Device Upgrade:  
When Should we Extract / Abandon?

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Section of EP and Pacing
Occluded Subclavian / Innominate Vein
Lead associated Axillary / Sub-Clavian / Innominate Stenosis

• Lead associated stenosis is not uncommon

• Venography in 100 consecutive patients undergoing lead addition:
  – 26% of patient with Stenosis > 70%
  – 9% with complete occlusion
Management Options?

• Are all leads functional?  No

• Is it preferred to remove the non-functional hardware?
  
  – Risks of extraction / removal
  
  versus

  – Consequences of abandoned hardware
Mechanical Extraction with Retained Guidewire Access:

- Complications:
  - SVC tear
  - Subclavian / innominate vein tear (mediastinal bleed / hemothorax)
  - AV Fistula
  - Functional lead dislodgement / damage
Running the Gauntlet: Subclavian Vein
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Running the Gauntlet: Innominate Vein
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Incidence, management, and outcomes of the arteriovenous fistula complicating transvenous lead extraction


From the *Section of Electrophysiology and Pacing, Department of Cardiovascular Medicine, Heart and Vascular Institute, Cleveland, Ohio, and †Department of Anatomic Pathology, Cleveland Clinic, Cleveland, Ohio.

• 8 AV fistulas occurring in 2471 extraction procedures from 2001 to 2012 (0.3% of procedures)
  – 3 left subclavian vein to LIMA
  – 3 Innominate vein to brachiocephalic artery
  – 1 Innominate vein to aorta
  – 1 left subclavian vein to left subclavian artery
Management Options?

• Are all leads functional?  No

• Is it preferred to remove the non-functional hardware?
  
  — Risks of extraction / removal

  versus

  — Consequences of abandoned hardware
1386 consecutive patients undergoing extraction, 323 (23%) had abandoned leads

Failure to achieve complete extraction without a major complication occurred more frequently in patients with abandoned leads (13.0 vs. 3.7%, p<0.0001)

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**TABLE 3** Procedural Profiles and Outcomes of Extraction of Infected Leads in Patients With or Without Previously Abandoned Leads in Place

<table>
<thead>
<tr>
<th>Procedural profiles</th>
<th>Patients With Abandoned Leads</th>
<th>Patients Without Abandoned Leads</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure duration, min</td>
<td>170 (130-220)</td>
<td>115 (85-155)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Fluoroscopy time, min</td>
<td>13.2 (7.7-24.8)</td>
<td>6.6 (3.2-13)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Specialized tools required</td>
<td>94.4</td>
<td>81.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Locking stylets</td>
<td>91.6</td>
<td>80.6</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Laser sheaths</td>
<td>83.3</td>
<td>67.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dilator sheaths</td>
<td>16.7</td>
<td>11.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Electrosurgical sheath</td>
<td>4.0</td>
<td>6.2</td>
<td>0.10</td>
</tr>
<tr>
<td>Evolution</td>
<td>4.0</td>
<td>2.2</td>
<td>0.07</td>
</tr>
<tr>
<td>Rescue femoral workstation</td>
<td>14.9</td>
<td>2.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Snare</td>
<td>19.2</td>
<td>4.2</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Procedural outcomes

- Failure to achieve primary endpoint*: 13.0 vs. 3.7% (p<0.0001)
- Lead material retention: 11.5 vs. 2.9% (p<0.0001)

Values are median (interquartile range) or %. *Complete procedural success defined as the successful removal of the device, all leads, and all lead material from the vascular space, in the absence of a major complication or procedure-related death.
Cardiac Implantable Electronic Device Infections
Added Complexity and Suboptimal Outcomes
With Previously Abandoned Leads

- Major and minor procedural complications occurred more frequently in patients with abandoned leads:
  - Major 3.7 vs. 1.4%, p=0.009
  - Minor 7.7 vs. 4.4%, p=0.02

<table>
<thead>
<tr>
<th>Complication</th>
<th>Patients With Abandoned Leads Group 1 (n = 323)</th>
<th>Patients Without Abandoned Leads Group 2 (n = 1,063)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any complication</td>
<td>11.5</td>
<td>5.6</td>
<td>0.0007</td>
</tr>
<tr>
<td>Major complication</td>
<td>3.7</td>
<td>1.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Minor complication</td>
<td>7.7</td>
<td>4.4</td>
<td>0.02</td>
</tr>
<tr>
<td>Hypoxemia</td>
<td>0.6</td>
<td>0.4</td>
<td>0.60</td>
</tr>
<tr>
<td>Hypercarbia</td>
<td>0.6</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td>Respiratory arrest</td>
<td>2.2</td>
<td>0.5</td>
<td>0.009</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>0</td>
<td>0.09</td>
<td>0.50</td>
</tr>
<tr>
<td>Hemothorax</td>
<td>0.3</td>
<td>0.4</td>
<td>0.90</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>0.6</td>
<td>0.3</td>
<td>0.40</td>
</tr>
<tr>
<td>Bradycardia requiring pacing</td>
<td>1.2</td>
<td>0.4</td>
<td>0.10</td>
</tr>
<tr>
<td>VT/VF</td>
<td>1.6</td>
<td>0.7</td>
<td>0.20</td>
</tr>
<tr>
<td>Unplanned defibrillation or cardioversion</td>
<td>0.9</td>
<td>0.8</td>
<td>0.80</td>
</tr>
<tr>
<td>Cardiac perforation</td>
<td>0.9</td>
<td>0.09</td>
<td>0.02</td>
</tr>
<tr>
<td>Pericardial effusion, no intervention</td>
<td>0.6</td>
<td>0.2</td>
<td>0.20</td>
</tr>
<tr>
<td>Tamponade</td>
<td>1.9</td>
<td>0.5</td>
<td>0.02</td>
</tr>
<tr>
<td>Advanced cardiac life support</td>
<td>1.2</td>
<td>0.5</td>
<td>0.20</td>
</tr>
<tr>
<td>OHS required</td>
<td>1.2</td>
<td>0.4</td>
<td>0.10</td>
</tr>
<tr>
<td>CTS consult</td>
<td>1.6</td>
<td>0.6</td>
<td>0.10</td>
</tr>
<tr>
<td>Vascular laceration</td>
<td>0.6</td>
<td>0.4</td>
<td>0.60</td>
</tr>
<tr>
<td>Acquired arteriovenous fistula</td>
<td>0.3</td>
<td>0.09</td>
<td>0.40</td>
</tr>
<tr>
<td>Transfusion required</td>
<td>3.7</td>
<td>0.9</td>
<td>0.0008</td>
</tr>
<tr>
<td>Vascular surgery required</td>
<td>1.2</td>
<td>0.4</td>
<td>0.10</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.3</td>
<td>0</td>
<td>0.09</td>
</tr>
<tr>
<td>ICU transfer</td>
<td>3.7</td>
<td>1.4</td>
<td>0.01</td>
</tr>
<tr>
<td>Death in procedure</td>
<td>0.6</td>
<td>0.2</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Management Options?

• Are all leads functional? **Yes**

Options to consider:

1. Cross “occlusion” with hydrophilic wire +/- catheter. Venoplasty as needed.
2. Puncture proximal to the site of occlusion
3. Tunnel from contra-lateral side
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END?
Cardiac Implantable Electronic Device extraction: Impact of Abandoned Leads
Subclavian venoplasty by the implanting physicians in 373 patients over 11 years

Seth Joseph Worley, MD,* † Douglas Charles Gohn, MD,* † Robert Ward Pulliam, MD,* †
Mandy A. Raifsnider, RN,* Benjamin I. Ebersole,* Joann Tuzi, RN†

From the *Implant Program, Heart Center, Lancaster General Hospital, the †Lancaster Heart and Stroke Foundation, and ‡Medtronic, Lancaster, Pennsylvania.

• Lead addition in 373 consecutive patient with vein occlusion
• Venoplasty was successful in 371 of 373 patients
  — 86% were crossed with a hydrophilic wire
  — Microdissection / excimer laser were used to cross three of the four wire-refractory occlusions

• No Complications reported:
  — Contrast extravasation was common.
  — Balloon rupture was rare (3), and not clinically significant
  — No damage to the existing leads
  — No clinical complications
• 713 patients undergoing lead addition at the time of generator change or device upgrade

• Major complications:
  – 2.4 % peri-procedure
  – 14% at 6 months