What Happens in Device Clinic?

KIM BO BAE, RN. BSN
Electrophysiology room, Severance Hospital,
Device Clinic in Severance

1. Device Clinic introduction
2. Case 1: Pacemaker mediated tachycardia
3. Case 2: Delayed shock therapy
Device Clinic introduction
8 심장혈관병원
Cardiovascular Hospital
Device Clinic introduction
Device Clinic introduction
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Device Clinic introduction
Pacemaker mediated Tachycardia
김OO (F/69)

- 2015’ 03. Holter: 5.9 s pause, TMT: 운동 후 4 s pause → SSS.
  Pacemaker implantation (Assurity, Abbott)
- 2016’ 09. AFL episode
- Medication : lixiana 30mg QD
- 내원 2시간 전 지하철에 앉아있는 중 Chest discomfort, dizziness 발생하여 박동기 클리닉 방문.
Case 1: Pacemaker mediated tachycardia
Case 1: Pacemaker mediated tachycardia
Case 1: Pacemaker mediated tachycardia

**Test Results: Atrium**

**Atrial Capture Test**
- 0.75 V @ 0.4 ms (Bi)
- Safety Margin: 4.6 : 1 @ 3.5 V
- No previous results

**Atrial Sense Test**
- 2.1 mV (Bi)
- Safety Margin: 4.2 : 1 @ 0.5 mV
- No previous results
Case 1: Pacemaker mediated tachycardia
Case 1: Pacemaker mediated tachycardia
Case 1: Pacemaker mediated tachycardia

Conditions to be fulfilled

- Initiator
- Retrograde (VA) conduction
- VDD or DDD Pacemaker

*Cardiac Pacemaker Step by Step, Serge Barold et al.*
Case 1: Pacemaker mediated tachycardia

PMT

1. Ventricular event occurs paced or sensed – usually PVC here.
2. Conducts retrograde through the AV node (typically)
3. And results in an atrial sense.
   - Which starts an SA, and results in a ventricular pace.
4. This is again conducted retrograde, and the sequence starts again VP,
   - which goes retrograde V-A, resulting in an AS starting an SAV,
   - resulting in a VP which goes retrograde V-A (AS-VP-AS-VP-AS-VP......)

Initiated by a loss of AV synchrony
- PVC most common cause
- Atrial loss of capture
- Atrial undersensing
- PAC
- Magnet removal

Cardiac Pacemaker Step by Step, Serge Barold et al.
Case 1: Pacemaker mediated tachycardia

PMT Solution

1. Magnetic
PMT requires atrial sensing. DOO suspends the pacemaker’s sensing function, so the PMT breaks.

2. Test
Atrial output threshold, Atrial sensing test → Is there a retrograde conduction?

3. To fix
- Reprogram the pacemaker outputs as needed
- Increase PVARP to make the retrograde atrial event an AR
  - Turn PMT Intervention “On” - VA interval at upper rate
  - Turn PVC Response “On” - PVARP
- A Pacing on PMT
- Rarely, may need to reposition a lead or ablate a pathway
Case 1: Pacemaker mediated tachycardia – PMT intervention

PVARP 480ms ↑
Case 1: Pacemaker mediated tachycardia –② PVC response
Case 1: Pacemaker mediated tachycardia – ③ A pacing on PMT

325 ms = VP-AS
200 ms Pace Interval

325 ms = AS-VP
Case 1: Pacemaker-mediated tachycardia – PVC response

A pacing  V pacing

PVARP 300ms  PVARP 300-480ms
Delayed shock therapy
Case 2: Delayed shock therapy

김OO (F/65)

- A-fib c RVR
- 2013’ 07. Pulseless VT, CPCR survivor → ICD insertion (Protecta DR, Med)
- 2014’ 06. ICD G/C (Evera DR, Med)
  - shock Tx, aborted Tx 200여 건의 episode (Real VT, A.fib, AT)
    → battery depletion되어 1년만에 Generator change.
### Case 2: Delayed shock therapy

#### Parameters

**VT/VF Detection**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>On/Off</th>
<th>V. Interval (Rate)</th>
<th>Initial</th>
<th>Redetect</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF</td>
<td>On</td>
<td>270 ms (222 bpm)</td>
<td>18/24</td>
<td>12/16</td>
</tr>
<tr>
<td>FVT</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td>On</td>
<td>350 ms (171 bpm)</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Monitor</td>
<td>OFF</td>
<td>450 ms (133 bpm)</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**PR Logic/Wavelet**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>On/Off</th>
<th>Other Enhancements</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF/AFL</td>
<td>On</td>
<td>Stability</td>
<td>Off</td>
</tr>
<tr>
<td>Sinus Tach</td>
<td>On</td>
<td>Onset</td>
<td>Off</td>
</tr>
<tr>
<td>Other 1:1 SVTs</td>
<td>On</td>
<td>High Rate Timeout</td>
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</tr>
<tr>
<td>Wavelet</td>
<td>On</td>
<td>VF Zone Only</td>
<td>Off</td>
</tr>
<tr>
<td>Template</td>
<td>05-Jun-2014</td>
<td>All Zones</td>
<td>Off</td>
</tr>
<tr>
<td>Match Threshold</td>
<td>70 %</td>
<td>TVwave</td>
<td>On</td>
</tr>
<tr>
<td>Auto Collection</td>
<td>On</td>
<td>RV Lead Noise</td>
<td>On+Timeout</td>
</tr>
<tr>
<td>SVT V. Limit</td>
<td>260 ms</td>
<td>Timeout</td>
<td>0.75 min</td>
</tr>
</tbody>
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**VF Therapies**

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<tr>
<th>VF Therapy Status</th>
<th>Rx1</th>
<th>Rx2</th>
<th>Rx3</th>
<th>Rx4</th>
<th>Rx5</th>
<th>Rx6</th>
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<tr>
<td>On</td>
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<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>ATP</td>
<td>Off</td>
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Case 2: Delayed shock therapy

Treated VT/VF Episode #1

- VT: 05-Jan-2014, 13:12, 20, 44/200
- VF: 05-Jan-2014, 13:12, 20, 350 ms

Detected: 24.6 ms

Redefected: 5.1 J

Synch and shock delivery(+)

Charging end

Redetection

VT detection

Synch and shock delivery(+)

Chart speed: 25.0 mm/sec

EGM1: Atp to Aning (1 mV)

EGM3: RVip to RVring (1 mV)

A-A (ms)

Markers

V-V (ms)
Case 2: Delayed shock therapy

VT redetection

Charging end

(VF detection

Synch and shock delivery(+)

Termination

12.8sec
Case 2: Delayed shock therapy – Confirmation: during charging

Confirmation = [Ongoing?] or [Terminated?]

[During Charging]

\[
\text{Confirmation interval} = [\text{VT} + 60\text{ms}] = 400 + 60 = 460\text{ms}
\]

\[
\text{Confirmation ON} = [\text{Rhythm cycle length} + 60\text{ms}] = 340 + 60 = 400\text{ms}
\]

4 / 5 VV intervals > Confirmation interval
→ Charging = Stop
→ Therapy = Cancel
Case 2: Delayed shock therapy – Confirmation: after charging

[After Charging]
1. 1 VV interval > Confirmation Interval [TDI+60 or RCL+60]
2. OR 3 consecutive VV intervals < 200ms
   → Acceleration? Significant oversensing?
   → Cardioversion = Aborted
Case 2: Delayed shock therapy

* Synchronization
– On the 2nd non-refractory arrhythmic ventricular event outside an AVP interval
– Or the third arrhythmic ventricular event

* After Charging (cardioversion)
  1. 1 VV interval > Confirmation Interval [TDI+60 or RCL+60]
  2. Or 3 VV intervals < 200ms => Aborted
Case 2: Delayed shock therapy – Atrial vulnerable period

AVP = AS $\rightarrow$ 150 ms $\sim$ 400 ms

$\rightarrow$ High voltage shock + AVP = Atrial Arrhythmia

$\rightarrow$ Therapy postponed once
Case 2: Delayed shock therapy
With the Love of God, Free Humankind from Disease and Suffering