Management of Supraventricular Arrhythmias

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Narrow-complex Tachycardias
Narrow-complex Tachycardias

- Rate > 100 beats per minute
- QRS duration < 120 msec
Narrow-complex Tachycardias

Originate in the atria (or adjoining veins) or

Depend on the AV junction
Narrow-complex tachycardias

- **Atrial**
  - Sinus tachycardia
  - Inappropriate sinus tachycardia
  - Sinus node reentrant tachycardia
  - Atrial fibrillation
  - Atrial flutter
  - Atrial tachycardia
  - Multifocal atrial tachycardia

- **AV junction**
  - AV nodal reentrant tachycardia (AVNRT)
  - AV reciprocating tachycardia (AVRT) (accessory pathway)
  - Junctional ectopic tachycardia
  - Non-paroxysmal junctional tachycardia
Narrow-complex Tachycardias

a systematic approach

- Review the clinical data
- Recognize at first glance
- Find the P wave
- Match P’s and QRS’s
- Pinpoint the diagnosis
- Confirm
Narrow-complex Tachycardias

recognize at first glance
Narrow-complex Tachycardias recognize at first glance

19-year-old asthmatic woman with extreme dyspnea
Sinus Tachycardia

recognize at first glance

- The most common ‘SVT’
- Overall P wave axis & morphology normal.
- Atrial rate 100-200.
- 1:1 P-to-QRS relationship
- Short PR interval (*high catecholamine tone*)
- Underlying condition, not rhythm, must be addressed (*e.g., beta-blockade deleterious in this case*)

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19-year-old asthmatic woman with extreme dyspnea
Keep in mind:
uncommon but similar

- Inappropriate sinus tachycardia
  - Persistently increased resting sinus rate
  - Exaggerated sinus response to physiologic exercise or emotion

- Sinus node reentrant tachycardia
  - Basis: inhomogeneity of conduction within the sinus node
  - Paroxysmal, can be induced and terminated by premature atrial stimuli
  - Vagal- & adenosine-responsive
Narrow-complex tachycardias
recognize at first glance

ATRIAL FIBRILLATION
Atrial Fibrillation

- Results from multiple reentrant atrial wavelets
- Often no discernable P waves
- Atrial rate ~ 300-600
- Atrial rate >> ventricular rate
- Irregularly irregular ventricular response
Narrow-complex tachycardias recognize at first glance (cont’d)

- **Atrial fibrillation**
  - *The most common sustained arrhythmia (~0.4% of general population, ~2.2 million Americans)*
  - *May accompany structural heart disease*
Narrow-complex tachycardias recognize at first glance (cont’d)
Narrow-complex tachycardias recognize at first glance (cont’d)

ATRIAL FLUTTER

- Usually result of single large reentrant circuit
- Atrial rate ~250-350
- Atrial rate > ventricular rate
- AV block may vary (e.g. 2:1, 4:1)
Narrow-complex tachycardias recognize at first glance (cont’d)

Typical atrial flutter (counter-clockwise)

Negative flutter waves II, III, aVF
Narrow-complex tachycardias recognize at first glance (cont’d)

Atypical atrial flutter (clockwise)

Positive flutter waves II, III, aVF
Major SVT types

AV Nodal Reentrant Tachycardia (AVNRT)

AV Reciprocating Tachycardia (AVRT)

Atrial Tachycardia

accessory pathway
Narrow-complex tachycardias

* a systematic approach *

- Review the clinical data
- Recognize at first glance
- Find the P wave
- Match P’s and QRS’s
- Pinpoint the diagnosis
- Confirm
Differential Diagnosis for Narrow QRS tachycardia

- REGULAR OR IRREGULAR
- RATE OF THE TACHYCARDIA
- P WAVES: VISIBLE OR INVISIBLE
  - LONG RP OR SHORT RP TACHYCARDIA
<table>
<thead>
<tr>
<th>ECG</th>
<th>Supraventricular tachycardia</th>
</tr>
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<tbody>
<tr>
<td><img src="image" alt="ECG" /></td>
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<td>Short RP Interval</td>
</tr>
<tr>
<td><img src="image" alt="ECG" /></td>
<td>Atypical AVNRT</td>
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</table>

- **No P wave**
- **Short RP Interval**
- **Long RP interval**
- **P-R**
- **R-P**
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<td><img src="image" alt="Long RP interval" /></td>
<td>Atypical AVNRT</td>
</tr>
<tr>
<td></td>
<td>Slow conduction accessory pathway</td>
</tr>
<tr>
<td></td>
<td>Atrial tachycardia</td>
</tr>
</tbody>
</table>
RP Classification of SVTs

- Typical AVNRT
- AVRT (*accessory pathway*)
- Non-paroxysmal junctional tachycardia

Short RP ($RP<PR$)

- Sinus tachycardia
- Sinus node reentry
- Atrial tachycardia
- Atypical AVNRT
- Permanent junctional reciprocating tachycardia (*PJRT*)
- Non-paroxysmal junctional tachycardia

Long RP ($RP>PR$)
32-year-old with recurrent palpitations

AV NODAL REENTRANT TACHYCARDIA (AVNRT)
Typical AV nodal reentrant tachycardia (AVNRT)

- Occurs at any age ($F>M$)
- Short VA time ($<90ms$)
- Pseudo R’ or no visible P wave (*buried in QRS*)
- Atrial rate ~150-250
- 1:1 P-to-QRS
- No delta wave
- Adenosine-sensitive
Typical AVNRT

AV nodal reentrant circuit
26-year-old with PSVT

- Short RP tachycardia
- VA is short but not as short as in AVNRT (no R')
AV reciprocating tachycardia (AVRT)

Baseline ECG: Wolff-Parkinson-White Syndrome

- Accessory pathway connects A & V
- AP may be manifest (pre-excitation) or concealed (conducts retrograde)
- WPW characterized by pre-excitation at baseline with PSVT
- In SVT, atrial rate ~150-200

short PR interval

delta wave
AV reciprocating tachycardia (AVRT)

Baseline ECG: **Wolff-Parkinson-White Syndrome**

- Short PR interval
- Delta wave
- Mid-septal, right-sided accessory pathway
Narrow-complex tachycardias recognize at first glance

**WOLFF-PARKINSON-WHITE SYNDROME**

- short PR interval
- delta wave

Left postero-septal accessory pathway
AVRT Circuits

Orthodromic Reentrant Tachycardia (ORT)

Antidromic Reentrant Tachycardia (ART)

Atrial Fibrillation
Atrioventricular bypass tracts, or accessory pathways, can be found anywhere along the muscular portion of the posterior and lateral aspects of the mitral and tricuspid annuli. They can be classified by their anatomic location as either

- right-sided,
- left-sided,
- posteroseptal, or
- anteroseptal.
Permanent Junctional Tachycardia (PJRT)

- frequently incessant
- Predominantly diagnosed in young patients
- may lead to tachycardia-induced cardiomyopathy
Automatic junctional tachycardia

- also known as junctional ectopic tachycardia or nonparoxysmal junctional
- Tachycardia originates from the AV junction probably as a consequence of enhanced automaticity or triggered activity.
- This arrhythmia is rarely seen in adults and is usually triggered by AV node injury after operative repair of complex congenital heart disease in children
Healthy 14-year-old surgically corrected congenital heart lesion in infancy
Atrial Tachycardias

Ectopic Atrial Tachycardia

Scar-Reentrant Atrial Tachycardia
Atrial Tachycardia

- Atrial rate ~150-240
- Regular rhythm
- Long RP interval
- P wave morphology or axis usually different from sinus
  - Multifocal (MAT): ≥ 3 morphologies
- Isoelectric baseline between P waves
- Typically terminates with a QRS
- Ventricle not necessary for the circuit

Adenosine given
Note that the P-waves (arrows) are clearly discernible, and that the PR interval is normal.
# Narrow-complex tachycardias

## Summary

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Atrial rate</th>
<th>AV relation</th>
<th>P-wave morphology</th>
<th>PR timing</th>
<th>Vagal response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus Tach</td>
<td>100-200</td>
<td>1:1</td>
<td>sinus</td>
<td>PR &lt; RP</td>
<td>slowing</td>
</tr>
<tr>
<td>A fib</td>
<td>300-600</td>
<td>A &gt;&gt; V</td>
<td>fib (F) wave</td>
<td>N/A</td>
<td>↓ vent. rate</td>
</tr>
<tr>
<td>A flutter</td>
<td>250-350</td>
<td>A &gt; V</td>
<td>saw tooth</td>
<td>N/A</td>
<td>↑ AV block</td>
</tr>
<tr>
<td>AVNRT</td>
<td>150-250</td>
<td>1:1</td>
<td>retrograde</td>
<td>PR &gt;&gt; RP</td>
<td>termination</td>
</tr>
<tr>
<td>AVRT</td>
<td>150-250</td>
<td>1:1</td>
<td>eccentric</td>
<td>PR &gt; RP</td>
<td>termination</td>
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<td>A tach</td>
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<td>A ≥ V</td>
<td>eccentric</td>
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<td>↑ AV block</td>
</tr>
<tr>
<td>Jct tach</td>
<td>60-120</td>
<td>1:1</td>
<td>retrograde</td>
<td>PR &gt;&gt; RP</td>
<td>sl. slowing</td>
</tr>
<tr>
<td>MAT</td>
<td>100-180</td>
<td>A ≥ V</td>
<td>3 or more</td>
<td>PR&lt;RP if 1:1</td>
<td>usually none</td>
</tr>
</tbody>
</table>
Narrow QRS tachycardia (QRS duration less than 120 ms)

Regular tachycardia?

Yes

- Visible P waves?

- Atrial fibrillation

Atrial tachycardia/flutter with variable AV conduction

MAT

No

- Atrial rate greater than ventricular rate?

Yes

- Atrial flutter or Atrial tachycardia

- Short (RP shorter than PR)

- RP shorter than 70 ms

- AVNRT

No

- RP interval

- Long (RP longer than PR)

- Atrial tachycardia PJRT

- Atypical AVNRT

- AVRT

- AVNRT

- Atrial tachycardia
Regular narrow QRS-complex tachycardia

IV adenosine

No change in rate
- Inadequate dose/delivery
- Consider VT (fascicular or high septal origin)

Gradual slowing then reacceleration of rate
- Sinus tachycardia
- Focal AT
- Nonparoxysmal junctional tachycardia

Sudden termination
- AVNRT
- AVRT
- Sinus node re-entry
- Focal AT

Persisting atrial tachycardia with transient high-grade AV block
- Atrial flutter
- AT
Management Strategies

- Acute management
- Long-term management
Emergency Approach

- Obtain a 12 lead ECG
- Assess the hemodynamic situation
IF Hemodynamically Unstable

1. Cardivert
2. Obtain a history
3. Record the postcardioversion ECG
4. Examine & compare pre- and post cardioversion ECGs to determine the type of SVT using a systematic approach
Whenever possible, a 12-lead ECG should be taken during tachycardia but should not delay immediate therapy to terminate the arrhythmia if there is hemodynamic instability.

At a minimum, a monitor strip should be obtained from the defibrillator, even in cases with cardiogenic shock or cardiac arrest, before direct current (DC) cardioversion is applied to terminate the arrhythmia.
If Hemodynamically Stable

1. Perform vagal stimulation; if unsuccessful:

2. Give Adenosine or Verapamil:
   Adenosine 6 mg as a rapid IV bolus; if unsuccessful increase dosage to 12 mg; this may be repeated
   Verapamil 10 mg; if unsuccessful:

3. Give B-blockers; if unsuccessful:

4. Perform electrical cardioversion
5. Obtain a history

6. Record a post cardioversion ECG

7. Examine & compare the pre & postcardioversion ECGs to determine the type of SVT using a systematic approach
Hemodynamic status

Stable (blood pressure >90/60 mm Hg)

- Narrow QRS and regular R-R
  - Vagal maneuvers
  - IV adenosine
  - IV verapamil, diltiazem
  - IV propafenone, sotalol
  - Refractory
    - IV adenosine
    - IV procainamide
    - IV amiodarone
    - Atrial pacing
    - Direct current cardioversion

Wide QRS complex

- Vagal maneuvers
- IV adenosine
- Procainamide

Direct current cardioversion

Unstable (blood pressure <90/60 mm Hg)

- Wide QRS complex
  - Contraindicated – digoxin, verapamil

- Direct current cardioversion
Narrow QRS-complex tachycardia SVT

- Vagal maneuvers  I B
- Adenosine  I A
- Verapamil, diltiazem  I A
- Beta blockers  IIb C
- Amiodarone  IIb C
- Digoxin  IIb C
Continuation of tachycardia with AV block is virtually diagnostic of AT or atrial flutter, excludes AVRT, and makes AVNRT very unlikely.
# Acute Pharmacologic Therapy for Supraventricular Tachycardia

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AV node-blocking agents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adenosine</td>
<td>6-12 mg bolus</td>
<td>Flushing, dyspnea, chest pain</td>
</tr>
<tr>
<td>Verapamil</td>
<td>0.15 mg/kg during 2 minutes</td>
<td>Hypotension, bradycardia</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>0.25-0.35 mg/kg during 2 minutes</td>
<td>Hypotension, bradycardia</td>
</tr>
<tr>
<td>Digoxin</td>
<td>0.5-1 mg during 2-10 minutes</td>
<td>Digoxin toxicity</td>
</tr>
<tr>
<td>Propranolol</td>
<td>1-3 mg at 1 mg during 1 min</td>
<td>Hypotension, bradycardia</td>
</tr>
<tr>
<td>Quinidine</td>
<td>6-10 mg/kg at 10 mg/min</td>
<td>Hypotension</td>
</tr>
<tr>
<td><strong>Class I antiarrhythmic agents</strong>: Use with caution in patients with congestive heart failure and an ejection fraction &lt; 40%</td>
<td></td>
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</tr>
<tr>
<td>Procainamide</td>
<td>10-15 mg/kg at 50 mg/min</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Disopyramide</td>
<td>1-2 mg/kg at 10 mg/min</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Propafenone</td>
<td>1-2 mg/kg at 10 mg/min</td>
<td>Bradycardia, gastrointestinal disturbance</td>
</tr>
<tr>
<td>Flecaainide</td>
<td>2 mg/kg at 10 mg/min</td>
<td>Bradycardia, dizziness</td>
</tr>
<tr>
<td><strong>Class III antiarrhythmic agents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sotalol</td>
<td>1-15 mg/kg at 10 mg/min</td>
<td>Hypotension, proarrhythmia</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>5 mg/kg during 5-10 minutes</td>
<td>Hypotension, bradycardia</td>
</tr>
</tbody>
</table>
LONG-TERM Management

Most common treatment strategies:

- Antiaarrhythmic drug therapy
- Catheter ablation
Initial Evaluation of patients with suspected tachycardia

- Clinical History of palpitations
- History of syncope
- Regular or irregular palpitations
- 12 lead ECG: during SR & during the tachycardia
- Exclude structural heart disease
- Event monitoring
Heart disease should always be addressed, and precipitating factors such as electrolyte imbalance, hypoxia, ischemia, and hyperthyroidism should be sought.
Recommendations for management of inappropriate sinus tachycardia

- **Medical**  Beta blockers I C – Verapamil, diltiazem IIa C

- **Interventional Catheter ablation**-sinus node modification/elimination II b C
Recommendations for long term treatment of AVNRT

- AADs
  - Verapamil; Delatiazem
  - B-blockers
  - Amiodarone
  - Sotalol
  - Propafenone
  - Flecainide

Pill in the pocket
Catheter Ablation for AVNRT

1- poorly tolerated AVNRT with hemodynamic instability
2- Recurrent symptomatic AVNRT
3- Infrequent episodes & the patient desiring abolition of the arrhythmia
Management of focal & nonparoxysmal junctional tachycardia

- Focal junctional tachycardia
  - Beta blockers IIa C
  - Flecaïnide IIa C
  - Propafenone* IIa C
  - Sotalol* IIa C
  - Amiodarone* IIa C
  - Catheter ablation IIa C
Nonparoxysmal junctional tachycardia

- Reverse digitalis toxicity I C
- Correct hypokalemia I C
- Treat myocardial ischemia I C
- Beta blockers, calcium-channel blockers IIa C
Accessory pathway mediated Tachycardia

- Patients who have WPW syndrome (pre-excitation and symptoms), and particularly those with hemodynamic instability during their arrhythmia, should undergo catheter ablation as first-line therapy.

- Patients who experience uncommon, minimally symptomatic episodes of SVT who do not have evidence of pre-excitation can be treated with a variety of approaches.

- Patient preference is always an important consideration.
- Catheter ablation has sufficient efficacy and low risk to be used for symptomatic patients, either as initial therapy or for patients experiencing side effects or arrhythmia recurrence during drug therapy.
Recommendations for treatment of atrial tachycardias

- **Acute treatment**
  - **A. Conversion**
    - Hemodynamically unstable patient
      - DC cardioversion I B
    - Hemodynamically stable patient
      - Adenosine IIa C
        - Beta blockers IIa C
        - Verapamil, diltiazem IIa C
        - Procainamide IIa C
        - Flecainide, propafenone IIa C
        - Amiodarone, sotalol IIa C

  - **B. Rate regulation (in absence of digitalis therapy)**
    - Beta blockers I C
      - Verapamil, diltiazem I C
      - Digoxin IIb C
Long term therapy of ATs

A) Recurrent symptomatic AT

- Catheter ablation I B
- Beta blockers, calcium- I C channel blockers
- Disopyramide I Ia C
- Flecainide, propafenone I Ia
- Sotalol, amiodarone I Ia C

B) Asymptomatic or symptomatic incessant ATs

- Catheter ablation I B

C) Nonsustained and asymptomatic

- No therapy I C
- Catheter ablation III C
Atrial flutter

- Unstable
  - CHF, shock, acute MI
    - DC cardioversion
      - If therapy for prevention of recurrences warranted
        - Antiarrhythmic drugs

- Stable
  - Rate control: AV-nodal blockers
    - Conversion
      - DC cardioversion
      - Atrial pacing
      - Pharmacological conversion
    - Catheter ablation
Management strategies during pregnancy

Acute conversion of PSVT

- Vagal maneuver I C
- Adenosine I C
- DC cardioversion I C
- Metoprolol, propranolol Ila C
- Verapamil Ilb C
Prophylactic therapy

- **Digoxin**
  - I C
- **Metoprolol**
  - I B
- **Propranolol**
  - IIa B
- **Sotalol, flecainide**
  - IIa C
- **Procainamid**
  - IIb B
- **Quinidine, propafenone, verapamil**
  - IIb C
- **Catheter ablation**
  - IIb C
- **Atenolol**
  - III B
- **Amiodarone**
  - III C
NHI recommendations

- Don’t rush for more than two AADs
- Consider the dose according to the age & body weight
- Re-evaluate the patient clinical status & the ECG if failure of one of the modalities of therapy failed
- Don’t forget to evaluate the metabolic status of the patient
“Logic will get you from A to B. **Imagination** will take you everywhere.”

~ Albert Einstein.
A 76-year-old man with CAD, heart failure, and chronic renal failure has recurrent SVT despite treatment with beta-blockers and calcium channel blockers. He declines to undergo an EP study for further evaluation and treatment of this problem. His arrhythmia occurs several times during dialysis and causes hypotension.

Which of the following is the most appropriate pharmacotherapy?

- A. Procainamide.
- B. Amiodarone.
- C. Flecainide.
- D. Sotalol.
- E. Propafenone.
The correct answer is B.

- Although amiodarone is not approved for treatment of supraventricular arrhythmias, it is commonly used for this purpose. It is the appropriate choice for selected patients. Low doses of amiodarone are very effective for treatment of SVT, and the risk of adverse effects is acceptable in a patient this age.

- Procainamide has a high incidence of GI side effects and drug-induced lupus. It prolongs repolarization and has a 1-3% incidence of torsade de pointes. Although it can be used in patients with renal failure by adjusting the dosage and monitoring levels, it is not as effective as amiodarone and is more difficult to use in patients with renal failure.

- Flecainide and propafenone are contraindicated in patients with CAD and heart failure because of their negative inotropic and proarrhythmic effects. Dosage adjustment is required in patients with renal failure because they are excreted by the kidneys.

- Sotalol is a negative inotrope and must be used cautiously in patients with heart failure. It is also cleared by the kidneys, which requires careful dosage adjustment and monitoring in patients with renal failure to avoid excessive QT prolongation and induction of torsade de pointes.