Device Interrogation - Pacemakers, ICD and Loop Recorders

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Device Clinic Coordinator, MHVI
Disclosures

Consultant: Medtronic

Speaker’s Bureau: St. Jude Medical
Cardiac Implantable Electronic Devices

Pacemaker

- Battery
- Capacitor
- Low Voltage
- High Voltage
- Asystole
- Heart Failure

- Brady Detections
- Brady Therapies
- AT/AF Detections
- AT/AF Therapies
- VT/VF Detections
- VT/VF Therapies
Cardiac Implantable Electronic Devices

ICD

- Battery
- Capacitor
- Low Voltage
- High Voltage
- Asystole
- Heart Failure

- Brady Detections
- Brady Therapies
- AT/AF Detections
- AT/AF Therapies
- VT/VF Detections
- VT/VF Therapies
Cardiac Implantable Electronic Devices

ILR

- Battery
- Capacitor
- Low Voltage
- High Voltage
- Asystole
- Heart Failure
- Brady Detections
- Brady Therapies
- AT/AF Detections
- AT/AF Therapies
- VT/VF Detections
- VT/VF Therapies
Cardiac Implantable Electronic Devices

Trends

ICDs: Expanding Indications for implantation

Pacemaker: Increasing co-morbid conditions
Expanding Indications


Expanding Indications

- 2014  HRS/ACC/AHA Expert Consensus Statement on the Use of Implantable Cardioverter-Defibrillator Therapy in Patients Who Are Not Included or Not Well Represented in Clinical Trials
  Circulation. 2014; 130:94-125
<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th>2009</th>
</tr>
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<tbody>
<tr>
<td>CCI &gt; 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VVI</td>
<td>14.1%</td>
<td>45%</td>
</tr>
<tr>
<td>DDD</td>
<td>13.5%</td>
<td>42.4%</td>
</tr>
</tbody>
</table>
Device Interrogation

Device Clinic:

Clinical and Technical Effectiveness

Safety and Education
Device Interrogation

Clinician:

Clinical Effectiveness

Impact on co-morbid conditions
Assessing Clinical effectiveness

Presenting rhythm
Assessing Clinical effectiveness

Presenting rhythm

EGM displayed at 25mm per second

- A
- RV
- LV

Shock

AS 765
AS 770
AS 780
LV 0
RV 765
RV 770
RV 780
Assessing Clinical effectiveness

Settings (Parameters)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF</td>
<td>200 bpm</td>
</tr>
<tr>
<td>VT</td>
<td>175 bpm</td>
</tr>
<tr>
<td>Mode</td>
<td>DDD - Biv</td>
</tr>
<tr>
<td>LRL - MTR</td>
<td>70 - 130 ppm</td>
</tr>
<tr>
<td>Paced AV Delay</td>
<td>180 - 180 ms</td>
</tr>
<tr>
<td>Sensed AV Delay</td>
<td>120 - 120 ms</td>
</tr>
<tr>
<td>LV Offset</td>
<td>0 ms</td>
</tr>
</tbody>
</table>
Assessing Clinical effectiveness

Intrinsic amplitude (mV)

P wave: measurement of intrinsic atrial signal

R wave: measurement of intrinsic ventricular signal
Assessing Clinical effectiveness

EGM displayed at 25mm per second

Ventricular undersensing

Ventricular oversensing

Shock
Assessing Clinical effectiveness

Atrial undersensing

Atrial oversensing
Assessing Clinical effectiveness

<table>
<thead>
<tr>
<th>Lead status:</th>
<th>Fracture</th>
<th>Insulation breach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold</td>
<td>↑↑↑↑</td>
<td>↑</td>
</tr>
<tr>
<td>Impedance</td>
<td>↑↑↑↑</td>
<td>↓↓↓↓</td>
</tr>
</tbody>
</table>
Assessing Clinical effectiveness

Lead status:

Lead chatter

EMI
Assessing Clinical effectiveness

Observations:
- Arrhythmia events
- Percent paced
- Histogram
- Red alert conditions
Assessing Clinical effectiveness

Observations:

Arrhythmia events

- Correlate clinical symptoms to arrhythmia occurrence
- Assess response to antiarrhythmic therapy
Assessing Clinical effectiveness

Observations:

Arrhythmia events

• Determine severity of arrhythmia vis-à-vis need for intervention

• Minimize ICD shocks
Minimizing ICD Shocks

Vern Hsen Tan et al. Circ Arrhythm Electrophysiol. 2014;7:164-170
## Minimizing ICD Shocks

<table>
<thead>
<tr>
<th>Conventional programming</th>
<th>Therapy reduction programming*</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF detection: 1 sec</td>
<td>VF detection: 60 sec</td>
</tr>
<tr>
<td>VT detection: 2.5 secs</td>
<td>VT detection: 6 - 12 secs</td>
</tr>
<tr>
<td>SVT discrimination: 188-200</td>
<td>SVT discrimination: 188-230</td>
</tr>
<tr>
<td>ATP therapy: 188-200 bpm</td>
<td>ATP therapy 188-230 bpm</td>
</tr>
</tbody>
</table>

*for primary prevention

2015 HRS/EHRA/APHRS/SOLAECE expert consensus statement on optimal implantable cardioverter-defibrillator programming and testing
INCIDENCE Appropriate and Inappropriate Shocks

- Appropriate Shock
- Inappropriate Shock

1997-2008: Physician discretion or 1 zone shock only

2008-2013: Shock reduction strategies: extended delay, high rate, discriminators, ATP


Moss, A, et al. NEJM 2012; 367:2275-2283
Assessing Clinical effectiveness

Observations: Percent paced

- Minimizing RV pacing

Effect of pacing mode on incidence of Afib

### Observations: Percent paced

- **Minimizing RV pacing**

<table>
<thead>
<tr>
<th>Study</th>
<th>Physiologic</th>
<th>Ventricular</th>
<th>Wt %</th>
<th>HR [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danish</td>
<td>39/110</td>
<td>57/115</td>
<td>4.1</td>
<td>0.66 [0.44, 0.99]</td>
</tr>
<tr>
<td>CTOPP</td>
<td>390/1094</td>
<td>565/1474</td>
<td>40.8</td>
<td>0.92 [0.81, 1.05]</td>
</tr>
<tr>
<td>PASE</td>
<td>32/203</td>
<td>34/204</td>
<td>2.9</td>
<td>0.94 [0.58, 1.52]</td>
</tr>
<tr>
<td>MOST</td>
<td>200/1014</td>
<td>204/996</td>
<td>17.8</td>
<td>0.97 [0.8, 1.18]</td>
</tr>
<tr>
<td>UKPACE</td>
<td>393/1012</td>
<td>387/1009</td>
<td>34.4</td>
<td>1.01 [0.88, 1.16]</td>
</tr>
</tbody>
</table>

**Overall:** 1054/3433 1247/3798

Association: chi-square = 1.72 p = 0.19

Effect of pacing mode on incidence of stroke

Assessing Clinical effectiveness

Observations:

Percent paced

- Minimizing RV pacing

![EKG Image]

Courtesy of Medtronic Inc

Loss of conduction

Back-up V-pace
Assessing Clinical effectiveness

Observations:
Percent paced
- Maximizing BiV pacing

2015 HRS/EHRA/APHRS/SOLAECE expert consensus statement on optimal implantable cardioverter-defibrillator programming and testing
Assessing Clinical effectiveness

Observations:
- Lung impedance
- Ave v rate
- Fluid index
Assessing Clinical effectiveness

Observations:

Histogram provides a quick look at median and range of HR
Assessing Clinical effectiveness

Observations: Need for rate response

Diagnose chronotropic incompetence

Correlate with activity level
Assessing Clinical effectiveness

Voltage: battery status

<table>
<thead>
<tr>
<th>Battery</th>
<th>Implant Date:</th>
<th>May 12, 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longevity: 5.3-8.7 yrs</td>
<td>Voltage</td>
<td>3.01 V</td>
</tr>
<tr>
<td>~ERI &gt; 5 yrs</td>
<td>Magnet Rate</td>
<td>100.0 ppm</td>
</tr>
<tr>
<td></td>
<td>Battery Current</td>
<td>12 uA</td>
</tr>
<tr>
<td></td>
<td>Remaining Capacity to ERI</td>
<td>&gt;95%</td>
</tr>
</tbody>
</table>
Assessing Clinical effectiveness

Evaluation (final):

Appropriate?

Normal function?
And let’s not forget the patient

Pocket appearance

Good

Bad

Ugly
And let’s not forget the patient
Deactivating CIEDs in terminally ill patients

CRT non-responders

Life with a CIED
Take away points

Device interrogation provides a myriad of data

A clinician’s focus
  clinical effectiveness
  Impact on co-morbidities
  Qol issues
Thank you!