Pacemakers
Outline

1. Pacemaker codes
2. Pacemaker configurations
3. Indications for pacemakers
4. Problems with pacemakers
5. Examples
Pacemakers
## Pacemaker Codes

<table>
<thead>
<tr>
<th>Position Function</th>
<th>1 Chambers Paced</th>
<th>2 Chambers Sensed</th>
<th>3 Response to Sensed Stimulus</th>
<th>4 Rate Modulation?</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (none)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O (non-rate responsive)</td>
</tr>
<tr>
<td>A (atrium)</td>
<td>A</td>
<td>T (triggered)</td>
<td>R (rate responsive)</td>
<td></td>
</tr>
<tr>
<td>V (ventricle)</td>
<td>V</td>
<td>I (inhibited)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D (both atrium &amp; ventricle)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Pacemaker Configurations**

**VOO**

**Indications**

Temporary mode sometimes used during surgery to prevent interference from electrocautery

<table>
<thead>
<tr>
<th>Pacemaker</th>
<th>Pacing Only</th>
<th>Sensing Only</th>
<th>Pacing and Sensing</th>
</tr>
</thead>
</table>
Pacemaker Configurations

**VVI**

**Indications**

The combination of AV block and chronic atrial arrhythmias (particularly atrial fibrillation).
Pacemaker Configurations

AAI

**Indications**

Sick sinus syndrome in the absence of AV node disease or atrial fibrillation.
Pacemaker Configurations
VDD

Indications
AV block with intact sinus node function (particularly useful in congenital AV block).
Pacemaker Configurations

**DDD**

**Indications**
1. The combination of AV block and SSS.
2. Patients with LV dysfunction and LV hypertrophy who need coordination of atrial and ventricular contractions to maintain adequate CO.
Indications for Pacemaker

Class I
1. Sinus node dysfunction with documented symptomatic bradycardia
2. Symptomatic chronotropic incompetence (failure to increase HR with exercise or increased metabolic demand)
3. 3° and advanced 2° AV block associated with any of the following:
   - Arrhythmias that require drugs resulting in symptomatic bradycardia
   - Sinus pauses > 3 seconds
   - Asymptomatic escape rate < 40bpm while awake
4. 3° or 2° AV block with associated symptomatic bradycardia
5. Type II 2° AV block with wide QRS, regardless of symptoms
Indications for Pacemaker

Class IIa

1. Syncope of unexplained origin when major abnormalities of sinus node function are discovered or provoked during EP studies.

2. Asymptomatic 3° AV block with an awake ventricular rate > 40bpm

3. Asymptomatic type II 2° AV block
Problems with Pacemakers

Failure to Capture

Causes:
- Threshold rise (electrolytes, drugs)
- Lead dislodgement
- Lead fracture
- RV infarct
Problems with Pacemakers

Failure to Pace

Causes:

- Oversensing
- Battery failure
- Internal insulation failure
- Conductor coil fracture

Problems with Pacemakers

Failure to Pace

Causes:  
- Crosstalk

Problems with Pacemakers

Failure to Sense

Causes:
- Undersensing
- Lead Fracture

Example 1

Ventricular sensed, ventricular paced

Consistent with VVI

The Alan E. Lindsay ECG Learning Center; http://medstat.med.utah.edu/kw/ecg/
Example 2

Atrial sensed, ventricular paced
Consistent with DDD or VDD

The Alan E. Lindsay ECG Learning Center; http://medstat.med.utah.edu/kw/ecg/
Example 3

Atrial paced

Consistent with AAI or DDD
Example 4

Failure to Pace

The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/
Example 5

Failure to Sense

The Alan E. Lindsay ECG Learning Center; http://medstat.med.utah.edu/kw/ecg/