PACEMAKERS

Indications

AVN dysfunction, SAN dysfunction, hypersensitive carotid sinus syndrome, neurogenic syncope, long QT, prevention of tachycardia, HTCM

Modes

1) **Fixed rate mode**: delivers at fixed rate regardless of patient’s heart; risk of discharging on T wave; rarely used
2) **Demand mode**: senses spontaneous cardiac activity; can be temporarily converted to fixed rate mode if magnet held over it
   - **Inhibited**: pulse generator inhibited by spontaneous cardiac activity
   - **Triggered**: pacemaker detects intrinsic cardiac activity and discharges during absolute refractory period (pacing spike after each intrinsic QRS complex)

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber paced</td>
<td>Chamber sensed</td>
<td>Response to sensing</td>
<td>Programmability</td>
<td>Anti-arrhythmic functions</td>
</tr>
<tr>
<td>0</td>
<td>none</td>
<td>0</td>
<td>none</td>
<td>0</td>
</tr>
<tr>
<td>A</td>
<td>atrium</td>
<td>A</td>
<td>T triggered</td>
<td>P</td>
</tr>
<tr>
<td>V</td>
<td>ventricle</td>
<td>V</td>
<td>I inhibited</td>
<td>M</td>
</tr>
<tr>
<td>D</td>
<td>both</td>
<td>D</td>
<td>D dual</td>
<td>C</td>
</tr>
<tr>
<td>S</td>
<td>single chamber</td>
<td>S</td>
<td></td>
<td>R</td>
</tr>
</tbody>
</table>

**AAI**: paces atrium, senses atrium
   - If atrial activity sensed, pacing inhibited
   - If no atrial activity sensed generates atrial pacing stimulus
   - **Atrial demand mode pacing** prevents atrial rate going too low; used in AVN dysfunction

**VVI**: paces ventricle, senses ventricle
   - If ventricular activity sensed, pacing inhibited
   - If no ventricular activity sensed, generates ventricular pacing stimulus
   - Used in chronic AF and flutter

**DDD**: paces both, senses both
   - As above for both chambers: senses atria and provides impulse if no native one → AV interval where pacer is inactive → at end of interval if no ventricular impulse has occurred, provides one
   - If tachycardia occurs, DDD will switch to VVI until tachycardia over, so that ventricles aren’t inappropriately paced too fast
   - Placing magnet over pacemaker will initiate AOO, VOO, DOO – which allows treatment of tachycardia

Problems

**With pocket**: infection, haematoma
**With leads**: separation → failure to capture, dislodgement → thrombosis / myocardial rupture / arrhythmia, infection
**Failure to pace**: battery, wire (fracture, dislodgement), electrode problems; tissue reaction around electrode; **oversensing** = pacemaker senses electrical activity not related to A/V depolarisations, therefore fails to generate impulse
**Failure to capture**: exit block, tissue damage
**Failure to sense**: intrinsic QRS small voltage, MI, electrolyte abnormality, exit block, tissue damage, new intrinsic arrhythmia, lead, battery) – doesn’t sense P wave, so paces atria despite P wave; can cause pacemaker to become fixed rate, with risk of discharging on T wave → arrhythmia
**Malfunction**: overpacing; electromagnetic interference, physiological electrical activity
**Pacemaker-mediated tachycardia**: re-entrant loop with pacemaker sensing retrograde P wave as native stimulus, and pacing ventricle
**Sensor-induced tachycardia**: when pacemaker senses wrong things and fires inappropriately