TACHYCARDIA IN KIDS

The Good, the Bad, the Ugly

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DISCLAIMER

- I have no financial relationships or conflicts in relation to the products or services described in this presentation.
INTRODUCTION

- Tachycardia in children may be a sign of clinical problems that range from trivial to life-threatening.
- As a primary care provider, it would be nice to know which fall in the latter category.
- Hopefully, we can provide you with some useful hints and guidelines.
INITIAL APPROACH

1. Known cardiac disease?
   - Yes: HF, arrhythmia
   - No: Extreme tachycardia? (
     - Yes: Narrow QRS complex?
       - Yes: P waves present?
         - Yes: Sinus tachycardia with shock
         - No: SVTΔ
       - No: VT\textsuperscript{o}, Torsades de pointes, SVTΔ with aberrancy
     - No: Consider causes of tachycardia without shock
   - No: Signs of shock?
     - Yes: Treat shock and underlying causes
     - No: Consider causes of tachycardia without shock
Sinus tachycardia is the most frequent finding in children with rapid heart rates.

Definition varies with age: 160-200 bpm in infants, 140-180 bpm in child, 100-150 bpm in young adults.

For exercise stress testing, the predicted maximum heart rate = 220 – age (in years).
SINUS TACHYCARDIA

Sinus Tachycardia: rate = 155

p-wave precedes each QRS complex
SINUS TACHYCARDIA

- May be seen with myocarditis, Kawasaki disease, acute rheumatic fever or congestive heart failure but mostly not due to heart problem.
- Consider hypoxemia, hypoglycemia, shock, sepsis, anemia, pain, fever, anxiety, hyperthyroidism, drug effect, electrolyte issues etc.
- Treat underlying cause rather than treat the tachycardia itself.
POSTURAL TACHYCARDIA SYNDROME (POTS)

- Common in teens and young adults.
- Autonomic neuropathy, baroreflex abnormalities, hypovolemia, sympathetic hyperactivity, etc.
- **Tilt table testing**: Pulse increases 30 bpm or over 120 bpm, flat to upright.
- Volume, fludrocortisone, midodrine, propranolol improve tilt table test.
TACHYCARDIA, NO SHOCK

- Fever?
  - Yes
    - Signs of cardiac disease?*
      - Yes
        - Myocarditis, pericarditis, ARF
      - No
        - Mucositis, conjunctivitis adenopathy?
          - Yes
            - Kawasaki disease
          - No
            - Goiter?
              - Yes
                - Hyperthyroidism
              - No
                - Infection or inflammation
  - No

- Suspected ingestion?•
  - Yes
    - Toxin induced
      - Yes
        - Dehydration, hypoglycemia, other causes of vomiting (eg, appendicitis, intussusception)
      - No
        - Vomiting, diarrhea?
          - Yes
            - Signs of cardiac disease?*
              - Yes
                - Myocarditis, pericarditis
              - No
                - Pallor?
                  - Yes
                    - Anemia
                  - No
                    - EKG does not show sinus rhythm?
                      - Yes
                        - Anxiety, pain, emotional response, thyrotoxicosis (goiter), pheochromocytoma (hypertension)
                      - No
        - Yes
          - No
        - No
          - No
THE BAD

- Tachycardia in children causing clinical deterioration as the primary issue.
- Most often due to abnormal cardiac wiring causing electrical “short circuit”.
- The most frequent model for reentrant supraventricular tachycardia (SVT) is Wolff-Parkinson-White syndrome.
SUPRAVENTRICULAR TACHYCARDIA

HEART RATE 235
SUPRAVENTRICULAR TACHYCARDIA
ST DEPRESSION; PROBABLY RATE RELATED
STSIDEHOLM-WOLFF-PARKINSON-WHITE SYNDROME
ABNORMAL ECG

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25 mm/sec  1.0 mm/mV

25 mm/sec  1.0 mm/mV

25 mm/sec  1.0 mm/mV
WOLFF-PARKINSON-WHITE ECG PATTERN
WHY WOLFF-PARKINSON-WHITE ECG PATTERN?
WHY WOLFF-PARKINSON-WHITE TACHYCARDIA?
SUPRAVENTRICULAR TACHYCARDIA

- SVT has a regular, narrow QRS complex tachycardia on ECG.
- Heart rate over 220 bpm in infants, over 180 bpm in older children.
- Adenosine or DC cardioversion.
- No WPW: digoxin, beta-blocker.
- WPW: beta-blocker.
- If resistant: procainamide, flecainide, sotalol or amiodarone.
SUPRAVENTRICULAR TACHYCARDIA

- 1 in 10,000 kids. 1/3 with WPW.
- No heart disease in 90%.
- Narrow QRS complex tachycardia also includes atrial fibrillation and atrial flutter.
- Seen in normal newborns or in children with heart disease.
- Adenosine to diagnose.
- Digoxin, beta-blocker to treat.
ATRIAL FIBRILLATION
ATRIAL FLUTTER
THE UGLY

- Dangerous tachycardia that you hope not to see in your office.
- Wide QRS complex rhythms often with hemodynamic collapse.
- This group includes ventricular tachycardia, ventricular fibrillation, torsades de pointes, and atrial fibrillation with WPW.
VENTRICULAR TACHYCARDIA
VENTRICULAR TACHYCARDIA

WHO GETS IT?: Patients with myocarditis or cardiomyopathy, after cardiac surgery with ventriculotomy (e.g. tetralogy of Fallot), ingestions (e.g. tricyclic antidepressants), occasionally in setting of normal heart.
VENTRICULAR FIBRILLATION

WHO GETS IT?: Patients with myocarditis or cardiomyopathy, after cardiac surgery with ventriculotomy (e.g. tetralogy of Fallot), ingestions (e.g. tricyclic antidepressants), occasionally in setting of normal heart.
TORSADES DE POINTES
WHO GETS IT?: Patients with long QT syndrome, either congenital from a genetic defect in ion transport, or acquired secondary to certain medications. Sudden death, syncope or deafness in family.
ATRIAL FIBRILLATION WITH WPW
ATRIAL FIBRILLATION WITH WPW

- **WHO GETS IT?:** Patients with Wolff-Parkinson-White pattern with bypass tracts conducting very well in antegrade direction.

- **WPW** has 3% rate of sudden death, atrial fibrillation more common than general population.

- Avoid digoxin, verapamil.
ATRIAL FIBRILLATION AND WPW
THE UGLY

- These rhythms are ugly with wide QRS complex, often irregular.
- Cardiopulmonary resuscitation first.
- Ventricular tachycardia, ventricular fibrillation, atrial fibrillation with WPW: defibrillation, epinephrine, amiodarone.
- Torsades de pointes: beta-blocker for congenital long QT; tranvenous pacing, IV magnesium for acquired.
**PALS:**

1. **Identify and treat underlying cause**
   - Maintain patent airway; assist breathing as necessary
   - Oxygen
   - Cardiac monitor to identify rhythm; monitor blood pressure and oxygenation
   - IO/IV access
   - 12-lead ECG if available; don't delay therapy

2. **Evaluate QRS duration**
   - Narrow (<0.09 sec)
   - Wide (>0.09 sec)

3. **Evaluate rhythm with 12-lead ECG or monitor**

4. **Probable sinus tachycardia**
   - Compatible history consistent with known cause
   - P waves present/normal
   - Variable R-R constant PR
   - Infants: rate usually <220/min
   - Children: rate usually <180/min

5. **Probable supraventricular tachycardia**
   - Compatible history (organic, nonspecific); history of abrupt rate changes
   - P waves absent/abnormal
   - HR not variable
   - Infants: rate usually <220/min
   - Children: rate usually <180/min

6. **Search for and treat cause**

7. **Consider vagal maneuvers** (no delays)

8. **Synchronized cardioversion**
   - If IO/IV access present, give adenosine
   - If IO/IV access not available, or if adenosine ineffective, synchronized cardioversion

9. **Possible ventricular tachycardia**

10. **Cardiopulmonary compromise?**
    - Hypotension
    - Acutely altered mental status
    - Signs of shock

11. **Synchronized cardioversion**

12. **Consider adenosine**
    - If rhythm regular and QRS monomorphic

13. **Expert consultation advised**
    - Amiodarone
    - Procainamide

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**DOSES/DETAILS**

**Synchronized cardioversion:** Begin with 0.3-1 J/kg; if not effective, increase to 2-3 J/kg. Sedate if needed, but don't delay cardioversion.

**Adenosine IO/IV dose:**
- First dose: 0.1 mg/kg rapid bolus (maximum: 6 mg).
- Second dose: 0.2 mg/kg rapid bolus (maximum second dose 12 mg).

**Amiodarone IO/IV dose:**
- 0.9 mg/kg over 20 minutes
  - OR
- Procainamide IO/IV dose:
  - 15 mg/kg over 30-60 minutes
  - Do not routinely administer amiodarone and procainamide together.
SUMMARY

- Tachycardia is good, a benign adaptive finding in most cases in most children.
- Tachycardia with persistent high pulse rates and reduced perfusion require an urgent approach.
- ECG monitoring will reveal the bad and the ugly rhythms requiring emergent intervention.
REFERENCES
