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“Reference Sheets”

May humanity benefit from your knowledge,

Dr. Dubin’s classic, simplified methodology for understanding EKG’s

Dale Dubin, MD

Learning Web Sites:

Physicians and medical students: www.theMDsite.com
Nurses and nurses in training: www.CardiacMonitors.com
Emergency medical personnel: www.EmergencyEKG.com
Personal Quick Reference Sheets

Dubin’s Method for Reading EKG’s

from: Rapid Interpretation of EKG’s
by Dale Dubin, MD
COVER Publishing Co., P.O. Box 07037, Fort Myers, FL 33919, USA

1. RATE (pages 65-96)
   Say “300, 150, 100” ... “75, 60, 50”
   • but for bradycardia:
     rate = cycles/6 sec. strip \times 10

2. RHYTHM (pages 97-202)
   Identify the basic rhythm, then scan tracing for prematurity, pauses, irregularity, and abnormal waves.
   • Check for: P before each QRS.
     QRS after each P.
   • Check: PR intervals (for AV Blocks).
     QRS interval (for BBB).
   • If Axis Deviation, rule out Hemiblock.

3. AXIS (pages 203-242)
   • QRS above or below baseline for Axis Quadrant
     (for Normal vs. R. or L. Axis Deviation).
     For Axis in degrees, find isoelectric QRS in a limb lead of Axis Quadrant using the “Axis in Degrees” chart.
   • Axis rotation in the horizontal plane: (chest leads)
     find “transitional” (isoelectric) QRS.

4. HYPERTROPHY (pages 243-258)
   Check \begin{cases} 
   P \text{ wave for atrial hypertrophy.} \\
   R \text{ wave for Right Ventricular Hypertrophy.} \\
   S \text{ wave depth in } V_1 \\
   + R \text{ wave height in } V_5 \text{ for Left Ventricular Hypertrophy.}
   \end{cases}

5. INFARCTION (pages 259-308)
   Scan all leads for:
   • Q waves
   • Inverted T waves
   • ST segment elevation or depression
   Find the location of the pathology (in the Left ventricle), and then identify the occluded coronary artery.
Determine Rate by Observation (pages 78-88)

Bradycardia (slow rates) (pages 90-96)
- Cycles/6 second strip × 10 = Rate
- When there are 10 large squares between similar waves, the rate is 30/minute.

Sinus Rhythm: origin is the SA Node (“Sinus Node”),
normal sinus rate is 60 to 100/minute.
- Rate more than 100/min. = Sinus Tachycardia (page 68).
- Rate less than 60/min. = Sinus Bradycardia (page 67).

Determine any co-existing, independent (atrial/ventricular) rates:
- Dissociated Rhythms: (pages 155, 157, 186-189)
  A Sinus Rhythm (or atrial rhythms) may co-exist with an independent rhythm from an automaticity focus of a lower level. Determine rate of each.

Irregular Rhythms: (pages 107-111)
- With Irregular Rhythms (such as Atrial Fibrillation) always note the general (average) ventricular rate (QRS’s per 6-sec. strip × 10) or take the patient’s pulse.
**Rhythm** (pages 97 to 111)

★★ Identify basic rhythm...
...then scan entire tracing for pauses, premature beats, irregularity, and abnormal waves.

★★ Always:
- Check for: P before each QRS.
- QRS after each P.
- Check: PR intervals (for AV Blocks).
- QRS interval (for BBB).
- Has QRS vector shifted outside normal range? (to rule out Hemiblock).

**Irregular Rhythms** (pages 107-111)

**Sinus Arrhythmia** (page 100)
Irregular rhythm that varies with respiration.
All P waves are identical.
Considered normal.

**Wandering Pacemaker** (page 108)
Irregular rhythm. P waves change shape as pacemaker location varies.
Rate under 100/minute...

...but if the rate exceeds 100/minute, then it is called

**Multifocal Atrial Tachycardia** (page 109)

**Atrial Fibrillation** (pages 110, 164-166)
Irregular ventricular rhythm.
Erratic atrial spikes
(no P waves) from multiple atrial automaticity foci. Atrial discharges may be difficult to see.
**Escape** (pages 112-121) – the heart's response to a pause in pacing

- An unhealthy Sinus (SA) Node may fail to emit a pacing stimulus ("Sinus Block"); this pause may evoke an escape beat from an automaticity focus.

- But a sick Sinus (SA) Node may cease pacing ("Sinus Arrest"), causing an automaticity focus to "escape" to assume pacemaker status.

- Then… the SA Node usually resumes pacing.

**Premature Beats** (pages 122-145) – from an irritable automaticity focus

- An irritable automaticity focus may suddenly discharge, producing a:

  - Premature Atrial Beat (pages 124-130)
  - Premature Junctional Beat (pages 131-133)
  - Premature Ventricular Contraction (pages 135-141)

PVC’s may be: multiple, multifocal, in runs, or coupled with normal cycles.
Tachyarrhythmias (pages 146-172), “focus” = automaticity focus

<table>
<thead>
<tr>
<th>Rates:</th>
<th>150</th>
<th>250</th>
<th>350</th>
<th>450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paroxysmal Tachycardia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flutter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibrillation</td>
<td>multiple foci discharging</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Paroxysmal (sudden) Tachycardia** …rate: 150-250/min. (pages 146-163)

- **Paroxysmal Atrial Tachycardia**
  - An irritable atrial focus discharging at 150-250/min. produces a normal wave sequence, if P' waves are visible. (page 149)
  - **P.A.T. with block**
    - Same as P.A.T. but only every second (or more) P' wave produces a QRS. (page 150)

- **Paroxysmal Junctional Tachycardia**
  - AV Junctional focus produces a rapid sequence of QRS-T cycles at 150-250/min.
  - QRS may be slightly widened. (pages 151-153)

- **Paroxysmal Ventricular Tachycardia**
  - Ventricular focus produces a rapid (150-250/min.) sequence of (PVC-like) wide ventricular complexes. (pages 154-158)

**Flutter** …rate: 250-350/min.

- **Atrial Flutter**
  - A continuous (“saw tooth”) rapid sequence of atrial complexes from a single rapid-firing atrial focus. Many flutter waves needed to produce a ventricular response. (pages 159, 160)

- **Ventricular Flutter** (pages 161, 162) also see “Torsades de Pointes” (pages 158, 345)
  - A rapid series of smooth sine waves from a single rapid-firing ventricular focus; usually in a short burst leading to Ventricular Fibrillation.

**Fibrillation** …erratic (multifocal) rapid discharges at 350 to 450/min. (pages 167-170)

- **Atrial Fibrillation** (pages 110, 164-166)
  - Multiple atrial foci rapidly discharging produce a jagged baseline of tiny spikes.
  - Ventricular (QRS) response is irregular.

- **Ventricular Fibrillation** (pages 167-170)
**Sinus (SA) Block**

An unhealthy Sinus (SA) Node misses one or more cycles (sinus pause)… the Sinus Node usually resumes pacing, but the pause may evoke an “escape” response from an automaticity focus. (pages 119-121)

---

**AV Block**

Blocks that delay or prevent atrial impulses from reaching the ventricles.

1° AV Block … prolonged PR interval (pages 176-178).

- PR interval is prolonged to greater than .2 sec (one large square).

2° AV Block … some P waves without QRS response (pages 179-185)

- Wenckebach … PR gradually lengthens with each cycle until the last P wave in the series does not produce a QRS.
- Mobitz … some P waves don’t produce a QRS response. If “intermittent,” an occasional QRS is dropped.

More advanced Mobitz block may produce a 3:1 (AV) pattern or even higher AV ratio (page 181).

2:1 AV Block … may be Mobitz or Wenckebach. (pages 182, 183)

- PR length and QRS width or vagal maneuvers help differentiate.

3° (“complete”) AV Block … no P wave produces a QRS response (pages 186-190)

- 3° Block: P waves—SA Node origin.
- QRS’s—if narrow, and if the ventricular rate is 40 to 60 per min., then origin is a Junctional focus.

- 3° Block: P waves—SA Node origin.
- QRS’s—if PVC-like, and if the ventricular rate is 20 to 40 per min., then origin is a Ventricular focus.

---

**Bundle Branch Block**

… find R,R' in right or left chest leads (pages 191-202)

**Right BBB** (pages 194-196)

**Left BBB** (pages 194-197)

**Caution:** With Left BBB infarction is difficult to determine on EKG.

---

**Hemiblock**

… block of Anterior or Posterior fascicle of the Left Bundle Branch. (pages 295-305)

**Anterior Hemiblock**

- Axis shifts Leftward → L.A.D.
- look for Q, S
  (pages 297-299)

**Posterior Hemiblock**

- Axis shifts Rightward → R.A.D.
- look for S,Q₃
  (pages 300-302)
**General Determination of Electrical Axis** (pages 203-242)

Is QRS positive (\(\uparrow\)) or negative (\(\downarrow\)) in leads I and AVF?

Is Axis Normal? (page 227)

**First Determine Axis Quadrant** (pages 214-231)

**Axis in Degrees** (pages 233, 234) **(Frontal Plane)**

After locating Axis Quadrant, find limb lead where QRS is most isoelectric:

<table>
<thead>
<tr>
<th>Extreme Right Axis Deviation</th>
<th>Left Axis Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>lead</td>
<td>Axis</td>
</tr>
<tr>
<td>I</td>
<td>(-90^\circ)</td>
</tr>
<tr>
<td>AVL</td>
<td>(-120^\circ)</td>
</tr>
<tr>
<td>III</td>
<td>(-150^\circ)</td>
</tr>
<tr>
<td>AVF</td>
<td>(-180^\circ)</td>
</tr>
</tbody>
</table>

**Axis Rotation (left/right) in the Horizontal Plane** (pages 236-242)

Find transitional (isoelectric) QRS in a chest lead.

<table>
<thead>
<tr>
<th>Patient's Right</th>
<th>Patient's Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_1</td>
<td>V_6</td>
</tr>
<tr>
<td>V_2</td>
<td>V_5</td>
</tr>
<tr>
<td>V_3</td>
<td>Normal Range</td>
</tr>
<tr>
<td>V_4</td>
<td></td>
</tr>
</tbody>
</table>

**Axis Rotation (left/right) in the Horizontal Plane** (pages 236-242)

Find transitional (isoelectric) QRS in a chest lead.
Atrial Hypertrophy (pages 245-249)

Right Atrial Hypertrophy (page 248)
- large, diphasic P wave with tall initial component

\[ \text{Initial component} \]

Left Atrial Hypertrophy (page 249)
- large, diphasic P wave with wide terminal component

\[ \text{terminal component} \]

Ventricular Hypertrophy (pages 250-258)

Right Ventricular Hypertrophy (pages 250-252)
- R wave greater than S in V_1, but R wave gets progressively smaller from V_1 - V_6.
- S wave persists in V_5 and V_6.
- R.A.D. with slightly widened QRS.
- Rightward rotation in the horizontal plane.

Left Ventricular Hypertrophy (pages 253-257)

\[
\text{S wave in } V_1 \text{ (in mm.)} \\
+ \text{R wave in } V_5 \text{ (in mm.)} \\
\text{Sum in mm. is more than 35 mm. with L.V.H.}
\]

- L.A.D. with slightly widened QRS.
- Leftward rotation in the horizontal plane.

Inverted T wave:
- slants downward gradually, but up rapidly.
**Infarction** (pages 259 to 308)

from: *Rapid Interpretation of EKG’s*

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---

**Q wave** = **Necrosis** (significant Q’s only)  
(pages 272-284)

- Significant Q wave is one millimeter (one small square) wide, which is .04 sec. in duration…
  … or is a Q wave 1/3 the amplitude (or more) of the QRS complex.

- Note those leads (omit AVR) where significant Q’s are present  … see next page to determine infarct location, and to identify the coronary vessel involved.

- Old infarcts: significant Q waves (like infarct damage) remain for a lifetime. To determine if an infarct is acute, see below.

---

**ST (segment) elevation** = (acute) **Injury**  
(also Depression)  
(pages 266-271)

- Signifies an acute process, ST segment returns to baseline with time.

- ST elevation associated with significant Q waves indicates an acute (or recent) infarct.

- A tiny “non-Q wave infarction” appears as significant ST segment elevation without associated Q’s. Locate by identifying leads in which ST elevation occurs (next page).

- ST depression (persistent) may represent “subendocardial infarction,” which involves a small, shallow area just beneath the endocardium lining the left ventricle. This is also a variety of “non-Q wave infarction.” Locate in the same manner as for infarction location (next page).

---

**T wave inversion** = **Ischemia**  
(pages 264, 265)

- Inverted T wave (of ischemia) is symmetrical (left half and right half are mirror images). Normally T wave is upright when QRS is upright, and vice versa.

- Usually in the same leads that demonstrate signs of acute infarction (Q waves and ST elevation).

- Isolated (non-infarction) ischemia may also be located; note those leads where T wave inversion occurs, then identify which coronary vessel is narrowed (next page).

---

NOTE: Always obtain patient’s previous EKG’s for comparison!
Infarction Location — and — Coronary Vessel Involvement (pages 259 to 308)

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Coronary Artery Anatomy (page 291)

Posterior
- large R with ST depression in V1 & V2
- mirror test or reversed transillumination test (Right Coronary Artery) (pages 282-286)

Inferior (diaphragmatic) Q's in inferior leads II, III, and AVF (R. or L. Coronary Artery) (pages 281, 294)

Lateral
- Q's in lateral leads I and AVL (Circumflex Coronary Artery) (pages 280, 292)

Anterior
- Q's in V1, V2, V3, and V4 (Anterior Descending Coronary Artery) (pages 278, 292)
Pulmonary Embolism (pages 312, 313)

- S1Q3 - wide S in I, large Q and inverted T in III
- acute Right BBB (transient, often incomplete)
- R.A.D. and rightward rotation (horizontal plane)
- inverted T waves V1 ➞ V4 and ST depression in II

Artificial Pacemakers (pages 321-326)

Modern artificial pacemakers have sensing capabilities and also provide a regular pacing stimulus. This electrical stimulus records on EKG as a tiny vertical spike that appears just before the “captured” cardiac response.

Demand Pacemakers: (page 322)

- are “triggered” (activated) when the patient’s own rhythm ceases or slows markedly.
- are “inhibited” (cease pacing) if the patient’s own rhythm resumes at a reasonable rate.
- will “reset” pacing (at same rate) to synchronize with a premature beat.

Pacemaker Impulse (delivery modes)

<table>
<thead>
<tr>
<th>Delivery Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventricular Pacemaker (page 323)</td>
<td>(Asynchronous) Epicardial Pacemaker Ventricular impulse not linked to atrial activity.</td>
</tr>
<tr>
<td>Atrial Pacemaker (page 323)</td>
<td>Atrial Synchronous Pacemaker (page 323) P wave sensed, then after a brief delay, ventricular impulse is delivered.</td>
</tr>
<tr>
<td>Dual Chamber (AV sequential) Pacemaker (page 323)</td>
<td>External Non-invasive Pacemaker (page 326)</td>
</tr>
</tbody>
</table>
**Electrolytes**

**Potassium** (pages 314, 315)
- Increased K⁺ (page 314) (hyperkalemia)
  - Moderate
  - Extreme

- Decreased K⁺ (pages 315) (hypokalemia)
  - Moderate
  - Extreme

**Calcium** (page 316)
- Hyper Ca**⁺**
  - Short QT
- Hypo Ca**⁺**
  - Prolonged QT

**Digitalis** (pages 317-319)
- EKG appearance with digitalis (“digitalis effect”)
  - Remember Salvador Dali.
  - T waves depressed or inverted.
  - QT interval shortened.

- Digitalis Excess (blocks)
  - SA Block
  - P.A.T. with Block
  - AV Blocks
  - AV Dissociation

- Digitalis Toxicity (irritable foci firing rapidly)
  - Atrial Fibrillation
  - Junctional or Ventricular Tachycardia
  - Multiple P.V.C.’s
  - Ventricular Fibrillation

**Quinidine** (page 320)
- EKG appearance with quinidine (page 320)
- Excess quinidine or other medications that block potassium channels (or even low serum potassium) may initiate Torsades de Pointes (page 158)
Dubin’s Quickie Conversion
—for—
Patient’s Weight from Pounds to Kilograms

Patient wt. in kg. = Half of patient’s wt. (in lb.) \( \text{minus} \) 1/10 of that value.

Examples:
- 180 lb. patient (becomes 90 \( \text{minus} \) 9) is 81 kg
- 160 lb. patient (becomes 80 \( \text{minus} \) 8) is 72 kg
- 140 lb. patient (becomes 70 \( \text{minus} \) 7) is 63 kg.

Modified Leads
—for—
Cardiac Monitoring

Locations are approximate. Some minor adjustment of electrode positions may be necessary to obtain the best tracing. Identify the specific lead on each strip placed in the patient’s record.

<table>
<thead>
<tr>
<th>Sensor Electrode</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>R (or RA)</td>
</tr>
<tr>
<td>–</td>
<td>L (or LA)</td>
</tr>
<tr>
<td>G*</td>
<td>G (or RL)</td>
</tr>
</tbody>
</table>

* Ground, Neutral or Reference

**Modified Lead I**

**Modified Lead II**

**Conventional Lead**

\( MCI_{1} \)
To make this \( MCI_{1} \) move \( + \) electrode to same (mirror) position on the patient’s left chest.