Pediatric Electrophysiology

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On Discovery…

“What is wanted is not the will to believe, but the will to find out, which is the exact opposite.”

Bertrand Russell
1872-1970


Electrophysiology…

Strange Recordings
www.starklab.siu.edu

Electrophysiology…

Strange Labs
www.starklab.siu.edu
Where We Are Going…

- Clinical Electrophysiology
  - Wide Complex Tachycardia in Pediatrics
- Interventional Electrophysiology
  - Evaluating SVT Mechanisms
- Diagnostic Procedures
  - Post-Operative Atrial Electrograms
- Device-Based Therapies
  - Basics of Pacemakers

Management of Wide QRS Tachycardias

What is the most appropriate therapy?

Wide QRS Tachycardias

Why adenosine for ventricular tachycardia?
Management of Wide QRS Tachycardias

- aberrantly-conducted orthodromic re-entrant tachycardia
- orthodromic re-entrant tachycardia with bundle branch block
- focal atrial tachycardia with aberrant conduction
- multifocal atrial tachycardia with aberrant conduction
- antidromic re-entrant supraventricular tachycardia
- atrial fibrillation with pre-excited tachycardia
- ventricular tachycardia

70% of all wide QRS tachycardias are supraventricular in origin

Aberrantly Conducted SVT

Tachycardia Cycle Length (Wide QRS) = 280msec (214 bpm)
Tachycardia Cycle Length (Narrow QRS) = 240msec (250 bpm)

So what does this mean?

Aberrant Conduction

Antidromic SVT
Antidromic SVT

- Requires the presence of pre-excitation (WPW) on the resting ECG
- ECG during SVT may be indistinguishable from VT
- Management of antidromic SVT is identical to that of other form of SVT

Outflow Tract Ventricular Tachycardia

Outflow Tract VT

What is Supraventricular Tachycardia?

Sinus Tachycardia vs SVT

- Probable sinus tachycardia
  - Compatible history consistent with known cause
  - P waves present/normal
  - Variable R-R; constant PR
  - Infants: rate usually <200/min
  - Children: rate usually <180/min

- Probable supraventricular tachycardia
  - Compatible history (e.g., non-specific, history of abrupt rate changes)
  - P waves absent/abnormal
  - HR not variable
  - Infants: rate usually >220/min
  - Children: rate usually >180/min
What is Supraventricular Tachycardia?

Decoding SVT

Left Anterior Oblique View

Right Anterior Oblique View

Decoding SVT

AV Re-Entry Tachycardia

AV Node Re-Entry Tachycardia

Why Are Mechanisms Important?

• Direct therapy
  • Proper selection of site for ablation
  • Some influence of the choice of medication

• Provide Prognosis
  • Likelihood of medical and procedural success
  • Likelihood of spontaneous resolution
The ICU Challenge

- 2 month old female
- 8 hours post-OP repair of double outlet right ventricle with aortic arch reconstruction
- Increasing tachycardia & hypotension with poor perfusion

What is the diagnosis?
What is the most appropriate therapy?

Surmounting the Challenge

Atrial Rate > Ventricular Rate = Variable AV Block
Atrial Rate < Ventricular Rate = Junctional/Ventricular Rhythm

Alternative Approach
Transesophageal Electrogram

CARDIAC DEVICE-BASED THERAPIES
Too Slow or Too Fast

Pacemakers
Implanted Defibrillators
Anti-tachycardia Devices
Transvenous
Epicardial

Arrhythmia Detection

Useful in pediatrics as much for what they “rule out” as they “rule in”

Decoding Pacing for Pediatricians

Things you need to know:
• Why does the patient have a pacer/ICD?
• Is the patient dependent on the pacemaker?
• What is the mode of pacing/ICD?
• What are the rate limits?
• Are the performing remote monitoring?
• What will the device do if there is a problem?

Decoding Pacing for Pediatricians

Pacing Modes:
• Sick sinus syndrome, sinus bradycardia
  • AAI (rarely VVI)
• Heart Block
  • DDD, VVI

Decoding the Pacing Mode:

A       A       I
Paced Chamber Sensed Chamber Response to Sensed Activity

Decoding Pacing for Pediatricians

Common Settings Examples:
• Patient has a single ventricle and is status post a Fontan procedure. Also has "sick sinus syndrome" but is not pacemaker-dependent:
  • Single-chamber epicardial system
  • Programming: AAI @ 70 ppm
• Patient has congenital complete heart block and has undergone a pacemaker implantation because of syncope:
  • Dual-chamber transvenous system
  • Programming: DDD @ 80-200 ppm
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Decoding Pacing for Pediatricians

Example of Malfunction:

DDD 60-180

Decoding Pacing for Pediatricians

Remote Monitoring:

www.medtronic.com
www.stjudemedical.com

Decoding Pacing for Pediatricians

CONCLUDING THOUGHTS

Key Points…
• All wide complex tachycardias in pediatrics are not ventricular tachycardia (though they should be respected as such)
  – Remember your PALS algorithm
• Understanding the type of SVT often requires an invasive EP study
  – Mechanisms can help direct therapy

Key Points…
• Bedside electrocardiograms can help to better understand the mechanism of tachycardia in patients who are poor candidates for formal invasive studies
• Pacemakers are the most common implanted cardiac device (used for slow heart rates in children due to sinus node dysfunction or AV block); other devices can diagnose and/or treat tachyarrhythmias.
Final Thoughts…

“The voyage of discovery is not in seeking new landscapes but in having new eyes.”

Marcel Proust 1871-1922