart disease
- Other causes of sinus tachycardia must be excluded

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Premature Atrial Contractions (PAC)
- Atrial bigeminy
Atrial Tachycardia
- Can be single rapidly firing focus in atrium, or small re-entry circuit in atrium
- Heart rates range from 120-200 bpm
- Can be seen with prior surgery or catheter ablation
- Commonly seen with digitalis toxicity

Atrial Tachycardia (ECG)
- Single P wave morphology that looks different than sinus P wave (unless originating near the SA node)
- Abrupt onset and termination
- Discrete P waves with isoelectric period between them (as opposed to atrial flutter)

Atrial Tachycardia

Multifocal Atrial Tachycardia
- Multiple (≥3) competing loci in atrium
- Irregularly irregular (no pattern)
- Atrial rate usually 100 – 180 bpm
- Visible P waves with different morphologies, different P-P and P-R intervals
- Often seen with chronic lung conditions

Multifocal Atrial Tachycardia

Atrial Fibrillation
- Most common cardiac arrhythmia
- Rapid and disorganized atrial impulses
- Irregular conduction through AV node leads to RR intervals with no pattern = “irregularly irregular”
Atrial Fibrillation

Fibrillatory activity

Sinus P wave

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Junctional Ectopic Tachycardia

- Caused by sudden rapid pacing of an automatic focus in the AV Junction
- 150-250 Beats per minute
- May also see retrograde P-waves immediately before, after, or buried in QRS

Re-Entry Circuits

- Electrical impulse travels in a tight circle within the heart, leading to fast heart rates
- Requires:
  - 2 different refractory periods
  - Zone of slow conduction
- Premature beat typically initiates the cycle

Sinus Node Reentrant Tachycardia (SNRT)

- A subset of focal atrial tachycardia due to reentry arising within the sinus node
- The P waves are identical to sinus tachycardia
- Abrupt onset and termination
- Atrial rate usually 100-150 bpm
- Unable to distinguish from sinus tachycardia on ECG unless onset/termination seen
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### Atrial Flutter

- Caused by re-entrant rhythm, typically in the right atrium around cavo-tricuspid isthmus
- Typical atrial rate is 240-300 bpm
- “F waves” are seen on ECG: rapid, negative sawtooth atrial waves without isoelectric intervals between them

![F waves](image1.png)

### Typical Atrial Flutter

![ECG.png](image2.png)

### AV Nodal Reentrant Tachycardia (AVNRT)

- Most common form of reentrant SVT; 60% of all paroxysmal SVT patients; more common in women
- Usually between 150-250 bpm
- Requires “dual AV nodal physiology”
AV Nodal Reentry Tachycardia (AVNRT)

- P waves typically buried in QRS or shortly after (can appear as pseudo R' in V1, or pseudo S wave in II, III, aVF)
- Due to nearly simultaneous activation of atria and ventricles (impulse travels up fast pathway)

Atypical AVNRT

- Reentry circuit in AV node with anterograde conduction via fast pathway and retrograde conduction via slow pathway
- P waves often visible because of delay traveling up slow pathway

Orthodromic Reciprocating Tachycardia (ORT)

- Second most common form of paroxysmal SVT; more common in men
- Requires accessory pathway that connects atrium and ventricle, allowing bypass of the AV node
Accessory Pathway

- Atrioventricular bypass tract is known as the Bundle of Kent (conduction can occur anterograde, retrograde, or both)
- During sinus rhythm, anterograde conduction down accessory pathway leads to ventricular “pre-excitation”
  - Short PR interval
  - Delta wave
  - Widened QRS

Orthodromic Reciprocating Tachycardia (ORT)

- Reentry circuit is established by conduction traveling anterograde through the AV node and retrograde through the accessory pathway
- Retrograde P wave usually falls after QRS complex

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  - Diagnostic approach
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NCT Evaluation

Key: Is the rhythm regular?

Regular NCT

- If regular, can be due to:
  - Single rapidly firing focus
  - Reentry rhythm
- Find the P-waves!
- Key point: determine if sinus tachycardia

Irregular NCT

- If QRS’s are irregular, can be due to:
  - Multiple rapidly firing foci (MAT, AF)
  - Any regular NCT with variable AV conduction
- Find the P-waves!
- Key point: determine if atrial fibrillation or MAT

Irregular NCT

- Atrial rhythm is regular (300 bpm)
- Atrial flutter with variable conduction
NCT Diagnosis Approach

- If either:
  - Regular rhythm, but not sinus tachycardia
  - Irregular rhythm, but not AF/MAT
  - Slow conduction through AV node to help with diagnosis
    - Atrial activity can be better visualized
    - Re-entry circuits that involve the AV node will be terminated
- Vagal maneuvers:
  - Carotid sinus massage
  - Valsalva
- Pharmacologic: adenosine

Adenosine

- Most potent AV nodal blocker
- Very short half-life (10-20 seconds)
- Give 6mg, 12mg, 12mg as rapid push with saline flush
- Typical side effects include flushing, chest pain, and dizziness – warn the patient!
- Contraindicated in asthma or severe COPD
- You should always get transient AV block – if not, enough adenosine did not get to the AV node
- Will terminate AVNRT or AVRT 90% of the time
- Does not terminate atrial fibrillation or MAT

SVT

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Initial Triage

Step 1:
Stable or Unstable?

- AF/MAT
- All others
- Rate Control

- Regular
- Sinus Tachycardia
- Atrial fibrillation

- Wide Complex
  - Rate Control
  - Valsalva
  - Carotid sinus massage

- Narrow Complex
  - Rate Control
  - Adenosine
  - Valsalva
  - Carotid sinus massage

Initial Triage

Work-up of NCT

- Comprehensive history and physical exam
- Consider:
  - Thyroid function testing (hyper or hypothyroidism)
  - Electrolyte testing (potassium and magnesium)
  - Hemoglobin measurement (anemia)
  - Cardiac biomarkers (in at risk patients)
  - Digoxin level (if prescribed)
  - Echocardiogram (to rule out structural heart disease)
  - Chest x-ray (cardiomegaly, pulmonary disease, edema)
Chronic Management: Re-entry Circuits

- For large reentry circuits, catheter ablation can be curative:
  - Atrial flutter
  - AVNRT
  - Accessory pathway (AVRT)
- Anti-arrhythmic therapy may be useful as well
- For infrequent AVNRT, teaching patient vagal maneuvers may be adequate

Chronic Management: Rapidly Firing Foci

- For rapidly firing foci:
  - Treat underlying cause
  - Catheter ablation
  - Antiarrhythmics can be useful
  - Rate control

24 year old woman with recurrent palpitations. You should give:
A. IV Metoprolol
B. IV Adenosine
C. Reassurance
D. IV fluids
E. DC cardioversion

54 year old man with no PMH and new onset dyspnea, fatigue. You suggest:
A. Cavotricuspid isthmus ablation
B. Pulmonary vein isolation
C. Amiodarone/cardioversion
D. Flecainide 100mg BID with Metoprolol ER 25mg daily
E. Metoprolol XL 100mg

84 year old man with recent long hospitalization for sacral decubitus ulcers, presents with acute onset dyspnea and chest pain. BP 80/50. You suggest:
A. Adenosine
B. Emergent cardioversion
C. Amiodarone
D. Metoprolol 5mg IV push x 3
E. IV fluids