PATHWAYS AROUND THE PITFALLS OF EKG RHYTHM INTERPRETATION

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I have no conflicts of interest relative to this lecture.

OBJECTIVES FOR PATHWAYS AROUND PITFALLS OF EKG RHYTHM INTERPRETATION

1. Identify ways to avoid common diagnostic errors in EKG rhythm interpretation through the use of a systematic approach to analysis
2. Discuss the differential diagnosis of the narrow QRS complex tachycardia
3. Differentiate between various AV conduction disturbances
4. Discuss strategies for dealing with the wide QRS tachycardia
5. Differentiate the rhythm disturbances creating the long R to R pause
IS THERE A RHYTHM ABNORMALITY?
1. Is the Dominant Atrial Activity Sinus? If Not, What Is It: Organized, Chaotic or Can’t Be Found?
2. Are the Atrial Waves & QRS’s in Equal Numbers with a Fixed PR or RP Interval? If Not, Is the Relationship AR>VR or VR>AR?
3. If Ventricles Not Driven By Atrial Activity, Is It a Junctional or Ventricular Mechanism?
4. Are There Any Unexpected Early QRS’s or Unexpected Pauses of the QRS’s?
5. If Any Long R-R Pause, Is It Terminated by a Believable PR? If Not, It’s an Escape Beat

DOMINANT ATRIAL ACTIVITIES

- Sinus: Regular; Rate (Adults) 40 – 180 (supine) or 200 (Maximum Exertion). P Upright in I &/or II; Never Inverted in II and aVF.
IF NOT CLEARLY SINUS, IS THE ATRIAL ACTIVITY:

1. Regular and Organized?

2. Chaotic and Disorganized?

3. Indiscernible?

DOMINANT ATRIAL ACTIVITIES

Other Regular Atrial Activities:


   A. AV Nodal Reentrant: 1 QRS:1 Retrograde P & Fixed R-P, Rate 140-220
   B. Focal Ectopic Atrial Tachycardia

3. Retrograde P Waves: Inverted in II & aVF
   A. Passive: 1 QRS: 1 P & Fixed R-P
   B. Active: All Other Retrograde P Waves

DOMINANT ATRIAL ACTIVITIES

Irregularly Irregular (Chaotic) Atrial Activity:

1. Atrial Fibrillation: Irregularly Undulating Baseline; Rate 400+.

2. Multifocal Atrial Tachycardia: Isolated occasional Sinus P plus ≥ 3 Multiformed APC’s with Average Heart Rate > 100 BPM
IF NOT CLEARLY SINUS, 
IS THE ATRIAL ACTIVITY:

1. Regular and Organized?

2. Chaotic and Disorganized?

3. Indiscernible?

ATRIAL ACTIVITY INDISCERNIBLE?
LOOK AT THE QRS’s!

Regular R to R & Narrow (<0.12 secs):

A. Slow QRS’s HR≤60: Atrial Asystole & Junctional Escape Rhythm


ATRIAL ACTIVITY IS INDISCERNIBLE. NOW WHAT?
LOOK AT THE QRS’s!

Irregularly Irregular R to R Intervals with QRS’s Wide or Narrow: Think First of Atrial Fibrillation.

Regular R to R Intervals with Wide (≥0.12 seconds) QRS’s: Proceed to the Ventricular Analysis – Usually Turns Out To Be One of the Ventricular Mechanisms
DIFFERENTIAL DIAGNOSIS: RAPID & REGULAR NARROW QRS RHYTHM

Clues According to QRS Rate

- If Rate > 180, Almost Always P.S.V.T.; Most Unlikely To Be Sinus or Atrial Flutter with 2:1 AV Block
- If Rate < 140, Almost Always either Sinus or Atrial Flutter with 2:1 AV Block; Unlikely To Be P.S.V.T.
- If Rate 140 – 180, Equally Likely To Be Sinus, Atrial Flutter with 2:1 AV Block, or P.S.V.T. Based Just on Rate of QRS’s.

DIFFERENTIAL DIAGNOSIS: RAPID & REGULAR NARROW QRS RHYTHM:

UNMASKING THE FLUTTER

- Look For Saw-tooth Pattern in Leads II, III, & aVF by Disregarding the QRS’s.
- Look For the Extra “p” in V1 &/or V2 by Looking Halfway In Between Discernible “p” Waves.
- Transpose the “PR” Found in V1 &/or V2 Back to Lead II. Does It Look Like a Sinus P There?
Atrial Flutter with 2:1 AV Block

Ignore the QRS's in II, III & aVF.  
Look for the Saw-Tooth Flutter Waves (See Arrows)

Atrial Flutter with 2:1 AV Block & One PVC (QRS #12)

Note the Extra Atrial Waves (down arrows) Exactly Halfway Between the Discernible Atrial Waves (up arrows) in V1 or V2

Atrial Flutter with 2:1 AV Block and One PVC (QRS #12)

Note the PR Interval of the Discernible Atrial Wave in V1 or V2 (or any other lead).  
Transpose that PR Interval to Lead II & Note Shape of Atrial Wave in Lead II (See Up Arrow).
IS THERE A RHYTHM ABNORMALITY?

1. Is the Dominant Atrial Activity Sinus? If Not, What Is It?
2. **Are the Atrial Waves and QRS's in Equal Numbers with a Fixed PR Interval?**
   If Not, What Is the Relationship?
   AR > VR or VR > AR
3. If Ventricles Not Driven By Atrial Activity, Is It a Junctional or Ventricular Mechanism?
4. Are There Any Unexpected Early QRS's or Unexpected Pauses of the QRS's?

HOW CAN ATRIAL & VENTRICULAR ACTIVITY BE RELATED?

- **1:1 (Must Have Fixed PR or RP!!)**
  - Antegrade (Atrium Activates Ventricle). Fixed PR.
  - Retrograde Activation of Atrium from Junctional or Ventricular Mechanism. Fixed RP

- **Atrial Rate (AR) Different Than Ventricular Rate (VR)**
  - AR > VR = 2\textsuperscript{nd} or 3\textsuperscript{rd} Degree Atrioventricular (AV) Block
  - VR > AR = AV Interference Dissociation

HEART BLOCK
SCHEME FOR IDENTIFYING THE NAME OF THE 2ND OR 3RD DEGREE AV BLOCK

Regular P’s, AR > VR = 2nd or 3rd Degree AV Block

Does the PR Vary?

YES

Does The R-R Vary?

YES

Mobitz I 3rd Degree

NO = 2nd

1. 2:1

2. ≥ 3:1

3. Mobitz II

NO

Degree

Mobitz I

3rd Degree

3. Mobitz II
ATRIOVENTRICULAR DISSOCIATION
- The Atria & The Ventricles Are Being Activated Independently
- Two Different Reasons This Can Happen:
  1. 3rd Degree (Complete) AV Block (AR > VR). A True Conduction Abnormality.

AV INTERFERENCE DISSOCIATION
- Dissociation Due To Collision In the AV Node of Antegrade Atrial Impulses & Retrograde Impulses From a Junctional or Ventricular Rhythm
- Can Only Occur If VR > AR
- Thus, Will Be Due To Either
  1. Slow Sinus Rate < Rate of Escape Pacers, And/Or
  2. Pathological “Ectopic” Junctional or Ventricular Rhythms At Rates > Sinus Rates
**IS THERE A RHYTHM ABNORMALITY?**

1. Is the Dominant Atrial Activity Sinus? If Not, What Is It?

2. Are the Atrial Waves and QRS's in Equal Numbers with a Fixed PR Interval? If Not, What Is the Relationship?

3. If Ventricle Not Driven By Atrial Activity, Is It a Junctional or Ventricle Mechanism?

4. Are There Any Unexpected Early QRS's or Unexpected Pauses of the QRS's?

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**WHEN TO GO TO THE VENTRICULAR ANALYSIS**

1. **Can't Discern Atrial Activity**—Anytime But Most Commonly When There Is a Wide & Regular QRS Rhythm

2. **A-V Dissociation** (3rd Degree AV Block or Interference AV Dissociation)

3. **Presence of Passive Retrograde Atrial Activity**

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<thead>
<tr>
<th>QRS Narrow (&lt;.12), It’s Junctional:</th>
<th>QRS Wide (£.12), Usually Ventricle:</th>
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<tbody>
<tr>
<td>40-60: Escape</td>
<td>20-40: Escape</td>
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<tr>
<td>70-130: Accelerated J. Rhythm</td>
<td>55-110: Accelerated Idioventricular Rhythm (Slow VT)</td>
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<tr>
<td>≥140: PSVT</td>
<td>&gt;120: V.T.</td>
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RULE I

ALL REGULAR & WIDE-QRS TACHYCARDIAS (Rate 140+)
Without Clearly Defined Sinus P Waves for Each QRS
ARE VENTRICULAR TACHYCARDIA
Until Proven Otherwise

RULE II

IN THE PRESENCE OF CLINICAL INSTABILITY OR STRUCTUAL HEART DISEASE,
DO NOT WASTE TIME PROVING OTHERWISE!!
RULE III

REMEMBER RULES I AND II

UNEXPECTED EARLY QRS or PAUSE IN THE REGULAR QRS's

**Unexpected Early QRS's:**
1. Most Will Be Premature Ectopic Beats: APC’s (if aberrantly conducted, look for the premature p wave), PJC’s, PVC’s
2. If AV Interference Dissociation Present & the Premature Complex Preceded by Atrial Wave, Probably a Ventricular Capture Beat by the Atrial Mechanism
II. Unexpected Pauses in Regular QRS’s

A. Sinus Arrest or Sino-atrial Block
B. Second Degree AV Block
C. Non-conducted (Blocked) APC

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<tr>
<th>CAUSE</th>
<th>HALLMARK</th>
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<tbody>
<tr>
<td>SA Arrest or Block</td>
<td>No P In the Pause</td>
</tr>
<tr>
<td>Mobitz I or II 2nd Degree AV Block</td>
<td>On Time P In the Pause</td>
</tr>
<tr>
<td>Blocked APC</td>
<td>Premature P In the Pause</td>
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THE LONG PAUSE

So You Have a Long Pause (Long R-R), What Is the QRS Complex That Terminates It?

Does that QRS Complex Have a Believable PR?

What Is Believable?

If No Believable PR, That QRS Is an Escape Beat.
Summary
A systematic analysis of rhythms consists of:
What are the atria doing? Sinus v Organized v Chaotic v Indiscernible?
What is the AV relationship: 1:1 (fixed PR or RP) v AR>VR v VR>AR. If AR>VR, Does PR vary; if not, does R-R vary?
If atria not creating the QRS’s, is QRS wide or narrow & at what rate.?
Long R to R: SA arrest v 2nd AV block v nonconducted APC.
What terminates a pause? Believable PR?