Management of PEDIATRIC ARRHYTHMIA in EMERGENCY ROOM

Mohammad Dalili MD

Pediatric Cardiologist
Interventional Electrophysiologist
Rajaie Cardiovascular Medical and Research Center,
Iran University Of Medical Sciences, Tehran, Iran
Requirements for correct approach:

1. Basic knowledge about the arrhythmia mechanisms
2. Careful evaluation of the patient
3. Choosing the best therapeutic option
The most common presenting ECG:
Reciprocating Tachycardias (AVRT, AVNRT)

- **Narrow QRS (Usual complex)**
- **1:1 AV association**
- **Short VA interval (very short in AVNRT)**

Usual complex refers to a QRS in tachycardia identical to that in sinus rhythm, regardless of QRS duration or morphology.
# Acute Management of Reciprocating Tachycardias

**Table 1** Recommendations for acute treatment of haemodynamically stable regular narrow QRS tachycardia in infants and children

<table>
<thead>
<tr>
<th>Drug/intervention</th>
<th>Dosage (iv)</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vagal manoeuvres</td>
<td>Ice immersion, gastric tube insertion in infants, Valsalva, and head stand in older children</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Transoesophageal atrial overdrive pacing&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Rapid bolus starting dosages:&lt;br&gt;For infants: 0.15 mg/kg.&lt;br&gt;For &gt;1 year of age: 0.1 mg/kg&lt;br&gt;Increasing dosage up to 0.3 mg/kg.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Adenosine</td>
<td>0.1 mg/kg slowly over 2 min</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Verapamil&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>1.5–2 mg/kg over 5 min</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td>Flecainide&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Loading: 2 mg/kg over 2 h&lt;br&gt; Maintenance: 4–7 μg/kg/min</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td>Propafenone&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Loading: 5–10 mg/kg over 60 min.&lt;br&gt; Maintenance infusion: 5–15 μg/kg/min</td>
<td>Iib</td>
<td>B</td>
</tr>
</tbody>
</table>

iv, intravenously; Class, recommendation class; Level, level of evidence.

<sup>a</sup>Most effective if AV reentrant tachycardias or atrial flutter.

<sup>b</sup>Myocardial depressant effect.

<sup>c</sup>Contraindicated in infants <1 year of age.
Less common presenting ECG:
Ectopic Atrial Tachycardia

- Narrow QRS (Usual complex)
- Long RP
- Constant short PR
Acute management of AT

- The arrhythmia is usually chronic and does not need emergent therapy

- Adenosine could terminate or slow the arrhythmia or only produce AV block and unmask the P waves

- In stable cases acute drug therapy may postpone until the long-term strategy planned

- Class Ic agents are the most effective drugs in most cases

- In cases with reduced cardiac function, ablation is the preferred treatment option
Less common presenting ECG:
Atrial Flutter

- Narrow or wide QRS
- Flutter waves may be seen
- Regular or regularly irregular rate

Uncommon in normal heart kids
Acute management of AFL

- Adenosine confirms the diagnosis ➔
  Echocardiography for R/O intra-cardiac clot:
  - No clot ➔ Cardioversion
  - Clot ➔ Rate control
Less common presenting ECG:
Ventricular Tachycardia

- Wide QRS
- V rate ≥ A rate

Uncommon in normal heart kids
### EHRA Recommendations (2013)

**Table 2** Recommendations for acute treatment of wide QRS tachycardia in infants and children

<table>
<thead>
<tr>
<th>Wide QRS tachycardia</th>
<th>Drug/intervention (dosages see Table 1).</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide QRS tachycardia of unknown mechanism</td>
<td>Electrical cardioversion</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Lidocaine iv bolus starting at 1 mg/kg (up to 3 doses in 10 min interval); followed by infusion of 20–50 µg/kg/min</td>
<td>Ila</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Amiodarone iv loading: 5–10 mg/kg over 60 min, followed by maintenance infusion of 10 mg/kg/day (5–15 µg/kg/min).</td>
<td>Iib</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Procainamide iv</td>
<td>Iib</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Esmolol iv bolus 500 µg/kg</td>
<td>Iib</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Magnesium sulphate iv</td>
<td>Iib</td>
<td></td>
</tr>
<tr>
<td>Antidromic tachycardia, pre-excited AF</td>
<td>Electrical cardioversion</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Flecaïnide iv</td>
<td>Ila</td>
<td></td>
</tr>
<tr>
<td>SVT with bundle branch block</td>
<td>See table for acute treatment of SVT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monomorphic ventricular tachycardia</td>
<td>Electrical cardioversion</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Propranolol iv</td>
<td>Iib</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Lidocaine iv</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sotalol iv</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymorphic ventricular tachycardia</td>
<td>Electrical cardioversion</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Propranolol iv</td>
<td>Iib</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Deep sedation or general anesthesia</td>
<td>Iib</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>Potassium and magnesium iv</td>
<td>Iib</td>
<td>C</td>
</tr>
</tbody>
</table>

*iv, intravenously; Class, recommendation class; Level, level of evidence; AF, atrial fibrillation; SVT, supraventricular tachycardia.*
A simple algorithm for diagnosing the arrhythmia mechanism

- **Tachycardia**
  - **Narrow complex QRS**
    - **AV**
      - 1:1
        - AV Reentry
        - AV Node reentry
      - >1:1
        - Atrial tachycardia
  - **Wide complex QRS**
    - **AV**
      - 1:1
        - VT SVT with BBB/Aberroton
      - <1:1
        - Ventricular tachycardia
    - **Variable AR EAT**
A Simple Algorithm
For Emergent Management of Pediatric Tachyarrhythmias

Initial Rapid Evaluation
+ Arrhythmia record

Stable Hemodynamics
- Vagotropic Maneuvers
  - Arrhythmia Termination
    - Monitoring Expert consult
  - Arrhythmia Continuation
    - Adenosine injection*
      - Brief response
        - Or No response

Unstable Hemodynamics
- DC Shock
  - IV Access

Evaluate The Response to Adenosine (AV node blockage)

* Adenosine injection should be avoided if defibrillator is not available
Response to Adenosine injection in different SVTs

- Arrhythmia termination
  - AVNRT
  - AVRT
  - SNRT

- Transient Slowing
  - JET

- P wave unmasking during AV block
  - AFL
  - AF
  - AT
A Rare Type of Tachyarrhythmia
Torsades de pointes (TdP)

Acute management of TdP

1) Any offending agent should be withdrawn. Predisposing conditions such as hypokalemia, and hypomagnesemia should be identified and corrected

2) Magnesium sulfate 50 mg/kg IV/IO (No Pulse: Push, Pulse: Give over 20-60 minutes, Max single dose 2 grams, can be repeated in 5-15 minutes)

3) Isoproterenol can be used in bradycardia-dependent torsade that usually is associated with acquired long QT syndrome (pause-dependent). It is contraindicated in the congenital form of long QT syndrome (adrenergic-dependent).

4) Temporary trans-venous pacing (Atrial pacing is the preferred mode, pacing rates 100-140 bpm)

5) Cardioversion or defibrillation in extremis with unpredictable results

- It is a specific form of PVT occurring in the context of QT prolongation
- It has a characteristic morphology in which the QRS complexes “twist” around the isoelectric line.
6 year-old boy with bradycardia (case 1)
6 year-old boy with bradycardia
(case 2)
Complete Heart Block (CHB)

- CHB could be observed as congenital or acquired defect
- The level of CHB could be supra-nodal, nodal, or infra-nodal
- Infra-nodal AV blocks have poorer prognosis in compare to nodal AV blocks
- Congenital CHBs are always nodal
Different types of CHB

Congenital (nodal) CHB with narrow QRS complexes

- Rates above 40 bpm always need no acute therapy
- Lower rates in symptomatic patients could be managed with temporary pacing or sympathomimetic drugs (i.e.: Isoproterenol infusion)

Sub-nodal CHB with wide QRS complexes and low ventricular rates

- Usually need acute therapy
- The only safe acute therapy is pacing
- Sympathomimetic drugs should be avoided
CONCLUSION

• ECG Recording is mandatory in any patient with arrhythmia

• Diagnosis of the arrhythmia mechanism is the main clue for controlling difficult cases

• Comprehensive evaluation of the arrhythmia response to Adenosine is very helpful for further decision making

• Amiodarone is not indicated as the first-line drug in any pediatric arrhythmia emergency

• Temporary pacing is the safest method for managing symptomatic brady-arrhythmias