Outcomes of Patients Undergoing Carotid-Subclavian Bypass in the Setting of Thoracic Endovascular Aortic Repair

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Disclosures—site PI
- Cook p-Branch
- Gore SSB
- Gore conformable
- Crest 2

Background
• Coverage of left subclavian artery (LSCA) during thoracic endovascular aortic repair (TEVAR) required in 10-50% of patients to achieve adequate PLZ
• LSCA contributes to critical vascular beds
  – LUE
  – Posterior cerebral circulation
  – Coronary circulation (LIMA graft)
  – Spinal cord via left vertebral a.
• LUE ischemia, posterior circulation CVA, and SCI potential complications
  – Low frequency

Support selective revascularization, depending on risk factors for ischemia after LSCA coverage

Purpose & Study Design
• Purpose: examine early and late outcomes of left common carotid-LSCA bypass in setting of TEVAR
• Methods: retrospective review of prospectively maintained Duke Center for Aortic Disease database
  – Identified all patients (n=579) who underwent TEVAR between March 2005-April 2016
  – N=112 (19%) underwent associated carotid-LSCA bypass
  – Study cohort

SVS PRACTICE GUIDELINES


Support selective revascularization, depending on risk factors for ischemia after LSCA coverage
Operative Technique

Study Design

• Phrenic nerve injury analysis
  – All pre- & post-TEVAR chest imaging radiology reports reviewed
  – New postoperative L hemidiaphragm elevation noted by reading radiologist
  – Two independent reviewers then analyzed images & categorized as severe or mild injury
  – No consensus definition in literature
  – All follow-up imaging assessed for recovery
  – Return of hemidiaphragm to normal anatomic position

• 3 consecutive CXRs = phrenic n. palsy
  – Two independent reviewers then analyzed images & categorized as severe or mild injury

• Severe injury = elevated hemidiaphragm to at least 1/3 of ipsilateral thoracic cavity

Patient Characteristics

• N=112 patients
• Mean age 65 ± 14 years
• 38% female
• Hypertension, hyperlipidemia, and tobacco most common comorbidities

Procedural Characteristics

• 95.5% (n=107) conduits 8 mm PTFE grafts
  – Small minority RSVG or Dacron
• 91% done concurrently at time of TEVAR
  – N=10 (9%) performed at separate operation from TEVAR
• Preparation for TEVAR
  • Address a complication
  • 79% of TEVAR were elective
  • Bypasses performed for standard indications
  – Spinal cord protection (78.6%)
  – Patent LIMA (8.9%)

Complications of LCCA-LSCA bypass

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. (%)</th>
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<tbody>
<tr>
<td>Neuropathy</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Asymptomatic axillary nerve injury</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Asymptomatic phrenic nerve injury</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Neck weakness</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Acute respiratory failure</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Asymptomatic carotid dissection</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Asymptomatic phrenic nerve injury</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Phrenic Nerve Injury

<table>
<thead>
<tr>
<th>Category</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No phrenic nerve injury</td>
<td>80 (75)</td>
</tr>
<tr>
<td>Mild phrenic nerve injury</td>
<td>11 (10)</td>
</tr>
<tr>
<td>Severe phrenic nerve injury</td>
<td>16 (15)</td>
</tr>
</tbody>
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- 52% recovery rate overall
- Severe injuries less likely to recover (31% severe vs. 82% mild, p<0.01)
- Longer recovery time for severe injuries (13±12 mo vs. 7±8 mo, p<0.002)
Do you want the figure with the bypass? Or just the one with the phrenic nerve?

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Late complications

- Rare
- Anastomotic pseudoaneurysm (n=2; 2%)
  1. Proximal anastomosis (1 month)
  2. Distal anastomosis (35 months)
- Graft ultrafiltration syndrome (n=1; 1%) (POD# 130)
- No graft infections

Graft Patency

- Follow-up CTA imaging available in 87% of n=106 operative survivors
- Mean imaging follow-up 27±26 months
- Actuarial primary patency 97% at 5 years
- 3 graft occlusions
  - Clinically silent at 30 and 28 months
  - Subclavian steal at 30 months requiring repeat revascularization

Summary

- Report examines early & late outcomes for CCA-SCA bypass
- Perioperative complications in nearly 1/3rd cohort
- Phrenic nerve injury most common (25% incidence)
  - 1st study to examine true incidence in detail
  - 52% of those with injury recovered in follow up
  - Severe injuries less likely to recover & took longer
- Low incidence of late-term complications
  - 2% pseudoaneurysm, 1% graft ultrafiltration, no graft infection
- Actuarial primary graft patency 97% at 5 years

Study Design

- Outcomes specific to carotid-subclavian bypass procedure
  - 30-day: cervical plexus nerve injury, bleeding, local vascular complications
  - Long-term: primary graft patency, anastomotic complications, nerve injury recovery

Recurrent Laryngeal Nerve Injury

- 2nd most common complication
- 5% incidence (n=6)
  - 5 of 6 required intervention
  - 4 underwent VC injection and recovered nerve function in follow up
  - 1 failed injection and required permanent VC implant

To cut down time I can just completely avoid talking about this injury. It cuts this slide and a couple of sentences in the discussion. Thoughts?

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