Natural History of Penetrating Atherosclerotic Ulcers

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Objectives: Increased utilization of computed tomography angiography (CTA) has increased the radiologic diagnosis of penetrating atherosclerotic plaque through the internal elastic lamina into the aortic media. However, their clinical relevance and indications for endovascular exclusion remain unclear.

Methods: The radiology database at a university hospital was searched for the CTA diagnosis of PAU from January 2003 to June 2009. All CTA scans were interpreted by a cardiovascular radiologist. Information on patient clinical characteristics and need for surgical repair due to PAU disease was also collected. PAU stability or progression was assessed by follow-up CTA, if available.

Results: A total of 385 PAUs in 315 patients were diagnosed by CTA interpretation (Table). There were 186 men (59.0%) and 129 women (41.0%), with a mean age of 73.3 ± 9.0 years. PAUs were located in the ascending aorta in 7 cases (1.8%), which were excluded from further analysis, the aortic arch in 27 (6.8%), the descending thoracic aorta in 243 (61.2%), and the abdominal aorta in 118 (29.7%). In 104 patients, there was an associated saccular aneurysm; in 48 there was an associated type B intramural hematoma; and the PAU in 163 patients was uncomplicated. Of the 163 patients with uncomplicated PAUs, 39 had follow-up CTAs: 31 (79.5%) showed increased size over 12.3 ± 9.0 months, and 8 (20.5%) showed increased size over 12.3 ± 14.4 months. Fifty (15.9%) patients required thoracic endovascular aneurysm repair (n = 31), endovascular aneurysm repair (n = 10), or open repair (n = 9) for ruptured PAU or PAU-related aneurysm.

Conclusions: Interventions for PAUs are not infrequently necessary. Given a rate of progression of PAU disease as high as 20%, follow-up imaging is indicated in these patients.

Table.

<table>
<thead>
<tr>
<th>Patients with uncomplicated PAU</th>
<th>163</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enlarged on serial CT</td>
<td>8/39 (20.5%)</td>
</tr>
<tr>
<td>Stable on serial CT</td>
<td>31/39 (79.5%)</td>
</tr>
<tr>
<td>Patients with PAU (associated) saccular aneurysm</td>
<td>104</td>
</tr>
<tr>
<td>Requiring repair</td>
<td>34*</td>
</tr>
<tr>
<td>Patients with PAU (associated) IMH</td>
<td>48</td>
</tr>
<tr>
<td>Patients with ruptured</td>
<td>16*</td>
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</tbody>
</table>

*Required open or endovascular repair

Adjunctive Endovascular Techniques in Management of Acute and Chronic Type B Thoracoabdominal Aortic Dissections: Implications of False Lumen Thrombosis, Pressurization, and Remodeling

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Objectives: We evaluated the impact of inducing false lumen (FL) thrombosis via coil embolization during repair of type B thoracoabdominal aortic (TAA) dissections.

Methods: Since 2007, 26 patients underwent treatment of type B TAA dissections for aneurysm formation (n = 18, 69%), unrupturing pain (n = 11, 42%), or rupture (n = 6, 27%). All thoracic endovascular aneurysm repair (n = 21, 81%) and endovascular aneurysm repair (n = 6, 19%) patients underwent coverage of all fenestrations along the descending thoracic aorta or intradural/ileac arteries. During the procedures, transluminal access was obtained into both true lumen and FL; the stent grafts were implanted in the true lumen, and a cardioMEMS Endosure wireless pressure sensor as well as coils were packed in the FL of the thoracic or abdominal aorta/ileac arteries. The ratio of "FL to systemic pressure" measurements were recorded at systolic, diastolic, mean, and pulse pressure index at the time of implantation, at 1 month and every 6 months thereafter, and computed tomography angiography (CTA) was obtained at annual intervals. Technical success was obtained in all procedures; completion arteriogram did not indicate contrast filling into the FL. Follow-up 6-month and 1-year CTA indicated several significant findings: marked FL thrombosis in 22 patients (85%), FL remodeling with ≥5-mm reduction in maximum diameter in 17 patients (65%), and none of the patients had an increase in FL maximum diameter. All systolic, diastolic, mean, and pulse pressure index ratios of "FL to systemic pressure" were significantly reduced in 23 patients (88%) at 6 months and 1 year. No patients developed spinal cord ischemia, there were no significant outcome differences in acute and chronic TAA dissections, and the 30-day mortality was 3.8%.

Conclusions: FL embolization during endovascular management of acute and chronic type B TAA dissections is safe and effective in reducing FL pressures and maximum diameter and can be a valuable alternative in management of high-risk TAA patients.

Thoracic Endovascular Aortic Aneurysm Repair With and Without Coverage of the Left Subclavian Artery in the 2005-2008 ACS NSQIP

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Objective: Thoracic stent grafts have been increasingly used to treat descending thoracic aortic aneurysms. In some instances, intentional coverage of the origin of the left subclavian artery (LSA) is necessary. Prior data have suggested that coverage of the LSA may increase the risk of stroke and that primary recanalization may decrease this risk. In this study we analyzed the outcomes of intentional coverage of the LSA during thoracic endovascular aortic aneurysm repair (TEVAR).

Methods: The 2005 to 2008 American College of Surgeons National Surgical Quality Improvement Program database was analyzed. Using International Classification of Disease, Ninth ed diagnosis codes, we identified all patients with a primary diagnosis of thoracic aneurysm who underwent TEVAR with and without coverage of the LSA and/or LSA recanalization. Of the 352 patients identified, 120 included coverage of the LSA but 232 did not. Concomitant LSA recanalization procedures were performed in 10 of the 120 patients. Primary LSA recanalization procedures without TEVAR were performed in 68 patients. We compared demographics, comorbidities, and postoperative complications.

Results: The cohorts were similar in age, race, gender, and comorbidities. Thirty-day mortality was similar: 5.0% for patients with LSA coverage vs 3.9% for patients with a preserved LSA (P = .68). The rate of postoperative stroke was significantly higher in the group with LSA coverage (7.5% vs 2.6%; odds ratio, 3.6, 95% confidence interval, 1.1-10.9; P = .03). Two of the 10 patients with concomitant recanalization suffered a stroke. Patients with LSA coverage and no recanalization had a stroke rate of 6.4%. The stroke rate for staged LSA recanalization without concomitant TEVAR was 7.4%. LSA recanalization patients also had a higher incidence of unplanned reintubation (10% vs 5%).

Conclusions: TEVAR for descending thoracic aortic aneurysms involving the LSA is associated with a high stroke rate regardless of whether a LSA recanalization procedure is performed concomitantly, at a separate setting, or not at all. This should be factored into the decision making when performing TEVAR.

In Situ Laser Fenestration and Stenting During TEVAR: A New Approach to Subclavian Artery Revascularization

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Objectives: A significant need exists for a versatile and accessible method to revascularize aortic branches during thoracic endovascular aneurysm repair (TEVAR). We present six TEVARs with laser fenestration of the left subclavian artery (SCA) as an alternative to debranching.

Methods: TEVAR is completed using a combination of Medtronic, Talent, or Cook TX2 endografts. Through retrograde brachial access, a 0.018-inch wire, followed by a Spectranetics Turbo Elite 2.0- to 2.5-mm laser catheter is placed in the SCA ostium. With gentle laser-endograft contact pressure, 45 psi/mm² at 25 pulses/s is applied to the endograft for 2 to 3 seconds to create a fenestration. The 0.018-inch wire is then advanced through the laser into the endograft lumen and exchanged for a 0.035-inch
wire. After endograft predilation, an Innuit ICAST 8- to 10-mm stent is deployed approximately one-quarter into the lumen and one-quarter into the branch vessel. The endograft portion of the covered stent is then flared and a completion angiogram performed.

**Results:** Six patients (3 men, 3 women), mean age of 50 years, underwent left SCA laser fenestration with TEVAR. All had hypertension, and four (67%) had a history of smoking, hypercholesterolemia, or congestive heart disease. Two patients had Marfan syndrome and two patients had previous aortic root replacement. Five patients had acute dissection, two with an intramural hematoma. One patient had a penetrating aortic ulcer distal to the left SCA after previous ascending aortic repair. Mean aortic size was 8.5 mm (range, 28-80 mm) mean contrast volume was 101 ± 51 mL. Mean operative time was 180 ± 38 minutes. Technical success was 83% (n = 5). One fenestration attempt was abandoned secondary to the acute angle of the SCA and a type III aortic arch. The SCA stent in this case was snorkeled into the aneurysm. OR-AAA decreased with increasing volume of OR-AAAs performed by a hospital. After adjusting for patient and hospital characteristics, increasing composite surgeon volume was associated with lower mortality. The American Board of Surgery.

**Conclusion:** In situ retrograde laser fenestration is an innovative, feasible, and effective option for revascularizing the SCA during TEVAR.

### The Impact of Surgeon Volume on Outcomes in Vascular Surgery: What Type of Volume Is Relevant?

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**Objective:** Prior studies reported improved clinical outcomes with higher surgeon volume, which was assumed to be a product of the surgeon's experience with the index operation. We hypothesized that composite surgeon volume is an important determinant of outcome. We tested this hypothesis by comparing the impact of operation-specific surgeon volume vs. composite surgeon volume on surgical outcomes, using open abdominal aortic aneurysm repair (OR-AAA) as the index operation.

**Methods:** The Nationwide Inpatient Sample was analyzed to identify patients undergoing OR-AAA from 2000-2008. Surgery was stratified into tertiles based on annual volume of OR-AAAs ("operation-specific volume") and overall volume of open vascular procedures ("composite volume"). Composite volume was defined by sum of several open vascular operations: carotid endarterectomy, aortobifemoral bypass, femoro-popliteal bypass, and femoral-tibial bypass. Multiple logistic regression analyses were used to examine the relationship between surgeon volume and in-hospital mortality for OR-AAA, adjusting for patient and hospital characteristics.

**Results:** Between 2000 and 2008, 111,533 elective OR-AAAs were performed nationwide, with an in-hospital mortality rate of 6.1%. The median number of OR-AAAs performed annually was four per surgeon (interquartile range [IQR], 2-10). The median composite volume was 28 operations per surgeon (IQR, 6-59). As expected, in-hospital mortality for OR-AAA decreased with increasing volume of OR-AAAs performed by a surgeon (Table I). Interestingly, a similar relationship was seen between in-hospital mortality and composite surgeon volume (Table II). After adjusting for patient and hospital characteristics, increasing composite surgeon volume remained a significant predictor of lower in-hospital mortality for OR-AAA (odds ratio, 0.999; 95% confidence interval, 0.990-0.999; P < .0001), whereas increasing volume of AAA repairs per surgeon was not protective from in-hospital mortality (odds ratio. 1.008, 95% confidence interval, 1.004-1.013; P = .001).

**Conclusion:** The current study suggests that composite surgeon volume—not operation-specific volume—is a key determinant of in-hospital mortality for OR-AAA. This finding has potential implications for credentialing of surgeons by hospitals and the American Board of Surgery.

### Table I. Mortality for open AAA repair by tertiles of surgeon volume of AAA repairs.

<table>
<thead>
<tr>
<th>Tertiles of open AAA volume</th>
<th>Mortality rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertile 1 (1-2 cases/y)</td>
<td>8.8</td>
</tr>
<tr>
<td>Tertile 2 (3-5 cases/y)</td>
<td>5.3</td>
</tr>
<tr>
<td>Tertile 3 (&gt;7 cases/y)</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Cochran-Armitage Trend Test, P < .0001.

### Table II. Mortality for open AAA repair by tertiles of composite surgeon volume.

<table>
<thead>
<tr>
<th>Tertiles of composite volume</th>
<th>Mortality rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tertile 1 (1-11 cases/y)</td>
<td>8.9</td>
</tr>
<tr>
<td>Tertile 2 (12-47 cases/y)</td>
<td>5.1</td>
</tr>
<tr>
<td>Tertile 3 (&gt;47 cases/y)</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Cochran-Armitage Trend Test, P < .0001.

### Is Routine Follow-up Angiography Warranted After Dialysis Access Intervention?

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**Objective:** The natural history of balloon angioplasty is that of recurrent stenosis and, ultimately, thrombosis of the vessel. Hemodialysis (HD) accesses tend to have a more rapid progression to failure than other native vessels subjected to balloon dilation. We reviewed our patient data to determine the validity of a routine follow-up for a failing HD access.

**Method:** All patients scheduled for a routine follow-up after an initial endovascular intervention on their HD access were included in this report. None of the patients had symptoms of a failing HD access by physical examination or dialysis unit measurements. Findings on diagnostic angiography and the specific interventions were recorded.

**Results:** A total of 121 patients underwent routine diagnostic angiography between January and September 2010. The follow-up study for all patients was scheduled at the time of their initial endovascular intervention (mean = 88.7 days). Seventy-six percent (86 of 121) of these asymptomatic patients required an intervention at the time of their diagnostic angiogram. Sixty-eight percent (59 of 87) of patients with arteriovenous fistulae and 79% (27 of 34) with an arterovenous graft required an intervention for an unsuspected stenotic lesion (x² = 1.09; P = .297; NS).

**Conclusion:** The need for routine follow-up is warranted based on the results presented. Seventy percent of patients undergoing an endovascular intervention had a documented stenotic lesion associated with their access that was not evident on clinical evaluation. Therefore, these results justify a standardized approach to the follow-up of patients undergoing an endovascular intervention of their HD access.

### A Fresh Cadaver Lab to Conceptualize Troublesome Anatomical Relationships in Vascular Surgery

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**Objective:** Troublesome knowledge and threshold concepts are those concepts difficult to conceptualize but once understood seem relatively simplistic. There are several complex anatomic relationships that are troublesome but whose understanding is critical to becoming a competent vascular surgeon. Unfortunately, due to work hour restrictions and an increase in minimally invasive procedures, there are declining opportunities for residents to participate in complex operations that provide the appropriate environment to visualize these anatomic relationships. Because mannequins and computer simulation do not provide sufficient realism and clinical context to adequately substitute for operative experience, we propose the use of fresh cadavers to assist resident comprehension of troublesome anatomic relationships in vascular surgery.

**Methods:** Twenty-two postgraduate year (PGY) 3s (n = 12) and PGY 4s (n = 10) attended four structured 3-hour cadaver skills laboratory sessions. Residents performed operative vascular exposures identified, by senior surgical residents, as conceptually difficult and not forgotten. Complex anatomic relationships can be troublesome and difficult to comprehend but once understood seem relatively simplistic. There are several complex anatomic relationships that are troublesome but whose understanding is critical to becoming a competent vascular surgeon. Unfortunately, due to work hour restrictions and an increase in minimally invasive procedures, there are declining opportunities for residents to participate in complex operations that provide the appropriate environment to visualize these anatomic relationships. Because mannequins and computer simulation do not provide sufficient realism and clinical context to adequately substitute for operative experience, we propose the use of fresh cadavers to assist resident comprehension of troublesome anatomic relationships in vascular surgery.

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