Lead Extraction: Technique and Complication

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Lead extraction

As it grows the number of cardiac implantable electronic device implantation, the necessity of lead extraction also grows

- Infection
- Chronic pain
- Thrombosis and vein steno
- Non Functional lead
Figure 1: Timeline of Advances in Lead Extraction

- Buck’s traction
- Basket extraction
- Snare extraction
- Forceps extraction
- Locking stylet
- Telescoping sheath
- Limited atriotomy
- Excimer laser
- Electrosurgical Dissection Sheath
- Evolution

1960 - Simple/weighted traction
1970 - Countertraction sheaths
1980 - Surgical extraction
1990 - 2000 - 2010
Lead Extraction

- Weight and pulley system
- Direct manual traction
- Trans-venous removal by counter-traction technique
- Surgery
Trans-venous approach -procedural step

- Lead preparation
- Gentle manual traction with stylet
- Telescoping Sheath application
Stylet insertion is very important step

- Stylets increase the tensile strength of the leads

<table>
<thead>
<tr>
<th></th>
<th>Locking Stylet</th>
<th>Standard Stylet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traction allowed</td>
<td>stronger</td>
<td>moderate</td>
</tr>
<tr>
<td>Traction</td>
<td>Localized to the tip</td>
<td>Not localized</td>
</tr>
<tr>
<td>removable</td>
<td>Not always</td>
<td>always</td>
</tr>
<tr>
<td>Cross-over to alternative approach</td>
<td>Difficult</td>
<td>simple</td>
</tr>
</tbody>
</table>
Telescoping sheath application

Gently push down the lead with rotation

Stay within line during sheath advancement
Causes of standard technique’s failure

• Narrow costo-clavicular space
• Tightness of binding sites at various sites
  • SVC
  • RA
  • Tricuspid valve
  • ventricle
The Pisa approach
My Experiences

• From 2012 to 2018, we conducted lead extraction for 52 patients. (M:F=35:17, mean age 63.4 [14-88] y.o.).

• There were 36 cases of lead failure and 16 cases of device infection including persistent occult gram-positive bacteremia.
Results

• Lead removal by manual traction was 21 cases.

• 20 cases were done by using telescoping sheath and locking stylet at ipsilateral site of device implantation. By this method 1 case of lead avulsion and fracture at SVC-RA junction occurred.

• 9 cases were done by trans-jugular approach without locking stylet after failure of advance of telescoping sheath beyond RA site.
M/67
C/C: inappropriate ICD shock due to lead failure
venogram
Advance of telescoping sheath with rotation
Advance...
Failure of Advance of sheath beyond TV
Femoral approach for lead release
Trans-jugular catch of the lead using snare (11Fr sheath)
Telescoping sheath again from jugular approach
Advance of sheath to the RV
Additional femoral approach using snare and deflectable catheter
Additional femoral approach using snare and deflectable catheter
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Results

• All of our case was done without serious complication.
Complications of lead extraction

<table>
<thead>
<tr>
<th>Major Event</th>
<th>2017 HRS expert consensus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.19%–1.80%</td>
</tr>
<tr>
<td>Cardiac avulsion</td>
<td>0.19%–1.20%</td>
</tr>
<tr>
<td>Vascular laceration</td>
<td>0.19%–0.96%</td>
</tr>
<tr>
<td>Respiratory arrest</td>
<td>0.16%–0.41%</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>0.20%</td>
</tr>
<tr>
<td>Pericardial effusion requiring intervention</td>
<td>0.07%–0.08%</td>
</tr>
<tr>
<td>Hemothorax requiring intervention</td>
<td>0.23%–0.59%</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>0.07%</td>
</tr>
<tr>
<td>Thromboembolism requiring intervention</td>
<td>0.07%</td>
</tr>
<tr>
<td>Flail tricuspid valve leaflet requiring intervention</td>
<td>0.03%</td>
</tr>
<tr>
<td>Massive pulmonary embolism</td>
<td>0.08%</td>
</tr>
</tbody>
</table>
## Complications of lead extraction

<table>
<thead>
<tr>
<th>Minor</th>
<th>Publication References</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pericardial effusion without intervention</td>
<td>62, 210, 245, 246, 282</td>
<td>0.60%–6.20%</td>
</tr>
<tr>
<td>Hematoma requiring evacuation</td>
<td>62, 210, 282</td>
<td>0.07%–0.16%</td>
</tr>
<tr>
<td>Venous thrombosis requiring medical intervention</td>
<td>62, 210</td>
<td>0.90%–1.60%</td>
</tr>
<tr>
<td>Vascular repair at venous entry site</td>
<td>62, 210, 245</td>
<td>0.10%–0.21%</td>
</tr>
<tr>
<td>Migrated lead fragment without sequelae</td>
<td>62</td>
<td>0.07%–0.13%</td>
</tr>
<tr>
<td>Bleeding requiring blood transfusion</td>
<td>62, 245, 282</td>
<td>0.20%</td>
</tr>
<tr>
<td>AV fistula requiring intervention</td>
<td>62</td>
<td>0.08%–1.00%</td>
</tr>
<tr>
<td>Coronary sinus dissection</td>
<td>62</td>
<td>0.16%</td>
</tr>
<tr>
<td>Pneumothorax requiring chest tube</td>
<td>282</td>
<td>0.13%</td>
</tr>
<tr>
<td>Worsening tricuspid valve function</td>
<td>282</td>
<td>1.10%</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>245</td>
<td>0.32%–0.59%</td>
</tr>
</tbody>
</table>

2017 HRS expert consensus
Central venous vascular tears constitute the potentially most lethal complication encountered during cardiac-implantable electronic device lead extraction.

Historically, the case fatality rate of these events has been 50% due to blood loss prior to getting the patient into an operating room and opening them up for surgical repair.
Conclusion

• Currently, lead extraction was done with limited availability of tools in Korea.
  (only telescoping dilator sheath and locking stylet)
• A lot of lead extraction could be done by simple traction with simple stylet. But minimal back up extraction tool is necessary for doing lead extraction.
• Additional femoral and jugular approach is necessary for difficult case.
• Surgical back up is must and bridge balloon is helpful for life saving.