Blocks & Dissociations

Reading Assignment (p47-52 in ‘Outline’)

Objectives
- Who are Wenckebach and Mobitz?
- Review SA and AV Blocks
- AV Dissociations: learning who’s the boss and why
2nd degree SA Block: type I vs. type II

Does it matter?

**SA Wenckebach ‘Rules’**
- PP shortens up to the pause
- PP of pause < any 2 preceding PP
- PP after pause > PP just before pause

**Answer is: No!**
Questions:
1. How did Wenckebach first detect 2nd degree AV block? (aka ‘Type I’); hint: it was before ECG was ‘invented’.
2. What advantages did Mobitz have in detecting Type ‘II’ 2nd degree AV block?
3. Why does it matter to differentiate Type I from II AV block but not SA block?
The “5-Step Method”

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)

<table>
<thead>
<tr>
<th>Measurements:</th>
<th>Rhythm (s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
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</thead>
<tbody>
<tr>
<td>A= V=</td>
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<td>PR=</td>
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<td>QRS=</td>
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<td>QT=</td>
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<td>Axis=</td>
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72 y.o. woman; lightheaded
# Interpretation

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Rhythm</th>
<th>Conduction</th>
<th>Waveform</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=85 V=85</td>
<td>Sinus rhythm</td>
<td>2nd degree SA block</td>
<td>rSr' in V1 (normal variant)</td>
<td>2nd degree SA block (this can be a manifestation of sick sinus syndrome and usually indicates need for a pacemaker)</td>
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<tr>
<td>PR=190</td>
<td>Normal AV, IV</td>
<td>Normal P, QRS, ST-T</td>
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<tr>
<td>QRS=100</td>
<td>Note: each pause has a missing P wave (?) suggesting the sinus fires but it doesn’t conduct to the atria.</td>
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<td>QT=360</td>
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<tr>
<td>Axis=-10</td>
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</table>
GS: Age 62.... Taking a pause once in awhile!
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A=70 | V=<70 | Normal SA, AV, and IV | Normal P and QRS; minor T wave abnormalities | Abnormal ECG: 1. Rhythm (PACs) 2. Nonspecific minor T wave abnormalities
PR=150 | | | | Note: the most common cause of an unexpected pause in the rhythm is a nonconducted PAC.
QRS=80 | | | |
80 year old man with pauses; (differential diagnosis of unexpected pauses?)
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A=55 V= 40-55 | Sinus rhythm with one nonconducted PAC (arrow) | 2nd degree AV block (type I, Wenckebach) | Normal P, QRS, ST-T | Abnormal ECG: 1. 2nd degree (type I) AVB; note the PR after the nonconducted P (*) is shorter than the PR before – indicating type I 2° AV block 2. Nonconducted PAC (arrow) |
44 year old man; history of atrial septal defect. (What type of ASD?)
Measurements: | Rhythm(s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A=60 V= ~50 | Sinus arrhythmia with 2 junctional escapes (*); note slightly different QRS. | • 2nd degree AV block (type I, Wenckebach) | • Normal P | Abnormal ECG: |
PR= varies | • Left anterior fascicular block | • Small q in aVL; S_{iii} > S_{ii} | | 1. Type I 2nd degree AVB |
QRS=100 | | | | 2. Left anterior fascicular block |
QT=440 | Note: junctional escapes are a normal response to long RR cycles (in this case due to the AV block) | | | LAFB is seen in ostium primum ASD; junctional escapes often have slightly altered QRS morphology compared to sinus beats. |
Axis= -45 | | | |
86 y woman; recent CVA; hx hypertension, diabetes, hyperlipidemia

What are the “Footprints of Wenckebach”?
**Measurements:**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90</td>
</tr>
<tr>
<td>V</td>
<td>~80</td>
</tr>
<tr>
<td>PR</td>
<td>varies</td>
</tr>
<tr>
<td>QRS</td>
<td>89</td>
</tr>
<tr>
<td>QT</td>
<td>380</td>
</tr>
<tr>
<td>Axis</td>
<td>+75</td>
</tr>
</tbody>
</table>

**Rhythm:** Sinus rhythm

**Conduction:**
- 2nd degree AV block (type I)
- Classic Wenckebach footprints (see above RR intervals)
  - Note: footprints work best when the sinus intervals (PP intervals) are regular; they don't work if there is sinus arrhythmia (varying PP's)

**Waveform:**
- Normal P, ST-T
- Poor R wave progression V1-6

**Interpretation:**
- Abnormal ECG:
  1. 2nd degree (type I) AV Block
  2. Poor R-progression (cause unknown)

**Footprints:**
- Decreasing RR intervals until pause
- RR after pause > RR before pause
- Pause is <2 preceding RR

These footprints are the result of PR increasing by smaller and smaller increments.
RH: 84 year old man admitted with sepsis; history of CAD, pulmonary fibrosis
Measurements:
- Rhythm (s):
  - Sinus tachycardia (arrows)
- Conduction:
  - 2nd degree AV block (type I)
  - IVCD (LBBB)
- Waveform:
  - Notched, monophasic R in I, aVL, V6
- Interpretation:
  - Abnormal ECG:
    1) Rate (sinus tachycardia)
    2) Conduction: type I 2nd degree AVB
    3) LBBB

Note: 3 footprints of Wenckebach: 1) decreasing RR intervals up to pause; 2) pause is < 2 preceding RR's; 3) RR after pause is > RR before pause

10:9 2° AV block, type I

P waves
Young man with more P’s than QRS’s
Measurements:  
A=100  V=50
PR=210
QRS=80
QT= ~440
Axis= +45

Rhythm (s):  
Sinus tachycardia (100 bpm)

Conduction:  
2:1 2nd degree AV Block

Waveform:  
- Normal P, QRS, inverted T in III (normal variant)
- PAF (R V2 > S V3); this is probably normal variant (early transition)

Interpretation:  
Abnormal ECG:
1. 2:1 2nd degree AVB (although we can’t differentiate type I from type II when 2:1 AVB present, this is likely type I because QRS is narrow and PR is borderline prolonged)
87 year old woman with presyncope
Measurements:
- **A=75**
- **V= ~60**
- **PR=220-240**
- **QRS=140**
- **QT=380**
- **Axis= -20**

<table>
<thead>
<tr>
<th>Rhythm (s):</th>
<th>Conduction:</th>
<th>Waveform:</th>
<th>Interpretation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus rhythm</td>
<td>1st degree AV block</td>
<td>rSR’ in lead V1 with late S in I, aVL, V6</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td></td>
<td>3:2 sino-atrial block</td>
<td></td>
<td>1. 2nd degree (3:2) SA block</td>
</tr>
<tr>
<td></td>
<td>IVCD (RBBB)</td>
<td></td>
<td>2. RBBB</td>
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</tbody>
</table>

In the elderly, conduction ‘disease’ often occurs in more than one location. In this case there is SA, AV, and IV block.
Provide 4 rhythm statements and 3 conduction statements... plus whatever else catches your eyes.
Measurements: | Rhythm (s): | Conduction: | Waveform: | Interpretation: |
---|---|---|---|---|
A=90 V=48 | • Junctional escape rhythm | • 3rd degree (complete) AV Block | • rsR' in V1 | Abnormal ECG: 1. Complete AV block with junctional escape rhythm 2. Incomplete RBBB 3. Left anterior fascicular block 4. PACs and one PVC |
PR= none! | • Sinus plus 3 PACs (arrows) and 1 PVC (last QRS) | • Incomplete RBBB | • rS II, III, aVF; S_{III} > S_{II} |
QRS= 110 | Note: each PAC resets the sinus timing (i.e., an incomplete pause) | • LAFB | |
QT=480 | | | |
Axis= -50 | | | |
Who is the boss?
M, Age 59

Measurements:
- A=75
- V=80
- PR=200 (just 2 captures)
- QRS=110
- QT=360
- Axis=+30

Interpretation:
- Accelerated junctional rhythm (80 bpm) competing with a slightly slower (75 bpm) sinus rhythm (i.e., the junction is in charge!)
- Incomplete AV dissociation with 2 sinus captures with RBBB aberration (arrows)

Waveform:
- Voltage and ST-T changes of LVH

Conduction:
- PR=200 (just 2 captures)

Abnormal ECG:
1. Rhythm (accelerated J-rhythm)
2. LVH with strain pattern

Note: There is no AV block; the AV dissociation is due to an accelerated rhythm overtaking a normal sinus rhythm. Only 2 P waves had an opportunity to conduct (arrows)
F, Age 76

What’s the clinical diagnosis?
**Measurements:**
- A=90
- V=65
- PR=120 (only one PR)
- QRS=160
- QT=420
- Axis=+120

**Rhythm:**
- Normal sinus and Accelerated junctional (*) rhythm

**Conduction:**
- Incomplete AV dissociation due to high grade 2nd AV block (only one sinus capture)
- IVCD (RBBB + LPFB)

**Waveform:**
- ST ↑ V1-5
- Q’s V1-6
- rS in I; qR in II, III (R_{III}>R_{II})

**Interpretation:**
- Abnormal ECG
  1. Extensive anterior STEMI
  2. RBBB + LPFB (bifascicular block)
  3. High grade 2nd degree AVB with incomplete AV dissociation, accelerated junctional rhythm (i.e., one small step away from 3rd degree AVB)
What’s at fault?
Measurements: | Rhythm (s): | Conduction: | Waveform: | Interpretation: |
<table>
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</thead>
<tbody>
<tr>
<td>A= ~37 V= ~45</td>
<td>Marked sinus bradycardia with a competing: Junctional escape rhythm (J)</td>
<td>Incomplete LBBB</td>
<td>Poor R progression V1-4</td>
<td>Abnormal ECG: 1. AV dissociation (sinus is too slow; junction escapes; sinus captures when an opportunity exists; typical of sick sinus syndrome) 2. Incomplete LBBB</td>
</tr>
<tr>
<td>PR= varies</td>
<td>Incomplete AV dissociation with 2 sinus captures (arrows and *)</td>
<td>Minor ST-T changes</td>
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<tr>
<td>QRS=120</td>
<td>QT=480</td>
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<td>Axis= -15</td>
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</table>
F, Age 72

Measurements: Rhythm(s): Conduction: Waveform: Interpretation:
--- --- --- ---
A ~50 V ~65 • Sinus bradycardia • 1st degree AV block for the 2 capture beats (*) • rS in I, aVL • Abnormal ECG:
PR ~280 (2 conducted) • Accelerated Junctional rhythm (J) • qR in III, aVF • 1. Incomplete AV dissociation due to
QRS= 110 • 1st degree AV block sinus slowing and accelerated
QT= 380 • rS in I, aVL junctional rhythm • Poor R progression V1-6
Axis= +135 • qR in III, aVF • ST-T abnormalities
1. ? Left posterior fascicular block
Nonspecific ST-T abnormalities
82 year old man with an unanswered question.
<table>
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<th>Interpretation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=40 V=30</td>
<td>Marked sinus bradycardia</td>
<td>3rd degree AV block</td>
<td>Normal P, QRS, and minor ST-T changes</td>
<td>Abnormal ECG:</td>
</tr>
<tr>
<td>PR= none</td>
<td>Junctional escape rhythm</td>
<td></td>
<td></td>
<td>1. 3^{rd} degree AVB</td>
</tr>
<tr>
<td>QRS=80</td>
<td>One nonconducted PAC (arrow)</td>
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<td></td>
<td>2. Rare PAC</td>
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<tr>
<td>QT=460</td>
<td>that resets the sinus clock</td>
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<td></td>
<td>The '?' refers to the unexpected pause in the sinus rhythm; the answer is a nonconducted PAC hidden in the previous QRS (arrow); this resets the sinus timing.</td>
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<tr>
<td>Axis= 0</td>
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Official ECG Interpretation:
Sinus rhythm
Second degree AV block, type I (Wenckebach) with occasional Aberrant conduction
Nonspecific intraventricular conduction delay
Abnormal ECG

67 year old woman
### Measurements:

<table>
<thead>
<tr>
<th>A=65</th>
<th>V=65</th>
<th>PR=480</th>
<th>QRS=90</th>
<th>QT=440</th>
<th>Axis=+30</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurements:</strong></td>
<td><strong>Rhythm(s):</strong></td>
<td><strong>Conduction:</strong></td>
<td><strong>Waveform:</strong></td>
<td><strong>Interpretation:</strong></td>
<td></td>
</tr>
<tr>
<td>Sinus rhythm</td>
<td>One nonconducted PAC (arrow)</td>
<td>Marked 1st degree AV block</td>
<td>Normal P, QRS, ST-T</td>
<td>Abnormal ECG:</td>
<td></td>
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<tr>
<td>One ventricular escape beat (*)</td>
<td>(the escape QRS morphology resembles LBBB; possible this is a junctional escape with bradycardia-dependent LBBB)</td>
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<td></td>
<td>1. 1st degree AV block</td>
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<td></td>
<td>2. Nonconducted PAC</td>
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<td>Extremely long PR intervals suggests that AV conduction is through the slow AV nodal pathway</td>
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</table>
76 y old man in ER 4 hrs. after onset of substernal chest pain

**Enough already?**

...or just one more?
Right sided chest leads

Measurements:  Rhythm(s):  Conduction:  Waveform:  Interpretation:

A=100  V=100  Sinus tachycardia  2nd degree AV block (type I)  

• ST↑ II, III, aVF
• ST↓ aVL, V1r, V2r, V3r

Abnormal ECG:
1. Acute inferior wall STEMI
2. 2nd degree AV block, type I

Note: right sided leads exclude the diagnosis of RV myocardial infarction.
so many P's....................
### Measurement:

| A=90 | V=30-40 |
| PR=400 (for 2 beats) |
| QRS=160 |
| QT ~480 |
| Axis= -60 |

### Rhythm(s):
- Sinus rhythm with 2 captured beats (*)
- Ventricular escape rhythm (V) from the LV

### Conduction:
- Incomplete AV dissociation due to high grade 2nd degree AV block
  - RBBB
  - LAFB
  - Tall P in lead II (>2.5 mm)
  - rSR' in V1 in the 2 conducted beats (*)
  - rS II, III with S III > S II

### Waveform:

### Interpretation:
1. Right atrial enlargement
2. High grade 2nd degree AV block with only 2 conducted beats (*)
3. Bifascicular block (RBBB + LAFB)
4. Ventricular escapes (note the ‘V’ beats do not have a fixed PR indicating that they are dissociated from the sinus P waves)