Introduction

- Most of the information (and figures) from this article was obtained from:
  - Link (2012) NEJM "Evaluation and Initial Treatment of SVT"
  - Bayes de Luna (2014) ECGs for Beginners (1st Ed)

Atrial Fibrillation

- Most common (3 million people in US)
- Multiple electrical wavelets appearing in the atrial simultaneously (similar to several pebbles drupped into a bucket at the same time)
- Acute:
  - If develops spontaneously (HR can jump from 60 to 160bpm)
- Chronic:
  - More gradual, occurs with physical activity or stressors
- Rate depends on AV node function (whether diseased or not) and on AV blocking drugs

Source: Bayes de Luna (2014) ECGs for Beginners (1st Ed)
Atrial Flutter

- **Second most common SVT**

  - A type of supraventricular tachycardia involving a re-entry loop in the right atrium.
    - The circuit is usually located in the right atrium. In the circuit, a critical component of slow conduction is frequently present, often located in the isthmus of right atrial tissue, which is between the tricuspid annulus, the inferior vena cava, and the coronary sinus with the eustachian valve and ridge. Occasionally, the circuit curves around a scar or surgical incision in the atrium or is confined to the left atrium.

  - **Characteristics:**
    - Organized regular rhythm
    - Atrial rate 280-300bpm --> ventricular rates 140-150bpm
    - Flutter waves usually in phase with T-waves, making diagnosis harder to distinguish from other SVTs
      - >150bpm is highly suggestive of other SVT

  - **Two Types:**
    - **Typical Atrial Flutter**
      - **Typical Flutter (counterclockwise):** Flutter waves negative in II and III and positive waves in lead V1 (slow downstroke, fast upstroke).
      - **Reverse Flutter (clockwise):** Positive flutter waves are present in the inferior leads and negative atrial deflection in lead V1.
      - Typical Atrial Flutter usually uses the cavo-tricuspid isthmus as part of its loop, which is amenable to catheter RF ablation.
    - **Atypical Atrial Flutter**
      - Other patterns
      - Example of typical atrial flutter:

- **Management**
  - Typical atrial flutter can be ablated with high success rates.
  - Pharmacologic cardioversion can be done with Class III drugs, such as ibutilide, dofetilide, azimilide, and sotalol.
    - For acute termination of AFL, intravenous ibutilide is most effective.
    - For prevention of recurrence:
      - The arrhythmia is usually caused by one or more atrial premature beats that can be prevented by class I drugs (flecainide, procainamide, quinidine), class III drugs, and amiodarone.
Maintenance of the arrhythmia can be prevented by prolonging the wave length of the circulating impulse by class III drugs.

For ventricular rate control during AFL, drugs should be prescribed that prolong the refractory period of the AV node, such as β-blocking agents, calcium antagonists, digitalis, and amiodarone (Table).

References:
- Medi & Kalman (2008) "Prediction of the atrial flutter circuit location from the surface electrocardiogram" Europace 10, 786–796

AV Nodal Reentrant Tachycardia (AVNRT)

- **AV node has two conduits** - one conducts rapidly and another conducts slowly
  - Slower pathway lies parallel to the tricuspid valve
  - The slow pathway allows reentry loop --> impulse meanders through the slow pathway, it exits AV node simultaneously:
    - 1. In a retrograde manner (back from AV node to the atrium) AND
    - 2. In anterograde manner (forward from AV node to the ventricle)

- **Characteristics:**
  - Rate often fast 150-220bpm
  - Because simultaneous depolarization of ventricles and atria --> P-waves are often not seen on ECG
  - Atrial retrograde depolarization can sometimes be seen in V1 as the terminal part of QRS

AV Reciprocating Tachycardia (AVRT)

- More common in young patients (compared to AVNRT)
- Conductive tissue that bypasses normal insulation of the tricuspid and mitral valves
- These bypass tracts can conduct in anterograde (forward only), retrograde (backwards only), and both!!
- A delta wave is present in many cases where bypass tract is able to conduct anterograde

- Tachycardia + Delta Wave = Wolff-Parkinson-White Syndrome
- Delta Wave (without tachycardia = WPW pattern (not syndrome)

- Both are at risk of supraventricular arrhythmias

- **Types of Arrhythmias**
  - **Orthodromic** (conduction down the AV node, retrograde through bypass tract)
    - Narrow Regular QRS Complex
  - **Antidromic** (conduction down the bypass tract, and retrograde up the AV node)
    - Wide Regular QRS Complex
  - **Pre-Excited Atrial Fibrillation**
    - Wide Irregular QRS Complex
    - Can be fatal due to extremely rapid ventricular rates
    - If bypass tract has long refractory period, it will not conduct fast.
    - If bypass tract has very short refractory period, AV conduction can be so rapid that it causes VF.
Atrial Tachycardia

- Less common than AVNRT and AVRT

- Abbreviated AT
- P-waves are ectopic (often peaked and narrow)
- Mechanism: increased automatism of ectopic focus (or atrial micro reentry).
- Characteristics:
  - Occur in repetitive short bursts
  - Warm-up phenomenon - atrial rate increases slightly over first 5-10s then stabilizes
  - P-wave before each QRS (although in fast rates, P can be obscured by T-wave)
- Rate tends to accelerate at the start and decelerate at the end (revving up phenomenon).
- Site of origin can be localized using P-wave morphology:

<table>
<thead>
<tr>
<th>P wave is - or ± in V1</th>
<th>Origin is R-atrium</th>
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</thead>
<tbody>
<tr>
<td>P wave is + or ++ in V1</td>
<td>Origin is L-atrium</td>
</tr>
<tr>
<td>Negative in II, III and aVF</td>
<td>Origin is lower atria (av-junction or surrounding area)</td>
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- P’ is often before the QRS P’-QRS < QRS-P’
- There is often a certain degree of concurrent AV block.

Source:
- Bayes de Luna (2014) ECGs for Beginners 1st Edition
Rare

Multifocal Atrial Tachycardia
- Atrial premature beats in atrium poisoned by hypoxia, increased atrial pressure, and (most important) theophylline
- **MAT is uncommon today because theophylline is rarely used**
- Characteristics:
  - ≥3 atrial P-wave morphologies seen
  - Generally slightly faster than baseline rate (usually baseline is sinus tachycardia)

Junctional Tachycardia
- Extremely rare, most physicians will never see in their career.
- Can occur in infants

Paroxysmal Junctional Retrograde Tachycardia
- Occurs with a bypass tract near AV node that conducts only in retrograde direction.
- Usually incessant, and causes dilated cardiomyopathy

Mahaim fiber tachycardia
- Caused by tissue that originates in the lateral right atrium and connects of the distal RBB.
- Wide complex tachycardia occurs with conduction down the abnormal tissue and back up the atrium through AV node.

Other Concepts

Ashman’s Phenomena

<table>
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<tr>
<th>Fisch Criteria for diagnosis of Ashman Phenomenon:</th>
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<tbody>
<tr>
<td>1. Long cycle immediately preceding the cycle terminated by aberrant QRS complex</td>
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<tr>
<td>(i.e. QRS--LongPause--QRS--AshmanBeat -- QRS)</td>
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<td>2. RBBB-form aberrancy with normal orientation of initial QRS vector</td>
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<tr>
<td>(A Series of wide QRS supraventricular beats is possible)</td>
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3. Irregular coupling of aberrant QRS complexes

4. Lack of fully compensatory pause


**Management**

- If Unstable --> SHOCK!
- If Stable --> YOU HAVE TIME!
  - For regular narrow complex tachycardias --> Vagal Maneuvers
    - **Modified Valsalva Maneuver**
      (Cardioversion in ≤ 43% success vs 17% for regular Valsalva in RCT)
      - Semirecumbent position followed by supine position and passive leg raise after the valsalva strain
    - Carotid sinus massage (risk of stroke 1%)
  - For irregular narrow complex tachycardias (AF or AFL with variable block) --> rate control vs. rhythm control decision