Emergency Diagnosis and Management of Tachycardias for Residents

September 20, 2010
Joe M. Moody, Jr, MD
UTHSCSA and STVAHCS
Outline

• Emergency Diagnosis
  – Nature of arrhythmia
    • Check 2 characteristics – width of QRS and regularity of rhythm
  – Clinical effect of arrhythmia
    • Underlying clinical situation

• Emergency Treatment
  – Adenosine
  – Cardioversion
  – Valsalva
  – Other activities
# Differential Diagnosis of Tachycardias

<table>
<thead>
<tr>
<th>Wide complex (≥120 msec)</th>
<th>Regular</th>
<th>Irregular</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) VT</td>
<td>1) Polymorphic VT</td>
<td></td>
</tr>
<tr>
<td>2) SVT w/ aberrancy</td>
<td>Torsades (long QT)</td>
<td></td>
</tr>
<tr>
<td>3) SVT w/ underlying BBB</td>
<td>Ischemia (normal QT)</td>
<td></td>
</tr>
<tr>
<td>4) AVRT (antidromic)</td>
<td>2) AF w/ aberrancy, etc.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Narrow complex (≤110 msec)</th>
<th>“SVT”</th>
<th>Regular</th>
<th>Irregular</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Sinus tach</td>
<td>1) AF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) AVNRT</td>
<td>2) Atrial flutter with variable response</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Junctional tachycardia</td>
<td></td>
<td>3) MAT</td>
<td></td>
</tr>
<tr>
<td>4) AVRT (orthodromic)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Intraatrial reentry/flutter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Focal atrial tachycardia</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wide Complex, Regular Tachycardia

- 75% are VT – 90% if there is organic heart disease
- To tell VT from SVT is a challenge – atrial activity is a key clue
  - AV dissociation with ventricular rate faster means VT
  - Retrograde VA conduction means VT (could be retrograde Wenckebach or 2:1 conduction)
  - Look for Dressler beats (capture beats) or fusion beats

SVT with wide QRS
- underlying BBB
- pre-excitation (WPW – antidromic AVRT)
- rate-related aberrancy (can be RBBB)

- Sinus tachycardia
- AVNRT
- Junctional tachycardia
- Intraatrial reentry/flutter
- Focal atrial tachycardia
- AVRT
Wide Complex, Irregular Tachycardia

- Ventricular tachycardias
  - Monomorphic sustained VT can be somewhat irregular
  - Torsades de pointes is polymorphic VT with prolonged QT interval in normal rhythm
  - Polymorphic VT with normal QT interval usually indicates ongoing severe ischemia

- Supraventricular tachycardias with wide QRS
  - Atrial fibrillation with rapid ventricular response
  - Atrial flutter with variable ventricular response
  - Atrial tachycardia with variable block
  - MAT
Diagnosis of WCT

Accuracy/AHA/ESC Practice Guidelines, Mgmt of SVT, 2003
WCT Case 1
Echo: reduced EF

Native sinus QRS is narrow with LAD  
Onset R to nadir S >100ms

LBBB configuration

LBBB and LAD suggest origin inferior wall of RV or IVS

AV dissociation?
P waves

Sinus tachycardia, dramatic transmural injury
Torsade de Pointes

“Long-short”, provokes even more prolonged QT
Set up for VT/VF

End of T wave
Middle of T wave
Baseline ECG shows inferior injury and then polymorphic VT
Same patient few seconds later, better polymorphic VT
Atrial Fibrillation and LBBB
WPW and Atrial Fibrillation
NSR and WPW Pattern – AFib resolved
Narrow Complex Tachycardias

- Atrial fibrillation* or flutter** with rapid ventricular response
- Atrial tachycardia (automatic or microreentrant or macroreentrant)
- Sinus tachycardia (search for primary cause)
- AVNRT (AV nodal reciprocating*** tachycardia)
- AVRT (Atrioventricular reciprocating*** tachycardia)
- Uncommonly, junctional tachycardia

* Irregular       *** or, “reentrant” (Guidelines use reciprocating)
** May be irregular
31 yo woman, Emergency Room

Rate 180 – normal P preceding QRS, best in V1 = STach
30 yo woman, L&D

Rate 190 – no P preceding QRS = SVT = AVNRT
30 yo woman, L&D, Resolved

Rate 80 – normal P preceding QRS, best in II and V1 = NSR
SVT in 30 yo woman, L&D

I, II, III

V1, V2, V3
Differential Diagnosis of SVT

Narrow QRS tachycardia (QRS duration less than 120 ms)

Regular tachycardia?

Yes

Atrial fibrillation
Atrial tachycardia/flutter with variable AV conduction
MAT

No

Visible P waves?

Yes

Atrial rate greater than ventricular rate?

Yes

Atrial flutter or Atrial tachycardia

No

Analyze RP interval

Short (RP shorter than PR)

RP shorter than 70 ms

AVNRT

RP longer than 70 ms

AVRT

Atrial tachycardia

No

Long (RP longer than PR)

Atrial tachycardia
PJRT
Atypical AVNRT

ACC/AHA Guideline for Management of SVT. 2003
ACC/AHA Guideline for Management of SVT. 2003

Typical AVNRT ("Slow-Fast")
Atypical AVNRT ("Fast-Slow")
Type I, common type

- SVC: Sinus venosa area
- IVC: Cavo-tricuspid isthmus

Slow conduction

Atrial Flutter
Atrial Flutter
Atrial Flutter
Atrial Flutter
Multifocal Atrial Tachycardia
MAT? … Flutter? … Fib?

Atrial rate 325 --- Atrial Flutter
Atrial fibrillation, rapid response, pericarditis, 26 yo man
Atrial fibrillation and rapid response
Serious Signs and Symptoms that Represent “Emergent” Presentations

• First, you must decide if the symptoms are actually a result of the tachycardia

• Serious **Symptoms**
  – Shortness of breath, chest pain, DOE, altered mental status

• Serious **Signs**
  – Pallor, diaphoresis, pulmonary edema, rales, rhonchi, hypotension, orthostasis, jugular vein distention, peripheral edema, ischemic ECG changes

Examples of Instability

• 52 yo man with SOB, palpitations and severe CP, pale and sweaty
• 45 yo woman with palpitations SOB and severe pressure in chest, extreme weakness and near syncope
• 58 yo man with severe CP, SOB, and a feeling of apprehension
• 60 yo man with palpitations, chest pain, and SOB, very lightheaded

Examples of Stability

• 47 yo woman with palpitations but no CP or SOB
• 62 yo man with palpitations, no dyspnea or CP
• 35 yo man with rapid HR and pounding HA without CP or SOB
• 49 yo woman with heart beating rapidly without CP or dyspnea

Management of Unstable Tachycardia (Wide or Narrow)

- HR >150 and not sinus with serious signs and symptoms – immediate cardioversion (optional brief medication trials, but medications are generally more appropriate in stable tachycardias)
- HR <150 – usually no cardioversion
- Remember O2, IV, suction, intubation equipment, also oximeter
- Generally start with 100J (can start lower for atrial flutter and higher for Torsades de Pointes or polymorphic VT, generally about half as high energy for biphasic defibrillator)
Management of Unstable Tachycardia (Wide or Narrow)

TACHYCARDIA With Pulses

- Assess and support ABCs as needed
- Give Oxygen
- Monitor ECG (identify rhythm), blood pressure, oximetry
- Identify and treat reversible causes

Symptoms Persist

Is patient stable?
- Unstable signs include altered mental status, ongoing chest pain, hypotension or other signs of shock
- Note: rate-related symptoms uncommon if heart rate <150/min

Perform immediate synchronized cardioversion
- Establish IV access and give sedation if patient is conscious; do not delay cardioversion
- Consider expert consultation
- If pulseless arrest develops, see Pulseless Arrest Algorithm

Cardioversion Electrode Placement

• Optimal placement for electrodes might depend on the particular arrhythmia, atrial fibrillation vs atrial flutter, or ventricular tachycardia/fibrillation

Kerber RE. Am J Cardiol. 1996;78(Suppl 8A):22-26
Anterior-Posterior Cardioversion Electrode Placement

- Elective cardioversion of persistent (about 5 months) atrial fibrillation, 108 pts, age 60, 74% on antiarrhythmic agents
- Prospective randomization: Anteroposterior vs anterolateral electrode placement
- Lifepak 9 with 12 cm back electrode sequential shocks: 50, 100, 200, 300, 360
- 96% vs 78% success, anteroposterior better (p<0.009)

Cardioversion Electrode Placement

Figure 37-2: Electrode positions commonly used for transthoracic defibrillation and cardioversion. The apex-anterior position is most commonly used, but all are effective. If shocks given from one electrode pair position fail to terminate the arrhythmia, it is the author’s practice to quickly change to another position and repeat the shocks. (From Kerber RE. Transchest cardioversion: Optimal techniques. In: Tacker WA, ed. Defibrillation of the Heart: ICDs, AEDs and Manual. St. Louis: Mosby-Year Book, 1994, chap 7. With permission.)
Zoll AP Cardioversion Electrode Placement

Place the front (apex) pad on the third intercostal space, mid clavicular line on the right anterior chest. The back/posterior pad should be placed in the standard posterior position on the patient’s left as shown.
Zoll Monophasic

Where is the synch button?
Zoll Monophasic

The synch button is in the software when the main switch is turned to “defib”
The synch button is in the software when the main switch is turned to "defib"
Zoll Monophasic Defibrillator

Monitor Screen

- DEFIB 200J SEL
- SELECT ECG LEADS
- SYNC 200J SEL
Verify that markers are clearly visible on the monitor and their location is appropriate and consistent from beat to beat. If necessary, use the LEAD and SIZE buttons to establish settings that yield the most consistent sync marker pattern.
Zoll Biphasic
UH Lifepak 9

Where is the synch button?
Where is the synch button?
Where is the synch button?
Defibrillation-induced Fibrillation

Synchronize!
Zoll Monophasic Defibrillators

Load

- 25 Ohm: ~2000V, 4 msec
- 50 Ohm: ~3000V, 6 msec
- 100 Ohm: ~3600V, 10 msec
Zoll Biphasic Defibrillators

Table A-2. Delivered Energy at Every Defibrillator Setting into a Range of Loads

<table>
<thead>
<tr>
<th>Selected Energy</th>
<th>25Ω</th>
<th>50Ω</th>
<th>75Ω</th>
<th>100Ω</th>
<th>125Ω</th>
<th>150Ω</th>
<th>175Ω</th>
<th>Accuracy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 J</td>
<td>92 J</td>
<td>147 J</td>
<td>166 J</td>
<td>175 J</td>
<td>179 J</td>
<td>180 J</td>
<td>174 J</td>
<td>±15%</td>
</tr>
<tr>
<td>200 J</td>
<td>123 J</td>
<td>196 J</td>
<td>221 J</td>
<td>233 J</td>
<td>246 J</td>
<td>263 J</td>
<td>259 J</td>
<td>±15%</td>
</tr>
</tbody>
</table>

* For all energy levels, accuracy is equal to either ±15% or 3 joules, whichever is greater.

E=IR
Volt=25A*50ohm
Volt=1,250V.
Effectiveness of SVT Emergent Cardioversion

- Israeli EMS analog, 1997-2001
- 84 pts, age 76 yo., prior unsuccessful medical therapy in 53%,
- Indications: hypotension 74%, severe pulmonary congestion 15%, significant angina 10%
- Cardioversion successful in 100% with 1 to 3 shocks, average 118J, all but one discharged alive in <7 da (one with CHF).
- No embolic event

Roth A et al. Am J Cardiol. 2003;91:489
Vagal Maneuvers

- **Valsalva Maneuver**
  - Mid inspiration
  - Forced exhalation against closed glottis
  - At least 40 mmHg pressure, 10-30 seconds
  - Resultant JVP distention and facial plethora

- **Carotid sinus massage** (if no bruit or risks for CVD)
  - Neck extended
  - Carotid bulb very near angle of jaw
  - Firm pressure for 3-5 seconds

- Diving reflex
- Eyeball pressure is discredited, don’t do it
Effects in a normal person, original data from Bannister text 1980.


Lu K et al. Am J Physiol 2001;281:H2661
Vagal Maneuvers in SVT

- 148 instances of SVT in the ED, pts >10 yo
  - 62 pts with **Valsalva** maneuver (40 mmHg, 30 sec)
    - 12 (19.2%) reverted
    - 50 not – 7 reverted with CSM (14%), 30.6% overall
  - 86 pts with **Carotid Sinus Massage**
    - 9 (10.5%) reverted
    - 77 not – 13 reverted with Valsalva (16.9%), 25.6% overall
- **Overall, 41 reverted (27.7%)**

Complications of Vagal Maneuvers

• **Valsalva**: retinal hemorrhage, other venous hemorrhages (conjunctival)
• **Carotid sinus massage**: stroke, TIA
• **Facial cold water immersion** ("Diving reflex"): messed up makeup and hairdo
Adenosine - 1

• Rapid IV injection- 6 mg in 1-2 sec
  – 10-15 mmHg initial increase in BP
  – 20 s after injection is sinus bradycardia for 10-15 sec, then tachycardia, also stimulation of respiration
  – slowed AVN conduction
  – usually no effect on accessory pathway

• Acute conversion of AVNRT:
  – 60% respond to 6 mg
  – 32% to 12 mg

Hurst, 2004, Ch. 35, p. 966
Adenosine - 2

- **Higher doses** if current theophylline or caffeine (antagonists); can reverse adverse effects with theophylline
- **Lower dose** if current dipyridamole or carbamazepine, heart transplant patients more sensitive, decrease dose to 1/3 or 1/5
- **Contraindicated** in SSS or AV block unless pacemaker;
- **Adverse effects last <60 sec**: facial flushing, chest pressure, nausea, headache, blurred vision

Hurst, 2004, Ch. 35, p. 966
Figure 6. Responses of narrow complex tachycardias to adenosine. AT indicates atrial tachycardia; AV, atrioventricular; AVNRT, atrioventricular nodal reciprocating tachycardia; AVRT, atrioventricular reciprocating tachycardia; IV, intravenous; QRS, ventricular activation on electrocardiogram; VT, ventricular tachycardia.
Management

**Initial IV dose:**
- Adenosine 6, 12 mg quick
- Verapamil 5 mg q 10 min
- Diltiazem 15-20 mg
- Metoprolol 5 mg
- Propranolol 1 mg
- Esmolol 15-30 mg/ 1 min
- Ibutilide 1 mg/10 min
- Procainamide 20 mg/min
- Lidocaine 100 mg

Figure 9. Acute management of patients with hemodynamically stable and regular tachycardia. *A 12-lead ECG during sinus rhythm must be available for diagnosis. †Adenosine should be used with caution in patients with severe coronary artery disease and may produce AF, which may result in rapid ventricular rates for patients with pre-excitation. **Ibutilide is especially effective for patients with atrial flutter but should not be used in patients with EF less than 30% due to increased risk of polymorphic VT. AF indicates atrial fibrillation; AV, atrioventricular; BBB, bundle-branch block; DC, direct current; ECG, electrocardiogram; IV, intravenous; LV, left ventricle; QRS, ventricular activation on ECG; SVT, supraventricular tachycardia; VT, ventricular tachycardia.

ACC/AHA/ESC Practice Guidelines, Mgmt of SVT, 2003
Questions?

- Wide QRS or Narrow
- Irregular or Regular
- Management
  - Cardioversion
  - Vagal maneuvers
  - Adenosine