ECG WORKSHEET

1. RATE
300, 150, 100, 75, 60, 50, 42…
(# QRS complexes on rhythm strip) x 6

2. RHYTHM (not an exhaustive list)
   - Sinus rhythm
     - Atrial dysrhythmias
     - Atrial fibrillation
     - Atrial flutter
     - Supraventricular tachycardia (SVT)
     - Multifocal Atrial Tachycardia (MAT)
   - Junctional rhythms
     - Ventricular tachycardia
     - Ventricular fibrillation
     - Ventricular flutter
     - Torsade de Pointes

3. AXIS
   - lower left quadrant: +I and +aVF = normal axis
   - lower right quadrant: -I and +aVF = right axis
   - upper right quadrant: -I and -aVF = extreme axis
   - upper left quadrant: +I and -aVF can be either
     - **upper** upper left quadrant: -II
     - **lower** upper left quadrant: +II

4. INTERVALS
   - PR = 120-200 ms
   - QRS = < 120 ms
   - QTc
     - φ < 440 ms // φ < 460 ms
     - > 500 ms → risk of torsades
     - QTc = QT / √(RR)
     - bisection method: <50% of the RR interval

5. LEFT VENTRICULAR HYPERTROPHY
   - Sokolow-Lyon Criteria:
     - (R in V5 or V6) + (S in V1) >35 mm (over 40y)
   - Cornell Criteria:
     - (R in aVL) + (S in V3 >28 mmφ or 20 mmφ)

6. STEMI LOCALIZATION

<table>
<thead>
<tr>
<th>localiz</th>
<th>ST elevation</th>
<th>Reciprocal ST depression</th>
<th>coronary artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>V2-V5</td>
<td>None</td>
<td>LAD</td>
</tr>
<tr>
<td>Septal</td>
<td>V1-V4,</td>
<td>none</td>
<td>LAD-septal</td>
</tr>
<tr>
<td></td>
<td>disappearance of</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>septum Q in leads</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>V5, V6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td>I, aVL, V5, V6</td>
<td>II,III, aVF</td>
<td>LCX or MO</td>
</tr>
<tr>
<td>Inferior</td>
<td>II, III, aVF</td>
<td>I, aVL</td>
<td>RCA (80%) or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RCX (20%)</td>
</tr>
<tr>
<td>Posterior</td>
<td>V7, V8, V9</td>
<td>high R in V1-V3 with ST depression V1-V3 &gt; 2mm (mirror view)</td>
<td>RCX</td>
</tr>
<tr>
<td>R Vent</td>
<td>V1, V4R</td>
<td>I, aVL</td>
<td>RCA</td>
</tr>
</tbody>
</table>

7. COMPARE WITH PREVIOUS ECG
   Are there any new changes?

8. CONCLUSION
   One sentence summary of what you see
RATE
The rate of an ECG is usually measured in one of two ways:
1. Divide the number of big boxes between two R-waves by 300.
2. Count the number of R waves on the entire strip and multiple by 6.

RHYTHM
Cardiac electrical activity starts in the SA node, follows the internodal pathways to the AV node and then to the ventricles is sinus rhythm. Technically, a “sinus” rhythm (originating from the sinus node) is defined by:
- A P for every QRS and a QRS for every P.
- Regular rhythm, but may vary with respirations
- Rate is between 60 and 100
- Upright P’s in I and II, and may be biphasic in V1

AXIS
The axis is the average direction of all the electrical activity of the heart. For most people this falls within -30 to 90 degrees (called normal axis). You need two axes to define a plan, I use I and aVF. Remember, right in this diagram represents the patient’s left side. Try not to memorize this but instead understand it.
- lower left quadrant: +I and +aVF = normal axis
- lower right quadrant: -I and +aVF = right axis
- upper right quadrant: -I and -aVF = extreme axis
- upper left quadrant: +I and -aVF can be either
  - upper upper left quadrant: -II
  - lower upper left quadrant: +II

Ventricular Tachycardia
Ventricular Flutter
Ventricular Fibrillation
Torsades de Pointes
INTERVALS
There are several intervals we are interested in when evaluating
timing in cardiac conduction. These are
- **PR** = length of delay in the AV node $\rightarrow 120$-$200$ ms
- **QRS** = speed through bundles $\rightarrow < 120$ ms
- **QTc** = how fast ventricles repolarize
  - $\text{QTc} = \frac{\text{QT}}{\sqrt{\text{RR}}}$
  - $< 440$ (men) 460 (women)
  - $< \frac{1}{2}$ the distance between two R waves

LOCALIZING INFARCTS and ISCHEMIA
For the next few sections you need to understand to which part
of the heart each lead corresponds. I tried to depict two planes
here, one coronal (I, II, F, III, R, L) and one transverse (V1 - V6). The leads are grouped as follows:
- **High lateral**: I and aVL (left circumflex)
- **Inferior**: II, F, III (right coronary or right circumflex)
- **Septal**: V1-V2 (left anterior descending, septal branches)
- **Anterior**: V3-V4 (left anterior descending)
- **Lateral**: V5-V6 (left circumflex)
- **Posterior**: V7-V9 (right circumflex)
- **Right Ventricle**: V1, V4R (right circumflex)

Changes in morphology should be reflected within the group.
For example, an ST-elevation III should have corresponding
ST-elevations in the other inferior leads: II, F.

ECG EVOLUTION OF MI
The ECG goes through several changes during ischemia
and infarction.
1. normal morphology
2. “hyperacute” T-waves (minutes)
3. ST-elevation (minutes to hours)
4. Q-waves and T-wave inversion
5. ST elevations improve, T-wave remain inverted
6. Finally, all normalizes except Q-waves persist

Of course, you can have an MI with a completely normal
ECG.

ST-SEGMENTS & T-WAVE INVERSION
Note the anatomic areas where you see ST-elevations.

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