# ECG Manifestations: Electrolyte Imbalance


<table>
<thead>
<tr>
<th>PR interval</th>
<th>Short (Think pre-excitation syndromes such as Wolff-Parkinson-White)</th>
<th>Prolonged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High K Low Ca</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QRS duration</th>
<th>Narrow</th>
<th>Wide (&gt;100 msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low K</td>
<td>High K</td>
<td>Low Ca</td>
</tr>
<tr>
<td>Low Ca</td>
<td>High Ca</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QTc interval</th>
<th>Short (&lt;350 msec)</th>
<th>Prolonged (&gt;440 msec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Ca</td>
<td>Low K Low Ca</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ST segment</th>
<th>Depressed</th>
<th>Elevated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low K</td>
<td>High K</td>
<td></td>
</tr>
<tr>
<td>High Ca</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T wave</th>
<th>Peaked/tall</th>
<th>Flattened</th>
</tr>
</thead>
<tbody>
<tr>
<td>High K</td>
<td></td>
<td>Low K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U wave</th>
<th>Absent</th>
<th>Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td></td>
<td>Low K Low Ca</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart rate</th>
<th>Slow (bradydysrhythmia, nodal block)</th>
<th>Fast (tachydysrhythmia)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High K</td>
<td>Low K</td>
<td>Low Ca</td>
</tr>
<tr>
<td>High Ca</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ca</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>• QTc prolonged (hallmark)</td>
<td>• QTc shortened (hallmark)</td>
<td></td>
</tr>
<tr>
<td>• U wave</td>
<td>• ST segment depression and shortening</td>
<td></td>
</tr>
<tr>
<td>• Heart blocks, ventricular dysrhythmias, torsades de pointes</td>
<td>• QRS widening</td>
<td></td>
</tr>
<tr>
<td>• Rare: bradydysrhythmias, bundle branch blocks, high degree AV blocks</td>
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<td></td>
</tr>
</tbody>
</table>

| K           | Early to late findings:  
|-------------|----------------------------|  
| • T wave: decreased amplitude | Early to late findings:  
| • T wave: flat or inverted | • T wave: tall, then “peaked” (symmetrical) |  
| • ST segment depression | • P wave flattening |  
| • U wave | • PR interval prolonged |  
| • QTc prolonged (at risk for VT or torsades de pointes) | • QRS widening |  
| • Sine wave: fusion of QRS and T wave --> VF or asystole | • Nodal blocks, escape beats |  

Mg derangements: Nonspecific ECG findings; often co-exist with Ca derangements.  
• Classic teaching: Low Mg level --> QTc prolongation --> torsades de pointes