Day 11
Interesting ECGs (& more advanced)

Reading Assignment (p1-91 in ‘Outline’)

Objectives
• What’s in an ECG?
The “5-Step Method”

<table>
<thead>
<tr>
<th>Measurements:</th>
<th>Rhythm (s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= V=</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PR=</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QRS=</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT=</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis=</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Compute the 5 basic measurements: HR, PR interval, QRS duration, QT interval, Axis
2. What’s the basic rhythm and other rhythm statements (e.g., PACs and PVC’s)
3. Any conduction abnormalities (SA blocks, AV blocks (Types I or II), and IV blocks)
4. Waveform abnormalities beginning with P waves, QRS complexes, ST-T, and U waves
5. Final interpretations: Normal ECG or Borderline or Abnormal ECG (list final conclusions)
73 year old man
Rhythm (s):
- Sinus rhythm
- PVC’s in a pattern of bigeminy (*);
  note, these are late (or end-
  diastolic) PVC’s occuring after the
  P wave onset. Morphology rules out aberrant conduction.

Conduction:
- 1st degree AV Block

Waveform:
- Inverted T waves V1-5
- Misplaced leads (V5, V6); note QRS and T wave differences.

Interpretation:
Abnormal ECG
1. Rhythm (bigeminal PVCs from RV)
2. Inverted T waves (etiology unknown)
3. 1st degree AV block
73 year old man: look for the P waves!
<table>
<thead>
<tr>
<th>Measurements:</th>
<th>Rhythm(s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR= varies</td>
<td>Sinus rhythm</td>
<td>2nd degree AV block (type I) with 2:1 and 3:2 group beating.</td>
<td>T wave inversion (multiple leads)</td>
<td>Abnormal ECG: 1. 2nd degree AVB (type I) 2. Prolonged QT 3. Nonspecific T abnormalities (etiology not known)</td>
</tr>
<tr>
<td>QRS=70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT= 520</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis= +15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2:1 conduction  
3:2 conduction  
3:2 conduction
79 year old woman; long standing atrial fibrillation
Measurements: | Rhythm (s): | Conduction: | Waveform: | Interpretation: |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A= V= -35</td>
<td>Atrial fibrillation</td>
<td>High grade or complete AV block</td>
<td>T wave inversion V1-4</td>
<td>Abnormal ECG: 1. Rhythm (A fib and PVC's) 2. 3rd degree AV block (note fixed RR intervals between junctional beats); this rules out conducted a-fib beats. 3. Nonspecific T abnormalities (uncertain etiology)</td>
</tr>
<tr>
<td>PR= none</td>
<td>Junctional escapes (J)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QRS= 80</td>
<td>PVC's (*) RV origin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT=480</td>
<td>Origin of the 1st beat (?) is uncertain but most likely a conducted beat from the a-fib. Junctional escapes may look slightly different from sinus or a-fib beats.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
49 year old man in the ER (history of Marfan’s syndrome post aortic root surgery)
<table>
<thead>
<tr>
<th>Measurements</th>
<th>Rhythm(s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A= 280 V= 140</td>
<td>Atrial flutter</td>
<td>2:1 AV block</td>
<td>• Flutter waves (arrows) • ST-T abnormalities</td>
<td>Abnormal ECG: 1) Rhythm (a-flutter) 2) Left axis deviation (uncertain cause) but not LAFB ($S_2 &gt; S_3$) 3) Nonspecific ST-T changes</td>
</tr>
<tr>
<td>PR= ?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QRS= 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT= 320</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis= -75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Measurements: 

A=50  V=70
PR=160
QRS=100
QT=380
Axis= +45

Rhythm(s): • Sinus bradycardia  
• Interpolated PVC's from RV

Conduction: Normal AV and IV

Waveform: • Increase P terminal force in V1 (area > 1 small box)

Interpretation: Abnormal ECG
• Left atrial enlargement (LAE)
• Interpolated PVC's (note: the PVCs are sandwiched between 2 sinus beats without a pause; the PR after the PVC is prolonged due to partial retrograde concealed conduction.)
53 year old man with pulmonary hypertension
A: 220 bpm  
V: 160 bpm  
QRS: 80 ms  
Axis: +150°

**Rhythm:** ectopic atrial tachycardia (or atrial flutter)  
**Conduction:** mostly 3:2 AV block (type I)  
**Diagnosis:** RVH + ectopic atrial tachycardia

**Waveform:** Prominent anterior forces (PAF)
21 year old woman. Tracing provided by Dr. Andres R. Perez Riera  (This one is very difficult!)
e = echo
f = fusion
83 year old man
### Measurements:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>68</td>
</tr>
<tr>
<td>V</td>
<td></td>
</tr>
<tr>
<td>PR</td>
<td>varies</td>
</tr>
<tr>
<td>QRS</td>
<td>110, 140</td>
</tr>
<tr>
<td>QT</td>
<td>420</td>
</tr>
<tr>
<td>Axis</td>
<td>0</td>
</tr>
</tbody>
</table>

### Rhythm (s):

- Sinus rhythm with occasional RV escape beats or LBBB sinus captures (*)

### Conduction:

- 2nd degree AV block, type I
- IVCD

### Waveform:

- rsR' in V1

### Interpretation:

**Abnormal ECG:**

1. 2nd degree AVB (type I)
2. Incomplete RBBB
3. Ventricular escape beats (alternative explanation: these beats are sinus captures with bradycardia-dependent LBBB)
77 year old man; history of syncope
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation:
---|---|---|---|---
A= 95  V= ~same | • Sinus rhythm (arrows) • 2 PVC’s (*) | 2nd degree AV block (type I) | Voltage and ST-T changes of LVH | Abnormal ECG
PR= varies | | | | 1. Type I 2nd degree AV block
QRS=90 | | | | 2. LVH with strain
QT= ~380 | | | | 3. Rhythm (PVC’s)
Axis= -15 | | | |
59 year old man; known ASCVD and history of atrial fibrillation
Measurements: | Rhythm (s): | Conduction: | Waveform: | Interpretation:
---|---|---|---|---
A= V= ~70 | Accelerated junctional rhythm (junctional rhythm slightly greater than 100 bpm) | • IVCD (RBBB) • 3:2 exit block between junction and ventricles | rsR’ in V1 | Abnormal ECG:
1. Rhythm (accelerated J-rhythm) 2. Conduction RBBB and 3:2 J-V exit block (note the group beating with pause less than 2 junctional cycles suggests a Wenckebach 2nd degree block between junction and ventricles; often due to digoxin toxicity)
71 year old man; hospitalized for a GI bleed
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A=100 & 150 | Sinus tachycardia | Three RBBB aberrancies at the onset of the atrial tachycardia (rate related) | Minor ST-T abnormalities | Abnormal ECG: 1. PAC’s and onset of ectopic atrial tachycardia. |
V=100 & 150 | PAC’s, conducted and nonconducted (*) | | | |
PR=160 | Ectopic atrial tachycardia (onset: red arrow) | | | |