Cardiac Rhythm Device Management

‘PBL STOP’ – Your acronym for a standardized follow-up
What’s in it for you?

• What do you need to feel comfortable with a pacemaker/ICD follow-up?
CORE OBJECTIVE

• Provide a technique for you to complete a successful device follow-up
“PBL STOP”

P Presenting Rhythm and Rate
B Battery Status
L Lead Status
S Sensing
T Threshold
O Observation, Data, and Events
P Program & Print
Presenting Rhythm and Rate
Rhythm Recognition

Atrial Fibrillation: No Pacing  VVI / 60

Atrial Flutter: No Pacing  DDDR / 60
Paced Rhythm Recognition

Single Chamber Device: Ventricular Pacing

Single Chamber Device: Atrial Pacing (AAI)
Paced Rhythm Recognition

Sensing in the Atrium & Sensing in the Ventricle (AS-VS)

Pacing in the Atrium & Sensing in the Ventricle (AP-VS)
Paced Rhythm Recognition

Sensing in the Atrium & Pacing in the Ventricle (AS-VP)

Pacing in the Atrium & Ventricle (AP-VP)
Loss of Capture
Troubleshooting

Loss of Atrial Sensing
Battery Status
(Volts and Longevity)
Assessing Battery Status
Lead Impedance (ohms)
Lead Impedance Trends
## Assessing Lead Status

![Image of a medical device interface displaying lead status measurements.](image)

### Battery and Lead Measurements (12/07/05 3:42:35 PM)

<table>
<thead>
<tr>
<th>Battery Status</th>
<th>Atrial Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Implant</td>
<td>Amplitude 1.64 V</td>
</tr>
<tr>
<td></td>
<td>Pulse Width 0.40 ms</td>
</tr>
<tr>
<td></td>
<td>Output Energy 1.72 μJ</td>
</tr>
<tr>
<td></td>
<td>Measured Current 2.80 mA</td>
</tr>
<tr>
<td></td>
<td>Measured Impedance 547 ohms</td>
</tr>
<tr>
<td></td>
<td>Pace Polarity Bipolar</td>
</tr>
<tr>
<td>Remaining Longevity</td>
<td>Ventricular Lead</td>
</tr>
<tr>
<td>Minimum</td>
<td>Amplitude 2.21 V</td>
</tr>
<tr>
<td>Maximum</td>
<td>Pulse Width 0.40 ms</td>
</tr>
<tr>
<td></td>
<td>Output Energy 2.60 μJ</td>
</tr>
<tr>
<td></td>
<td>Measured Current 3.12 mA</td>
</tr>
<tr>
<td></td>
<td>Measured Impedance 667 ohms</td>
</tr>
<tr>
<td></td>
<td>Pace Polarity Bipolar</td>
</tr>
</tbody>
</table>

### Parameters

- Voltage: 2.77 V
- Current: 15.33 μA
- Impedance: 103 ohms

**Note:**
- The device is set to 60 bpm / 1,000 ms.
- Marker Annotation contains annotations for atrial and ventricular signals.

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**Medtronic, Inc. USA, September 2006**
Sensing (millivolts mV)

The ability of the pacemaker to see Intrinsic Heart Beats
Normal Sensing Values

• Acute Phase (within 3 months of implant)
  – P-waves = > 1.5mV
  – R-waves = > 6mV

• Chronic Phase (>3 months post-implant)
  – P-waves = > 1.0mV
  – R-waves = > 5mV
Sensitivity: *Not Sensitive Enough*

As You **Lower** The Number, 
You Make The Pacemaker **More** Sensitive

<table>
<thead>
<tr>
<th>Amplitude (mV)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

- **5 mV**
- **2 mV**
- **1 mV**
Sensitivity: Too Sensitive

5 mV

2 mV

1 mV

Amplitude (mV)

Time

5.0

2.5

1.25
Sensitivity: *Just Right*

Why is sensing so important?
Oversensing vs. Undersensing

Intrinsic beat not sensed

Scheduled pace delivered

Marker Channel™ shows intrinsic activity...

...though no activity is present
Threshold

The least amount of energy it takes to “capture” the heart
Travels via the myocardium, not the native cardiac conduction system, therefore, the QRS is wide.
GOAL → Find the minimum amount of energy needed to consistently capture the heart (stimulation threshold).

1. Pulse amplitude – the amount of voltage delivered to the heart by the pacemaker to ensure capture of the heart (strength of an output pulse)

2. Pulse width – time (duration) of the pacing pulse
Amplitude Threshold Testing

Keeping pulse width stable, decrement voltage until loss of capture

@ 0.5ms

1.5V → 1.0V → .5V
Observations, Data, and Events
Observations:

1. Vent. High Rate Episode
2. 10 days with >4 hours AT/AF
3. At times, VS rate >100 bpm during AT/AF

Clinical Status Since Last Session: 02-Jun-2004

- Device Status
  - Battery Voltage: 3.21 V
  - (EPI=3.61 V)
- Last Full Charge: 8.7 sec (27-May-2004)
- Lead
  - P Wave (mV): 1.7 vs 2.3
  - RV Delib (ohms): 53
  - SVC Delib (ohms): 60
  - Sensitivity (mV): 0.3 vs 0.3
  - Amplitude (V): 3 vs 3
  - Pulse Width (ms): 0.4 vs 0.9
- Observations (4)
  - 5 days with more than 6 hr AT/AF
  - Ventricular Rate > 100 bpm during AT/AF
  - Higher battery drain: Pre-arrhythmia EGM is serifs
  - On Continuous
  - AT/AF Detection On, but all AT/AF therapies Off

Diagnostic Information
• Up to 14 months of data
• Annotations to mark Programming (P), Interrogation (I) or Remote Interrogations ( _ )
• Rhythm-control assessment with *Treated VT/VF episodes per day* and *AT/AF total hours/day*
• Rate-control assessment with *V. Rate during AT/AF and V. Rate during VT/VF*
• %Pacing/day to assess reduction of unnecessary right ventricular pacing
• Three HF Status Indicator Trends
  – Average V. Day/Night heart rates
  – Patient Activity
  – HR variability
Programming & Printing Final Reports
Programmed Parameters
Print Reports

• Print Final Reports
  – Sensing test results
  – Threshold test results
  – Key observations
  – Any changes this session noted on final report
“PBL STOP”

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