READING THE WAVES- THE HEART’S ELECTRICAL MESSAGE

FINANCIAL DISCLOSURE

Dr. Schroeder has no financial relationships to disclose

OBJECTIVES

• Tips on reading routine office EKG’s
• EKG’s findings for common office complaints
  + Chest pain
  + Palpitations/tachycardia
  + Syncope/dizziness
  + Family history (sudden death, ect)
• When to observe vs refer
LEAD PLACEMENT

INTERPRETATION

- Develop a systematic approach
- The Dubin system:
  - Rate
  - Rhythm (including intervals and blocks)
  - Axis
  - Hypertrophy/enlargement
  - Conduction
  - QTc
  - Infarction/ST changes

Basic EKG Anatomy
NORMAL INTERVALS- VARIES WITH AGE

- **PR**
  - 0.20 sec (less than one large box)
- **QRS**
  - 0.08 – 0.10 sec (1-2 small boxes)
- **QT**
  - Kids < 440ms
  - 450 ms in men, 460 ms in women
  - Based on sex / heart rate
  - Half the R-R interval with normal HR

THE QRS AXIS

- Represents the overall direction of the heart’s activity
- Axis of –30 to +90 degrees is normal

THE QUADRANT APPROACH

- QRS up in I and up in aVF = Normal
RATE - QUICK DETERMINATION

× Rule of 300 - Divide 300 by the number of big boxes between each QRS = rate

![ECG diagram with annotations]

WHAT IS THE HEART RATE?

(300 / 6) = 50 bpm

COMMON PEDIATRIC COMPLAINTS
ARRHYTHMIA

- Palpitations +/- syncope (Race, Flutters, Beeps and Thumps)
  - Benign variant rhythms (sinus arrhythmia, ectopic atrial, ventricular or junctional rhythm)
  - Ectopy (PAC’s, PVC’s)
  - Pathological tachycardia (SVT)

RHYTHM

- Sinus
  - Originating from SA node
  - P-wave before every QRS
  - P-wave in same direction as QRS
  - If P-wave is down-going II, III, AVF, think ectopic atrial rhythm

ECTOPIC ATRIAL RHYTHM VS TACHYCARDIA
WHAT IS THE RHYTHM?

Rate increases with inspiration and decreases with expiration. Due to fluctuations in parasympathetic vagal tone. During inspiration stretch receptors in the lungs stimulate the cardioinhibitory centers in the medulla via fibers in the vagus nerve. Treatment is not usually required unless symptomatic bradycardia is present.

WHAT'S MISSING???

Rate 40-60, no p waves, narrow complex QRS

THIS LOOKS BAD. IS IT????

Ventricular escape rhythm, 40-110 bpm
PRE-MATURE ATRIAL CONTRACTIONS

Trigeminy pattern

WHAT ARE PVC’S?

Terminal branches of the Purkinje fibers

Ventricular Contraction

QRS
Benign vs Concerning PVC’s

Multiple PVC’s from an irritable focus

Each irritable focus produces its own distinctive PVC

Compensatory vs Noncompensatory Pauses

Normal Sinus Rhythm

Premature Ventricular Contraction

To measure a full compensatory pause:
1. Mark the first pause of the normal cycle preceding a PVC.
2. Mark the first pause of the normal cycle preceding the last PVC.
3. These two pauses should be equal and measure the compensatory pause.

SYNCOPE

- Bradycardia
- Heart block
- Pericardial effusion
- Tachyarrhythmia
**BLOCKS**

× AV blocks
  + First degree block
    × PR interval fixed and > 0.2 sec (benign)
  + Second degree block, Mobitz type 1
    × PR gradually lengthened, then drop QRS (benign)
  + Second degree block, Mobitz type 2
    × PR fixed, but drop QRS randomly (bad)
  + Type 3 block
    × PR and QRS dissociated (bad)

**NORMAL OR ABNORMAL?**

1st degree AV block
PR is fixed and longer than 0.2 sec

**MOBITZ TYPE I- 2ND DEGREE BLOCK (WENCKEBACH)**

“Group Beating” Pattern
MOBITZ TYPE II 2ND DEGREE HEART BLOCK,

PR interval fixed, QRS dropped intermittently

3RD DEGREE HEART BLOCK (COMPLETE)

V1: RSR prime pattern with inverted T wave
V6: Wide deep slurred S wave

RIGHT BUNDLE BRANCH BLOCK-BENIGN

V1: RSR prime pattern with inverted T wave
V6: Wide deep slurred S wave
SUPRAVENTRICULAR TACHYCARDIA

Narrow complex, regular; retrograde P waves, rate <220

WOLFF-PARKINSON-WHITE SYNDROME

Short PR interval <0.12 sec
Prolonged QRS >0.10 sec
Delta wave
Can simulate ventricular hypertrophy, BBB

CHEST PAIN

• Hypertrophy (non-athletic)
• Pericarditis/Pericardial effusion
• Myocarditis
• Kawasaki
• Contusion
HYPERTROPHY

LVH    RVH

PERICARDIAL DISEASE

PERICARDIAL TAMponade
**MYOCARDIAL ISCHEMIA**

![ST Depression ECG Image]

**CONCERNING FAMILY HISTORY**

- Sudden unexplained death (LQTc, HCM)
- Unexplained seizure or syncope (LQTc)
- Need for pacemakers (HCM, arrhythmogenic RV, Brugada)
- Need for transplant (dilated/hypertrophic or others)

**ATRIAL ENLARGEMENT**

<table>
<thead>
<tr>
<th>Condition</th>
<th>P Wave Morphology</th>
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<tbody>
<tr>
<td>Normal Sinus Rhythm</td>
<td></td>
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<tr>
<td>Right atrial enlargement</td>
<td></td>
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<tr>
<td>Left Atrial Enlargement</td>
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</tbody>
</table>

*FIGURE 1: Effect of atrial enlargement on P wave morphology*
FAMILIAL HYPERTROPHIC CARDIOMYOPATHY

NORMAL HEART

HEART WITH HYPERTROPHIC CARDIOMYOPATHY

PROLONGED QT

- Normal corrected
  - Men 450ms
  - Women 460ms
  - Kids 440ms
- Corrected QT (QTc)
  - QTmax/√(R-R)
- Causes
  - Drugs (Na channel blockers)
  - Hypocalcemia, hypomagnesemia, hypokalemia
  - Hypothermia
  - AMI
  - Congenital
  - Increased ICP
BRUGADA SYNDROME

- Usually 2nd-3rd decade of life.
- History of aborted sudden death with the EKG pattern of ST elevation in leads V1-V3, +/- right bundle branch block.
- Screening EKG indicated if there is a + FHx.

WHEN TO CALL OR REFER TO CARDIOLOGY

<table>
<thead>
<tr>
<th>Benign (if asymptomatic)</th>
<th>Not so Benign</th>
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<tbody>
<tr>
<td>Sinus rhythmia</td>
<td>Hypertrophy</td>
</tr>
<tr>
<td>1st AV block</td>
<td>Mobitz II block</td>
</tr>
<tr>
<td>Type I, 2nd degree AV block</td>
<td>3rd degree block</td>
</tr>
<tr>
<td>Right bundle branch block</td>
<td>Tachy or barycardia</td>
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<tr>
<td>Early repolarization</td>
<td>Ventricular rhythm</td>
</tr>
<tr>
<td>QTc &gt; 450ms</td>
<td>ST segment elevation/low voltage</td>
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<tr>
<td>Single beat ectopy</td>
<td>Multiform, multiple beat ectopy, 5%/24h</td>
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Questions are guaranteed in life; Answers aren't.