LSA Perfusion Is Not Always Necessary With TEVAR: When May It Be Unnecessary And What Are The Risks And Downsides Of LSA Revascularization

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Schwartz Buckley Professor of Surgery
New York University Langone Health
New York, NY

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Disclosures

Cook
Gore
Endologix
Medtronic

Dr. Dan Clair...
Pillar of the community
Leader in Vascular Surgery,
All around good guy...
We all want to be Dan Clair

Palmetto Health-USC Medical Group welcomes Dr. Daniel Clair
April 1, 2016

Dr. Daniel Clair will assume the role of Chair of the Department of Surgery for the University of South Carolina (USC) and the Palmetto Health-USC Medical Group effective April 1, 2016. He will also serve as the senior Medical Director for Surgical Services at Palmetto Health.

As a vascular surgeon, Clair served as chair of the Department of Vascular Surgery at Cleveland Clinic from 2005 to 2015. Under his leadership, the department expanded from seven surgeons to more than 20 surgeons who perform over 8,000 procedures annually.

Clair received his medical degree from the University of Virginia School of Medicine in Charlottesville, Virginia, followed by an internal medicine residency and chief residency in surgery at Brigham and Women’s Hospital in Boston. After completing his residency, he pursued a fellowship in clinical oncology from the American Cancer Society, a fellowship in vascular surgery from Brigham and Women’s Hospital in Boston, and a research fellowship as an assistant scientist at Boston’s Massachusetts General Hospital.
Dr. Dan Clair… is the zone…

So why not revascularize every LSA you cover during TEVAR?

What’s the big deal?

Left Subclavian Revascularization is not always benign

- Stroke (2-6%)**
- Injury to:
  - Subclavian Artery
  - Subclavian Vein
  - Brachial Plexus
  - Vagus Nerve
  - Phrenic Nerve (4.4%)*
  - Thoracic Duct

- Infection (1-2%)
- Bleeding
- Additional Operation (cardiac risk)

Cumulative risk of 9.4% ***

124 patients CSB for occlusive disease

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<tr>
<td>2D patient</td>
<td>(%)</td>
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<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Headache</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>Myalgia</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Muscular tension</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Thromboembolic event</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Neurologic event</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Maligic muscular pain</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Stroke</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Neurologic defect</td>
<td>9</td>
<td>90</td>
</tr>
</tbody>
</table>

From 1966 to 2000, 516 patients who underwent CSB and 511 patients who underwent a SCT were reported in the literature.

Covering the Left Subclavian

Is revascularization mandatory?

**Absolute Indications:**
- Prior LIMA coronary bypass
- Dominant Left Vertebral
- Absent or interrupted Right Vertebral artery

**Relative Indications:**
- Long segment aortic coverage
- Compromised collateral flow
  (i.e. prior aortic surgery)

Studies Reporting Major Neurologic Adverse Events after TEVAR with and without LSA revascularization

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>LSA revasc</th>
<th>LSA not revasc</th>
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<tbody>
<tr>
<td>Stroke</td>
<td>1161</td>
<td>26 (5.8%)</td>
<td>56 (7.3%)</td>
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<tr>
<td>SCI</td>
<td>52</td>
<td>11 (2.7%)</td>
<td>31 (4.2%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>52</td>
<td>11 (2.7%)</td>
<td>31 (4.2%)</td>
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No significant reduction in periop stroke, SCI, or mortality with LSA revascularization
“... High quality RCT evidence for or against routine or selective revascularization of the LSA in TEVAR is not currently available. It is not possible to draw conclusions with regard to the optimal management of LSA coverage...”.

**Systematic review and meta analysis of the literature**

**51 eligible studies**

The GRADE system categorizes recommendations as:
- strong (GRADE 1) denoted by the phrase “we recommend,”
- or
- weak (GRADE 2) denoted by the phrase “we suggest.”

The quality of evidence is graded as:
- high-quality (level A), typically derived from well conducted randomized trials,
- moderate-quality (level B), typically derived from less rigorous or inconsistent randomized trials,
- low- or very-low quality, (level C), derived from observational studies, case series, and unsystematic observations or expert opinion.

**Recommendation 1:** In patients who need elective TEVAR where achievement of a proximal seal necessitates coverage of the LSA, we suggest routine preoperative revascularization despite the very low-quality evidence (GRADE 2, level C).

**Recommendation 2:** In selected patients who have an anatomy that compromises perfusion to critical organs, routine preoperative LSA revascularization is strongly recommended despite the very low-quality evidence (GRADE 1, level C).

**Recommendation 3:** In patients who need very urgent TEVAR for life-threatening acute aortic syndromes where achievement of a proximal seal necessitates coverage of the LSA, we suggest that revascularization should be individualized and addressed expectantly on the basis of anatomy, urgency, and availability of surgical expertise (GRADE 2, level C).

**How do we decide?**

Take aim and select carefully

**Spinal Cord Ischemia**

Assess collateral flow

LONG SEGMENT COVERAGE

PRIOR INFRARENAL AORTIC SURGERY

COMPROMISED PELVIC COLLATERALS

T8-L2
ASSESS HYPOGASTRIC OCCLUSIVE DISEASE

Etiology of Stroke following TEVAR

Hydroperfusion or Embolic probably both at times?

Neurological complications after left subclavian artery coverage during thoracic endovascular aortic repair: A systematic review and meta-analysis

David G. Cooper, MS, FRCS; Stewart K. Welsh, MS; RN; MD; Adam S. Banerjee, MD; Ayusha N. Konduru, MD; Paul D. Honer, MD, FRCS; and Jonathan B. Birx, MD, FRCS

Conclusions

Conclusions from the systematic review of 126 patients, 29 LSCA covered without bypass. CV Ap 2/29 (7.4%): embolic. None were posterior circulation. Hypertrophy of Right Vertebral in 7/27 (25.9%) of patients.

Selectivity coverage of the left subclavian artery without revascularization in patients with bilateral patent vertebralbasilar junctions during thoracic endovascular aortic repair

Minoru Ito, MD; Koichi Ito, MD; Ryo Oshika, MD; Takehito Kurihara, MD; Tomo Katsuki, MD; and Hiroshi Kikui, MD

Objectives: The primary purpose of the current study was to assess the safety and effectiveness of selective coverage of the left subclavian artery (LSCA) without revascularization during thoracic endovascular aortic repair (TEVAR) in patients with bilateral patent vertebralbasilar junctions. The secondary purpose was to assess changes of the vertebral artery (VA) size and frequency of VA dissection after TEVAR in patients with patent LSCA.

Methodology: A retrospective review of 126 patients (74 men, 52 women; average age 76.2 ± 9.2 years) who underwent TEVAR for descending aortic aneurysms at a single institution between January 2008 and December 2017. The patients were divided into two groups: Group I (n = 74) and Group II (n = 52). Group I included patients with patent LSCA and Group II included patients with occluded LSCA.

Results: Of the 126 patients, 29 LSCA were covered without bypass. CV Ap 2/29 (7.4%); embolic. None were posterior circulation. Hypertrophy of Right Vertebral in 7/27 (25.9%) of patients.

Table II. Serial changes of the hypertrophied right VA diameter after TEVAR

<table>
<thead>
<tr>
<th>Segment</th>
<th>Diameter (mm)</th>
<th>At follow-up months</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Foraminal (n = 4/15)</td>
<td>3.2, 4.1, 4.2, 4.2, 4.2, 4.2</td>
<td></td>
</tr>
<tr>
<td>Intradural (n = 3/12)</td>
<td>4.3, 4.3, 5.2, 5.2, 5.2, 5.2, 5.2</td>
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Hypertrophy of Right Vertebral in 7/27 (25.9%) of patients.
How do we select who to revascularize?

**IMAGING**

**Risk Factors for Perioperative Stroke During Thoracic Endovascular Aortic Repair (TEVAR)**

Robert J. Fieo, MD; Tomen D. Martin, MD; Philip J. Hess, MD; Charles T. Khledel, MD; Thomas M. Beaver, MD; Thomas S. Huber, MD, PhD; James M. Seeger, MD; and W. Anthony Lee, MD

*Division of Vascular Surgery and Endovascular Therapy and Thoracic and Cardiovascular Surgery, Department of Surgery, University of Florida College of Medicine, Gainesville, Florida, USA.*

Patient Selection may be important!

**Early Study Period (no routine cerebral imaging):**

110 pts (56.1%): Posterior Circulation STROKE 5.5%

**Late Study Period (routine imaging obtained):**

86 pts (43.9%): Posterior Circulation STROKE 1.2%

*J Vasc Surg 2013 Jan 57(1):116-24*

- Retrospective review of prospectively collected data on consecutive patients undergoing TEVAR
- Six high volume centers >150 TEVAR experience
- 1189 patients total

**Left subclavian artery coverage during thoracic endovascular aortic aneurysm repair does not mandate revascularization**

- Thiessen B, Mahmodov, MD; David Decker, MD; Carson B. Buchekian, MD; Frank J. Verhe, MD; Karen Goss, MD; South Amherst, OH; Thiessen, Benett, MD; Bayliff, Michael, MD; Wakefield, Charles, MD; and Edwards, Progressive, Pa.

**NO difference in MAE between covered LSA with/without revascularization**

<table>
<thead>
<tr>
<th>Group</th>
<th>SCI</th>
<th>CVA</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>16/212 (7.5)</td>
<td>13/212 (6.1)</td>
<td>24/212 (11.3)</td>
</tr>
<tr>
<td>C</td>
<td>7/372 (1.9)</td>
<td>11/372 (2.9)</td>
<td>18/372 (2.9)</td>
</tr>
<tr>
<td>D</td>
<td>2/72 (2.7)</td>
<td>9/72 (12.5)</td>
<td>5/72 (6.9)</td>
</tr>
</tbody>
</table>

Increased risk of Stroke in Women during TEVAR

<table>
<thead>
<tr>
<th>Gender</th>
<th>Group B (LSA Covered)</th>
<th>Group C (LSA bypassed)</th>
</tr>
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<tbody>
<tr>
<td>Female</td>
<td>4/76 (5.3%)</td>
<td>8/67 (11.9%)</td>
</tr>
<tr>
<td>Male</td>
<td>9/136 (6.6%)</td>
<td>3/106 (2.8%)</td>
</tr>
</tbody>
</table>

*Only female gender differed between groups, with an increased risk of stroke in female patients undergoing left subclavian artery revascularization

Conclusions

• LSA revascularization is not always benign...

• NO GOOD EVIDENCE TO SUGGEST MANDATORY LSA REVASCULARIZATION

• LSA coverage during TEVAR does not appear to confer increased risk of SCI or stroke and should not mandate revascularization

• A policy of selective LSA revascularization appears to result in equally good outcomes when compared with non-revascularization.
Conclusions

• LSA revascularization is not always benign…
• NO GOOD EVIDENCE TO SUGGEST MANDATORY LSA REVASCULARIZATION
• LSA coverage during TEVAR does not appear to confer increased risk of SCI or stroke and should not mandate revascularization
• A policy of selective LSA revascularization appears to result in equally good outcomes when compared with non-revascularization.
• Proper patient selection can help minimize risk
  – Obtain routine intracerebral imaging and pelvic imaging
  – Special care in women: may have increased risk of stroke when undergoing LSA revascularization

SELECTIVE LSA Revascularization is the way to go when TEVAR covers the LSA Orifice