41st ANNUAL SCIENTIFIC MEETING

DELAWARE VALLEY VASCULAR SOCIETY

THE UNION LEAGUE OF PHILADELPHIA
PHILADELPHIA, PENNSYLVANIA

Thursday, May 9, 2019

ADMINISTRATIVE OFFICE
Delaware Valley Vascular Society
9400 W. Higgins Rd., Suite 315, Rosemont, IL 60018
Telephone: 312-334-2321 · Fax: 312-334-2320
Email: DVVS@vascularsociety.org · www.vascular.org/dvvs
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Program
Dawn M. Salvatore, MD, Chair

Ad-Hoc Registry
Grace J. Wang, MD, Chair

Bylaws
Douglas A. Troutman, DO, Chair

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PAST PRESIDENTS

1979-1980.................................Charles C. Wolferth, Jr. MD
1980-1981.................................Charles C. Wolferth, Jr. MD
1981-1982.................................Robert Tyson, MD
1982-1983.................................Rudolph C. Camishion, MD
1983-1984.................................William Gee, MD
1984-1985.................................Paul Nemir, Jr. MD
1985-1986.................................Brooke Roberts, MD
1986-1987.................................Dominic A. DeLaurentis, MD
1987-1988.................................Gary G. Nicholas, MD
1989-1990.................................Richard K. Spence, MD
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1991-1992.................................Anthony J. Comerota, MD
1992-1993.................................Brian L. Thiele, MD
1993-1994.................................William H. Hardesty, MD
1994-1995.................................R. Anthony Carabasi, MD
1995-1996.................................John V. White, MD
1996-1997.................................James B. Alexander, MD
1997-1998.................................Keith D Calligaro, MD
1998-1999.................................Robert G. Atnip, MD
1999-2000.................................Thomas K. Evans, MD
2000-2001.................................Mark B. Kahn, MD
2001-2002.................................Matthew J. Dougherty, MD
2002-2003.................................Eric C. Jaxheimer, MD
2003-2004.................................Michael A. Golden, MD
2004-2005.................................David P. Franklin, MD
2005-2006.................................Paul J. DiMuzio, MD
2006-2007.................................John Blebea, MD
2007-2009.................................Robert J. DiGiovanni, MD
2009-2010.................................John J. Flanagan, Jr. MD
2010-2011.................................Edward Y. Woo, MD
2011-2012.................................Frank Schmieder, MD
2012-2013.................................Ralph P. Ierardi, MD
2013-2014.................................James R. Elmore, MD
2014-2015.................................Joseph V. Lombardi, MD
2015-2016.................................Benjamin M. Jackson, MD
2016-2017.................................Theodore Sullivan, MD
2017-2018.................................Grace J. Wang, MD
PURPOSE AND CONTENT

The purpose of this meeting is to present state-of-the-art clinical research and vascular biology relating to surgical aspects of vascular disease. The program will include presentations of original research by investigators in the field of Vascular Surgery and other areas of practice building. A significant portion of the program has been reserved for question and answer interaction between the presenters and the audience.

PROGRAM OBJECTIVES
At the end of this activity, participants will be able to:

1. Discuss strategies in management and use of outpatient vascular lab, wound care center, outpatient angiography suite;
2. Recognize importance of radiation safety and implement changes to minimize radiation exposure;
3. Evaluate and discuss advanced open and endovascular surgical treatment options for rare arterial and venous aneurysms;
4. Review novel endovascular techniques for treatment of peripheral artery disease and bypass grafts;
5. Describe thoracic outlet syndrome (venous, neurogenic) anatomic variations and management;
6. Manage complex aortic pathology with unique open and endovascular surgical approaches.

DISCLOSURE INFORMATION
In compliance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity has disclosed all relevant financial relationships with any commercial interest. All reported conflicts are managed by a designated official to ensure a bias-free presentation. Please see the insert to this program for the complete disclosure list.

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation
This activity has been planned and implemented in accordance with the Essential Areas and Policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American College of Surgeons and the Delaware Valley Vascular Society. The American College of Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

AMA PRA Category 1 Credits™
The American College of Surgeons designates this live activity for a maximum of 6.75 AMA PRA Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Of the AMA PRA Category 1 Credits™ listed above, a maximum of 3.0 credits meet the requirements for Self-Assessment.
DELAWARE VALLEY VASCULAR SOCIETY SELF-ASSESSMENT
QUESTIONS FOR MAINTENANCE OF CERTIFICATION

Of the *AMA PRA Category 1 Credits*™ listed above, a maximum of 3.00 credits meet the requirements for Self-Assessment.

To answer the MOC questions, please go to the following website or scan the QR code below:


- You must achieve at least 75% correct to receive the MOC credit.
- You may re-take this test as many times as you like.
- Please click on the Submit button for your final test results.
- These questions will be posted for 10 calendar days after the end of the meeting (May 19, 2019) and may be taken at any time.

Attendees are required to complete an evaluation form to claim CME. Please complete the evaluation form and return to the registration counter. CME certificates will be emailed post-meeting.

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**BEST TRAINEE AWARD**

Abstracts presented by our trainees will be eligible for the Clinical Research Award and Basic Science/Case Report Award.

DVVS members will conduct the review and scoring of these presentations. Please complete the score sheet and return them to the registration counter by 5:00 pm. There will be monetary awards and certificates presented to each winner at the evening’s dinner.
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<tr>
<th>Time</th>
<th>Session Title</th>
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<tr>
<td>11:00 a.m.</td>
<td>Welcome</td>
<td>Rashad Choudry, MD, DVVS President</td>
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<tr>
<td>11:05 a.m.</td>
<td>Aortic and Arterial Case Reports</td>
<td>Moderators: Paul Foley, MD; Jose Trani, MD</td>
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<td>Anthony Feghali, MD, Kevin Nyugen, MD, Dawn Salvatore, MD; Babak Abai MD;</td>
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<td>Paul DiMuzio, MD</td>
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<td>11:11 a.m.</td>
<td>Understanding Hepatic Artery Anatomy and Possible Anatomic Variables through</td>
<td>Anthony Feghali, MD, Kevin Nyugen, MD, Dawn Salvatore, MD; Babak Abai MD;</td>
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<td>Open Treatment of a Complex Hepatic Artery Aneurysm</td>
<td>Paul DiMuzio, MD</td>
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<td>11:17 a.m.</td>
<td>Penetrating Aortic Ulcers: Review of Acute Aortic Syndrome and Comparison of</td>
<td>Nicholas Madden, DO; Matthew Dougherty, MD; Douglas A Troutman, DO;</td>
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<td>Two Patients</td>
<td>Krystal Maloni, MD; Keith Calligaro, MD</td>
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<td>11:23 a.m.</td>
<td>Treatment of Type 1a Endoleak Rupture with Banding of Aortic Neck</td>
<td>Mohamed Elsagga, DO; Mohammed Javed, DO; Kane Chang, MD</td>
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<td>11:29 a.m.</td>
<td>A 6cm Right Renal Artery Aneurysm and a 2cm Left Renal Artery Aneurysm in a</td>
<td>Tarik Ali, MD; Maria Castello, MD; Faisal Aziz, MD</td>
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<td>Patient with Prior Open Abdominal Aortic Aneurysm Repair</td>
<td>Anand Parikh, MD; Julia Glaser, MD; Venkat Kalapatapu, MD</td>
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<td>11:35 a.m.</td>
<td>Infrainguinal Cryopreserved Vein Graft Aneurysm Repaired with an Interposition</td>
<td>Anand Parikh, MD; Julia Glaser, MD; Venkat Kalapatapu, MD</td>
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<td>Saphenous Vein Graft</td>
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<td>11:41 a.m.</td>
<td>Endovascular Management of Complex Popliteal Artery Aneurysm with Critical</td>
<td>Arthelma C. Tyson, MD; Jacinto Camarena III, MD</td>
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<td>Limb Ischemia</td>
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<td>11:47 a.m.</td>
<td>Non-Anastamotic Pseudoaneurym as a Late Complication of Cadaveric Vascular</td>
<td>Katelynn Ferranti MD; Faisal Aziz MD; John Radtka, MD</td>
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<td>Allograft</td>
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<td>11:53 a.m.</td>
<td>Urgent Explant of Endografts From Rapidly-Expanding Aneurysm Sac with</td>
<td>Sandra Toth, MD; Ashley Leberfinger, MD; Scott Armen, MD; Faisal Aziz, MD;</td>
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<td>Endotension: A Case Report</td>
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<td>11:59 a.m.</td>
<td>A Case Report of Symptomatic Primary Aortic Mural Thrombosis in Apparently</td>
<td>Anoushiravan Amini Hadjibashi, MD; Kenji Minakata, MD; Eric Choi, MD</td>
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<td>Healthy Young Female Patient Whom Admitted forSplenic Infarction</td>
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11:59 a.m. – 12:05 p.m.  Changes in the Central Aortic Pressure Waveform Following Abdominal Endograft Deployment: A Study of Two Cases
Marcos Kuroki, MD-PhD; Maria Castello-Ramirez, MD; John Radtka III, MD; Faisal Aziz, MD; Lawrence Sinoway, MD

12:05 p.m. – 12:11 p.m.  Case Report: Hybrid Repair of Type II Thoracoabdominal Aortic Aneurysm
Kevin Nguyen, MD; Anthony Feghali, MD; Dawn Salvatore, MD: Paul DiMuzio, MD; Babak Abai, MD

12:11 p.m. – 12:17 p.m.  Aberrant Right Subclavian Serving as Outflow for Persistent False Lumen Perfusion After TEVAR for Type B Aortic Dissection
Samuel Chen, MD; Christopher Burke, MD; Joseph Bavaria, MD; Paul J. Foley, III, MD

12:17 p.m. – 12:23 p.m.  Antiphospholipid Syndrome Presenting as Bilateral Popliteal Occlusions
Katherine McMackin, MD; Sneha Kolla, BA; Jose Trani, MD

12:23 p.m. – 12:29 p.m.  Cervical Debranching for Aortic Arch Reconstruction
Alexander Fairman, MD; Benjamin Jackson, MD; Grace Wang, MD; Paul Foley, MD; Joseph Bavaria, MD; Wilson Szeto, MD; Nimesh Desai, MD; Prasanth Vallabhajosyula, MD; Ronald Fairman, MD

12:30 p.m. – 1:30 p.m.  Lunch with Industry Partners/Exhibits

1:30 p.m. – 3:00 p.m.  Panel on Adjuncts to Vascular Surgery Practice
Moderator: Faisal Aziz, MD
Danielle Pineda, MD - Outpatient Angio Suite
Douglas Troutman, DO - Outpatient Vascular Lab
Evan Deutsch, MD - Outpatient Wound Care Center
Aaron Ilano, MD - Radiation Safety

3:00 p.m. – 3:15 p.m.  DVVS Business Meeting (members only)

3:00 p.m. – 3:30 p.m.  Coffee Break/Exhibits

3:30 p.m. – 5:00 p.m.  Clinical Research and General Case Reports
Moderators: Evan Ryer, MD; Grace Wang, MD

3:30 p.m. – 3:38 p.m.  Site of Service Influence on Stent Utilization for Hemodialysis Access Interventions
Nicholas Madden, DO; Matthew Dougherty, MD; Douglas Troutman, DO; Krystal Maloni, MD; Keith Calligaro, MD

3:38 p.m. – 3:46 p.m.  Evolving Strategies for Venous Thoracic Outlet Syndrome
Nicholas Madden, DO; Keith Calligaro, MD; Matthew J. Dougherty, MD; Krystal Maloni, MD; Douglas A. Troutman, DO

3:46 p.m. – 3:52 p.m.  Treatment of Median Arcuate Ligament Syndrome in Young Patients at a Community Hospital
Kathryn Capasso, MD; Nadia Awad, MD; Evan R. Deutsch, MD; Aaron Ilano, MD; Rashad G. Choudry, MD
3:52 p.m. – 3:58 p.m.  Repair of a Symptomatic Popliteal Vein Aneurysm via Posterior Approach
Anand Parikh, MD; Julia Glaser, MD; Venkat Kalapatapu, MD

3:58 p.m. – 4:04 p.m.  Symptomatic Duodenal Perforation by a Bird’s Nest Vena Cava Filter
Anand Parikh, MD; Julia Glaser, MD; Venkat Kalapatapu, MD

4:04 p.m. – 4:12 p.m.  Occupational Radiation Exposure Among General Surgery Residents: Is it a Real Concern?
Jacob Katsnelson, MD; Danielle Pineda, MD

4:12 p.m. – 4:20 p.m.  Outcomes of Patients Undergoing Carotid Endarterectomy with Concomitant Coronary Disease
Karol Meyermann, MD; Jose Trani, MD; Philip Batista, MD; Joseph V. Lombardi, MD

4:20 p.m. – 4:28 p.m.  Anatomic Variation of the Phrenic Nerve and Brachial Plexus Encountered During 100 Supraclavicular Decompressions for Neurogenic Thoracic Outlet Syndrome with Associated Post-Operative Neurologic Complications
Scott R. Golarz, MD; Joseph M. White, MD

4:28 p.m. – 4:36 p.m.  National Trends in Inferior Vena Cava Filter Placement and Retrieval Reflect a Significant Increase in Filter Retrieval Rates
Nathan Belkin, MD; Scott Damrauer, MD; Benjamin Jackson, MD; Paul Foley, MD; Venkat Kalapatapu, MD; Michael Golden, MD; Ronald Fairman, MD; Grace Wang, MD

4:36 p.m. – 4:44 p.m.  Dual Application Strategies of Applicants Applying to Integrated Vascular Surgery Residency
Katherine McMackin, MD; Nick Hoell, BA; Joseph Lombardi, MD

4:44 p.m. – 4:52 p.m.  Coronary Drug-Eluting Stents for the Treatment of Threatened Lower Extremity Autologous Bypass Grafts: A Single Institution Case Series
Jon Quatromoni, MD; Daniel Newton MD; Yana Etkin, MD; Paul Foley, MD; Benjamin Jackson, MD

4:52 p.m. – 5:00 p.m.  Revising Lumbar Sympathectomy in Unreconstructable Peripheral Artery Disease
Jason Cohen, MD; N. Awad, MD; Evan Detusch, MD; Rashad Choudry, MD

5:00 p.m. – 6:00 p.m.  Reception in Exhibit Hall

6:15 p.m. – 8:30 p.m.  Dinner and Keynote Lecture
Presentation of Best Trainee Awards

“Burnout in Vascular Surgeons”

Malachi G. Sheahan, III, MD
Claude C. Craighead Jr., Professor and Chair
Division of Vascular and Endovascular Surgery
Louisiana State University Health Sciences Center
New Orleans, LA
ABSTRACTS

11:05 a.m. – 11:11 a.m.  Understanding Hepatic Artery Anatomy and Possible Anatomic Variables through Open Treatment of a Complex Hepatic Artery Aneurysm
Anthony Feghali, MD, Kevin Nyugen, MD, Dawn Salvatore, MD; Babak Abai MD; Paul DiMuzio, MD

DEMOGRAPHICS: 74-year-old male presents with an incidentally found 2.4cm hepatic artery aneurysm on CT being followed for history of bladder cancer. CT in 2014 measured the aneurysm 1.7cm.

HISTORY: Significant history includes treated bladder cancer. CTA revealed a common hepatic artery aneurysm extending to its origin on the aorta and involving the gastroduodenal artery (GDA) into the proper hepatic.

PLAN: Given the CT findings we performed an angiogram to see if there was a role for endovascular treatment. On angiography the aneurysm appeared to only involve a short segment of the hepatic artery. On imaging of the GDA, there was a branch going into the left lobe of the liver. Given these complex findings we planned for an open repair. We considered an aortic to hepatic artery bypass or interposition grafting. We were prepared to reimplant the GDA if it provided flow into the left lobe of the liver.

DISCUSSION: We explored through a midline laparotomy. We entered the lesser sac and dissected out the large hepatic artery aneurysm. We mobilized the aneurysm to the origin of the hepatic artery on the aorta which was normal in caliber. The aneurysm also involved the GDA. There was normal artery at the hepatic proper. After harvesting saphenous vein we placed an interposition bypass from the proximal hepatic artery to hepatic proper and removed the aneurysm. We attempted to mobilize the GDA and sew it in a side fashion with the hepatic proper but the vessel tore. Instead we bypassed from the origin of the hepatic artery to the hepatic proper. After our bypass the liver appeared viable. On exploration, the hepatic proper divided into the left/right hepatic arteries. There was good back-bleeding of the GDA due to collateral circulation of the SMA, thus we ligated the GDA. Post-op he recovered well with with normal liver function and went home. This case proved to be challenging based on understanding hepatic anatomy and the many anomalies that can be encountered.
Interposition bypass between hepatic artery and hepatic proper
Penetrating Aortic Ulcers: Review of Acute Aortic Syndrome and Comparison of Two Patients
Nicholas Madden, DO; Matthew Dougherty, MD; Douglas A Troutman, DO; Krystal Maloni, MD; Keith Calligaro, MD

Introduction: Acute aortic syndrome encompasses a spectrum of conditions that present within 14 days. Although aortic dissection is the most common and easily recognized, intramural hematoma, limited intimal tear, and penetrating aortic ulcers (PAU) collectively make up this syndrome. The management of such conditions is generally non-operative but specific circumstances may warrant operative intervention. Here, we compare two cases of PAUs, discuss the entities that encompass acute aortic syndrome, and review the generally accepted indications for surgical intervention.

Case report 1: First, a 77 year old male presented to the emergency room with chest pain and shortness of breath. CT angiogram demonstrated an uncomplicated PAU in the proximal descending thoracic aorta, just distal to the left subclavian artery. He was managed medically and had resolution of symptoms. Follow-up imaging at 6 months demonstrated stability of the PAU.

Case report 2: An 87 year old male presented with chest pain and hypertensive urgency. CT angiogram demonstrated a PAU in the descending thoracic aorta with peri-aortic inflammatory changes concerning for rupture. Despite optimal medical management, he had persistent symptoms and underwent percutaneous thoracic endograft placement. His symptoms improved and he was discharged two days later. He remained stable in short-term follow-up.
INTRODUCTION: Type 1a endoleaks are a relatively uncommon complication following endovascular aortic aneurysm repair with a reported frequency of up to 8%. Although uncommon type 1a endoleaks carry a high risk of rupture due to direct filling of the aneurysm sack. First line therapy includes endovascular proximal extension cuffs/stents, endoanchor and embolization techniques for which the majority are successfully treated. Failed endovascular interventions typically mandate formal open techniques for definitive repair. Novel techniques for enoleak repair have been proposed and utilized in attempts at endograft salvage, eliminating aortic cross clamping and ultimately minimizing operative time.

PRESENTATION OF CASE: We present a case of a 92 year old gentleman with a ruptured persistent type 1a endoleak that failed multiple attempts at endovascular repair. The patient’s medical co-morbidities precluded formal open repair with endograft explanation. He was taken emergently to the operating room. Prior to induction of general anesthesia percutaneous right femoral access was obtained and a large compliant balloon was placed at the level of the proximal endograft in preparation for balloon occlusion. Laparotomy was performed. The infrarenal aortic neck was circumferentially dissected and two umbilical tapes were used to encircle the aortic neck and tied down to allow apposition of the aorta to the endograft. The aneurysm sack was incised, this confirmed resolution of type Ia endoleak and ruled out occult type II endoleak.

DISCUSSION: Novel techniques for repairing type Ia endoleaks have been described but are likely underreported and underutilized. Scattered case reports and case series have demonstrated technical success and trends toward decreased morbidity with endograft preservation and avoidance of aortic cross clamping.

CONCLUSION: In the emergent setting of ruptured type Ia endoleak aortic banding provides an efficient and effective technique for patients not suitable for formal open repair with aortic cross clamping.
Background: The incidence of isolated renal artery aneurysms (RAA) is 0.001- 0.09%. About 10% of such aneurysms are associated with contralateral RAA. Rupture of RAA is associated with significantly high morbidity and mortality. It is generally recommended to repair such aneurysms when the diameter exceeds 2cm.

Case presentation: A 74-year-old male with a history of atrial fibrillation on chronic anticoagulation, hypertension and a prior history of open repair of a ruptured abdominal aortic aneurysm with a tube dacron graft eight years prior. He was found to have a significant increase in the size of a previously known small renal artery aneurysms on a routine aortic duplex. A CTA was performed which showed a 6cm right renal artery aneurysm and a 2.4cm left renal artery aneurysm. The patient was asymptomatic with no dysuria, hematuria, hematochezia, or melena. On physical exam the abdomen was soft, non-tender, with no palpable mass. A Nuclear dynamic renal scan revealed that the right kidney was contributing 30% to the total renal function likely due to poor blood flow to the renal parenchyma. He was offered an open surgical repair. An open thoracoabdominal aneurysm exposure at the seventh intercostal space was used for the repair with replacement of the visceral aortic segment with a 24 mm graft. The distal portion of the graft was sewn to the prior dacron graft in an end-to-end fashion. The celiac and SMA arteries were sewn to the dacron graft as a Carrell patch. The origin of the aneurysmal right renal artery was ligated. The left renal artery aneurysm was resected and the distal portion of normal renal artery was revascularized with a 6mm dacron graft.

Discussion: Visceral artery aneurysms are generally repaired when the diameter is greater than 2cm. This case represented unique anatomic complexity due to a prior open AAA repair and a lack of any feasible endovascular options.
Demographics: The patient is a 68-year-old male status post right femoral-anterior tibial bypass with cryopreserved vein who presents with a slowly enlarging mass of the right calf.

History: An otherwise healthy 68-year-old male former smoker with a history of a failed prior right lower extremity bypass more recently status post a right common femoral to anterior tibial artery bypass with cryopreserved vein three years ago presents with an 8 month history of a slowly enlarging right lateral calf mass just above his prior AT incision. Duplex demonstrated a patent bypass graft with a 2 cm fusiform aneurysmal degeneration of the distal cryovein graft just proximal to the distal anastomosis. CT angiography confirmed a 2.5 x 3 cm true aneurysm of the cryovein graft just proximal to the anterior tibial anastomosis without evidence of mural thrombus.

Plan: The patient was taken to the operating room where intraoperative ultrasound was used to identify a segment of right greater saphenous vein of appropriate diameter in the medial thigh. An adequate length of saphenous vein was then harvested. An incision was then made over the aneurysmal segment of cryovein graft and the vein aneurysm was dissected sharply. Proximal and distal control was obtained at healthy appearing segments of the cryovein graft proximal to the distal anastomosis, which was not encountered or dissected out. The cryovein graft was then clamped and the aneurysmal segment resected. The harvested piece of greater saphenous vein was then reversed, spatulated, and anastomosed end-to-end both proximally and distally as an interposition vein graft.

Discussion: Cryopreserved vein graft aneurysms are a rare complication when used for infrainguinal bypass. While cryopreserved vein grafts have been used with some success, there is a chronic immunologic rejection mediated by lymphocytic infiltration by the recipient against the graft. This has been demonstrated histologically to affect the intima, media, and adventitia leading to an increased propensity for aneurysmal degeneration when compared to autologous vein. The true incidence and natural history of cryopreserved vein graft aneurysm formation is difficult to determine as it is thought that most of these bypass grafts will occlude prior to the development of a detectable aneurysm. Additionally due to their rarity, there are no consensus recommendations on management of cryopreserved vein graft aneurysms, however rupture of these aneurysms has been reported in the literature. Therefore, close surveillance should be performed for all cryopreserved vein grafts and graft revision performed upon detection of an aneurysm. Repair of these vein graft aneurysms should be performed with interposition autologous vein when feasible.
Endovascular Management of Complex Popliteal Artery Aneurysm with Critical Limb Ischemia
Arthelma C. Tyson, MD; Jacinto Camarena III, MD

Introduction: The prevalence of popliteal artery aneurysms (PAA) is 0.1-3%.1 If left untreated, PAA may thrombose, lead to thromboembolism, or rupture. Reported amputation rates for thrombosed PAA vary considerably but have been noted to be at least 15% - 25%.2 PAA rupture is rare, occurring in only 2.5% of cases. 3 PAA rupture with limb threatening ischemia results in a 50-70% amputation rate. 2 Distal embolization and/or runoff vessel thrombosis are complicating factors that affect post-intervention patency.

Case: A 67-year-old male with no known medical history presented to the ED with a Rutherford’s IIa acute left lower extremity ischemia. He was 2-weeks status post MVC with no known injuries. A heparin drip was immediately started and CTA demonstrated a left proximal popliteal pseudoaneurysm (PSA), but the mid to distal popliteal artery could not be visualized. There was limited outflow. A limited arterial duplex exam revealed a more distal thrombosed popliteal artery aneurysm in addition to the proximal popliteal artery PSA (see Image).

He was taken for angiogram. Blush into the PSA was visualized and there was occlusion of the mid-popliteal artery through the pedal arch except for small patent collaterals and a small patent segment of the mid anterior tibial artery (AT) and the mid to distal peroneal (PR) artery. This was managed with suction thrombectomy followed by intravascular ultrasound (IVUS) to determine the extent of the popliteal aneurysm. Overlapping Gore Viabahn stents were then deployed for coverage of the diseased artery with adequate overlap to healthy vessel. Overnight catheter-directed thrombolysis was performed through the stented popliteal artery to improve runoff. On day 2, additional thrombectomies and tibial angioplasties were performed. Completion angiogram demonstrated an excellent result with patent popliteal artery and 2-vessel runoff with a patent pedal arch. The patient was discharged two days later on NOAC, clopidogrel, and statin therapy. He remains in excellent condition. Preoperative duplex and intraoperative IVUS were key elements to the operative decision-making and the success of this case.
The use of cryopreserved cadaveric grafts is an option for treating patients with infected fields. However, the presence of a pseudoaneurysm along a graft raises the concern for a graft infection. We present a patient who developed a spontaneous pseudoaneurysm in the mid-portion of the left iliac limb of a cadaveric aorto-iliac graft. This patient initially had a polytetrafluoroethylene axillary bi-femoral artery bypass placed following an explantation of an infected aortic endograft. The patient developed drainage from the right groin incision and this prompted a replacement of the distal portion of the axillary bi-femoral artery bypass with a cadaveric aorto-iliac graft for a presumed infection. Four years following this surgery she developed a sudden pain in her abdomen. The patient denied any symptoms of an infection and was not maintained on suppressive antibiotics. A duplex was performed and demonstrated a pseudoaneurysm of the mid portion of the iliac limb of the cadaveric aorto-iliac graft. The patient had a normal white blood cell count and negative blood cultures. A computerized tomography angiogram (CTA) revealed that a pseudoaneurysm was present and there were no fluid collections surrounding the graft (Figure 1). The pseudoaneurysm was located at the site of the internal iliac artery on the cadaveric graft. Since there were no signs of infection, this pseudoaneurysm was treated by excluding the origin of the cadaveric internal iliac artery with a viabahn stent. The patient’s symptoms improved immediately and she was discharged on hospital day four. This case demonstrates that spontaneous rupture of cadaveric arterial branches is a late complication that can occur when using these grafts.

Figure 1. Figure 1 – CTA reconstruction showing pseudoaneurysm (arrow)
Introduction: Endovascular aortic aneurysm repair (EVAR) has become the procedure of choice for the repair of abdominal aortic aneurysms (AAA). However, patients who have undergone EVAR require lifelong surveillance as some aneurysms will continue to enlarge after endovascular repair, requiring secondary interventions in up to 15% of the cases. The vast majority of secondary interventions may be performed using endovascular techniques. Nonetheless, late conversion to open repair (COR) is required in a subset of these patients. We present a unique case of endotension which did not respond to relining of the endograft and required urgent explanation due to rapidly expanding, symptomatic Aneurysmal sac.

Case Report: A 73-year-old male with a history of AAA status post endovascular aneurysm repair (EVAR) was referred to our clinic after he was noted to have an expanding aneurysmal sac on surveillance imaging. He had undergone EVAR with Endologix device at an outside facility five years ago. Three years later, he was found to have expanding sac with suspicion of either a type III endoleak or endotension which was treated at the outside institution with relining of the main body of endograft with Medtronic’s stent graft. Shortly prior to his referral to our clinic, he underwent CT angiography which revealed an 11.2 x 10.7 cm aneurysmal sac, which had enlarged from 10.3 cm on imaging 6 months prior. In addition, a 3 cm left common iliac artery aneurysm was present. Two days following his repeat imaging and stress test, he presented to our hospital after he experienced the sudden onset of severe abdominal and back pain. He was hemodynamically normal CT angiogram was performed and revealed a stable aneurysmal sac with no evidence of rupture. Due to concern for a symptomatic AAA and sac expansion, he was taken emergently to the operating room. After exploratory laparotomy, supra celiac aortic clamping was performed. Upon exploration of the aneurysmal sac, liquid thrombus was encountered which was under pressure such that it began squirting out as the aortic sac was incised. Previously placed endografts were removed. Aortobifemoral bypass was then performed with 20x10 dacron graft. Post operatively, his back pain was completely resolved. His postoperative course was uneventful.

Discussion: Early COR is defined as less than 30 days from endovascular implantation to open repair and has been attributed largely to technical errors, the causes of late COR (greater than 30 days) are more diverse. The majority of late COR are due to aneurysm sac enlargement secondary to endoleak. Of patients with endoleak requiring late COR, the most common type of endoleak is type 1, with types 2, 3, and 5 being described with roughly equal frequency in various case series. Type 5 endoleak, or endotension, is defined as a persistently elevated pressure within the aneurysm sac leading to aneurysm enlargement, in the absence of a detectable endoleak. Several mechanisms have been proposed for the pathophysiology of endotension, including defects in the endograft fabric due to sutures or wireforms, pressure transmitted through the wall of the stent graft due to the inherent porosity of endografts, pressure transmission through thrombus at the origin of the inferior mesenteric artery or lumbar arteries or between the stent graft and aortic wall, and a low-flow or intermittent endoleak that is not captured on conventional imaging. This case was unique as the endotension persisted despite relining the previously placed endograft. The recurrent presentation was more acute and required urgent explantation.
Introduction: Primary aortic mural thrombus in the absence of atherosclerotic occlusive or aneurysmal disease is a rare condition; but also it is very important to address because of devastating complication of this entity. The open operative option is usually reserved for patient with thrombosis near the main branches of aorta. The following case is our experience with such a condition.

Case Report: A 35-year-old morbidly obese female presented with complaints of left sided upper abdominal and lower chest pain with episodes of vomiting for 3 days prior to the admission. She had significant past medical history for anemia, asthma, bronchitis and fibroids. She is current smoker and smokes one pack of cigarette per day for 15 years. She has had several prior surgeries including cesarian section, cholecystectomy, appendectomy, and hernia repair. She states that in last 3 months prior to the admission she started to have pain and muscle cramps while walking and diagnosed with possible sciatica. Physical exam demonstrated left upper abdominal and left lower chest tenderness; pulse exam revealed no palpable distal pulses, biphasic signals on right dorsalis pedis (DP), absent signals on right posterior tibialis (PT), and biphasic left DP and PT signals.

CT scan showed non-occlusive thrombi in the descending thoracic para-celiac aorta and infrarenal abdominal aorta with the following distal emboli: 1) splenic thromboemboli with multiple splenic infarcts; 2) infarct in the superior pole of the right; 3) non-occlusive thrombus in a jejunal branch of the superior mesenteric artery without evidence of bowel ischemia; 4) complete occlusion of the right superficial femoral and popliteal arteries, the anterior tibial, posterior tibial, and peroneal arteries exhibit distal filling secondary to collaterals from the deep femoral artery with a patent dorsalis pedis and plantar arch; and 5) left deep femoral artery is not appreciated and likely occluded given multifocal arterial thrombi, non-opacification of the anterior and posterior tibial arteries in the distal left lower extremity, as well as non-visualization of the dorsalis pedis or plantar arch. CT scan also showed some pelvic lymphadenopathies. Vascular physiologic studies showed Ankle/Brachial Index of 0.35 in the right side and 0.65 in the left side.

After preoperative and cardiac work up (negative intracardiac thrombus on echocardiogram), an open thromboembolectomy with spiral thoracoabdominal exposure was planned. The procedure included the following: 1) lumbar drain placement; 2) thoracoabdominal spiral incision through left thoracotomy; 3) partial cardiopulmonary bypass; 4) open thrombectomy of descending thoracic aorta and infrarenal abdominal aorta with Dacron patch aortoplasty of descending thoracic aorta and infrarenal abdominal aorta; and 5) lymph node biopsy.

Intraoperative findings were firm, well organized thrombi in supra-celiac aorta and infrarenal aorta extending to left common iliac which was removed en bloc and sent to pathology (diagnosis was organized blood clot). Lymph nodes were unremarkable. She was treated with intravenous heparin and bridged to Coumadin postoperatively. Her hematology work up revealed elevated homocysteine level and also elevated sedimentation rate and C-reactive protein; there were no other positive findings including factor V Leiden. She had otherwise uneventful postop period and she was discharged on postoperative day 13. In her first postoperative visit she was healing well, taking her Coumadin and unfortunately she continues to smoke.
Conclusion: Symptomatic primary aortic mural thrombus is an uncommon but important source of noncardiogenic embolus. It appears to occur more frequently in young women. Endovascular coverage of the aortic thrombus, when feasible, appears to be an effective and safe procedure with either stent grafts or closed-cell metal stents. When thrombus is located adjacent to visceral vessels, it should be managed with an open thromboembolectomy.

Reference

Images
Changes in the Central Aortic Pressure Waveform Following Abdominal Endograft Deployment: A Study of Two Cases
Marcos Kuroki, MD-PhD; Maria Castello-Ramirez, MD; John Radtka III, MD; Faisal Aziz, MD; Lawrence Sinoway, MD

Prior reports have shown that abdominal endografts used for the treatment of abdominal aortic aneurysms (EVAR) increases carotid-femoral pulse wave velocity (PWV), an index of vascular stiffness. Elevated PWV is generally regarded as a risk factor for cardiovascular morbidity and mortality in the general population, however, the physiological impact of such changes in patients with AAA is unknown. Changes in PWV alters central aortic pressure, which may impact cardiac afterload and coronary blood flow. As part of an ongoing study, we measured central aortic pressure changes before and after deployment of EVAR in 2 patients undergoing elective AAA repair. Pressure was measured using an end-hole catheter advanced into the descending thoracic aorta over a Bentson wire inserted through an 8Fr (pre-deployment) or 16Fr sheath (post deployment) in the SFA. Pulsatile pressures were recorded for 2 minutes in conjunction with the ECG. Medtronic Endurant II aortic stent grafts were used for the repair in both patients. Patient demographics, AAA characteristics and details of the repair are found in Table 1. Diastolic, systolic and pulse pressures, as well as the subendocardial viability ratio (SEVR), the ratio between the areas under the curve of the diastolic (diastolic time index; DTI), and systolic (tension time index; TTI) portions of the pressure waveform, were calculated from trigger averaged waveforms using the ECG R-wave (Table 2). In both subjects, there was an increase in pulse pressure immediately after EVAR, and a decrease in the SEVR, consistent with changes in pressure wave reflection characteristics in the aorta. The decrease in SEVR is suggestive of a relative oxygen supply deficit relative to myocardial workload after EVAR deployment. Neither of our patients had any acute post-operative cardiac complications, but these changes may have an impact on long term cardiac morbidity in this patient population.

Table 1: Subject characteristics and details of repair

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**Table 2:** Change in central aortic pressure before and after EVAR

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Introduction: Traditional open type II thoracoabdominal aortic aneurysm (TAAA) repair is associated with high rate of morbidity and mortality. We present a staged hybrid approach with a TEVAR to address the thoracic portion of the TAAA followed at interval with open repair to address the abdominal portion of the TAAA.

Case report: A 72-year-old female with history of COPD, obesity, CAD, DM was admitted to the hospital after an incidental finding of a thoracic aneurysm on an echo done for evaluation of heart failure. A CT scan was obtained showing a type II TAAA with significant mural thrombus in the proximal descending aorta and aneurysmal dilatation measuring 6.6cm at its largest diameter. We repaired the thoracic portion of the TAAA with a TEVAR (Cook Zenith Alpha Thoracic Endograft 44x233mm, 46x233mm) leaving the end of the endograft free floating above the celiac artery. The patient returned five weeks later for an open repair of the abdominal portion of the TAAA through a retroperitoneal thoracoabdominal incision. We used a Dacron tube graft to repair the aneurysm using the “clamp and sew” technique. The proximal anastomosis was performed by sewing the Dacron graft directly to the Cook endograft. The right renal artery, celiac artery and superior mesenteric artery were anastamosed to the tubed graft as a Carrel patch. Distally, the Dacron graft was attached to normal aorta above the bifurcation. The left renal artery anastomosis was created directly to the tube graft. Neural protection strategies were employed to prevent spinal cord ischemia. Cool renal perfusate was also used to protect the kidneys during ischemia. Total bowel ischemic time was 35 minutes. The patient tolerated the procedure well and was discharged to rehab on post-operative day 7.

Discussion: Traditional open type II TAAA repair is associated with higher morbidity and mortality than type III or IV TAAA. Type II repair requires proximal exposure of the descending aorta, left heart bypass and in some cases hypothermic arrest for proximal clamping of the aorta, which further contributes to the complexity and morbidity of the case. A hybrid approach with TEVAR effectively converting a type II TAAA to a type IV TAAA, eliminates the need for proximal aortic clamping and left heart bypass. The procedure can be completed in a second stage with a standard open approach to address the abdominal portion of the TAAA. It is possible to safely repair a suitable type II thoracoabdominal aneurysm using a staged hybrid approach.
Introduction: True lumen (TL) endografting for type B aortic dissection (TBAD) with aneurysmal degeneration of the descending thoracic aorta (DTA) is well-documented with a primary goal being thrombosis of the false lumen. Aberrant right subclavian artery anatomy leading to persistent false lumen (FL) perfusion and aneurysmal growth after TEVAR is rare. The surgical management of this unusual anatomy in the context of aortic dissection is complex.

Case: The patient is a 76-year-old man who suffered a DeBakey I aortic dissection with distal extension to the left common iliac artery bifurcation in 2009. He underwent emergent ascending aortic repair at an outside hospital. Two years later at the same facility he underwent a Zone 2 arch debranching and reconstruction, left carotid-subclavian bypass and TEVAR with left subclavian coverage and proximal left subclavian coiling for progressive aneurysmal degeneration of his dissected aortic arch and DTA. Subsequent to this, he demonstrated progressive aneurysmal growth of his DTA to 6cm with persistent FL perfusion on surveillance post-operative imaging. He was then referred to our institution where, on review of his imaging, was found to have a previously unrecognized aberrant right subclavian artery originating from the proximal DTA which was dissected and aneurysmal.

Surgical Plan: To distinguish whether the aberrant right subclavian was being perfused antegrade via FL perfusion originating from a fenestration at the distal left CIA where the dissection terminates; or instead via retrograde collateral flow from the ipsilateral vertebral, we performed a standard TL aortogram which demonstrated delayed aberrant right subclavian flow with antegrade branch/vertebral artery perfusion. We then selected the FL through the fenestration in the distal left CIA and confirmed FL perfusion of the aberrant right subclavian artery, thereby suggesting that this persistent outflow had allowed continued FL patency and DTA growth. To address this complex anatomy, we performed a staged right carotid-subclavian artery bypass followed by distal extension of the thoracic stent graft and embolization of the aberrant right subclavian artery proximal to the vertebral takeoff with a combination of Amplatzer plugs and coils via the FL. Completion angiogram showed brisk TL filling through the endograft and excellent outflow through the subclavian arteries bilaterally. Early post-operative CTA demonstrated thrombosis of the aberrant right subclavian artery and thrombosis of the false lumen in the DTA. The patient’s recovery was complicated by left lateral gaze palsy, which improved during the hospitalization. He was able to achieve therapy goals for activities of daily living while in-house and was discharged on POD#7.

Conclusion: Persistent FL pressurization can lead to aneurysmal growth in TBAD. In this case, we discovered that FL outflow via a previously unrecognized aberrant right subclavian artery was maintaining FL perfusion. Successful early false lumen thrombosis was achieved with staged right carotid-subclavian artery bypass, thoracic aortic stent grafting and embolization of the aberrant right subclavian artery (via FL access). This anatomy is rare but can be successfully managed with a staged hybrid approach.
Antiphospholipid Syndrome Presenting as Bilateral Popliteal Occlusions
Katherine McMackin, MD; Sneha Kolla, BA; Jose Trani, MD

Introduction: Although antiphospholipid syndrome normally presents with obstetric complications, arterial extremity thrombosis can be the rare presenting symptom. The antiphospholipid antibodies interfere with the coagulation system and the normal hemostatic reactions, leading to thrombosis secondarily due to the antiphospholipid antibody itself and less likely due to other classical risk factors of arterial disease. Young patients with arterial thrombus without other clear etiology should be considered for antiphospholipid syndrome as part of their prothrombotic workup.

Case Description: A 26 y.o. Female presented with blue discoloration of the first and fourth toes accompanied by rest pain on the left lower extremity as well as life limiting calf claudication. Echocardiogram did not demonstrate any cardiac thrombus. Lower extremity studies including an arterial lower extremity duplex, CTA runoff and MRI of the bilateral knees, were consistent with popliteal artery occlusive disease however, no study's findings were consistent with either cystic adventitial disease, popliteal artery aneurysms or popliteal entrapment, the most common forms of popliteal occlusive disease in patients under age 50. Digital subtraction angiography revealed bilateral popliteal artery occlusive disease with distal reconstitution of the tibial-peroneal trunk. Given the clinical symptoms, the patient underwent bilateral popliteal to TP trunk bypass with reverse greater saphenous vein harvested from right lower extremity. One month follow up showed patent bypasses on duplex US with clinical relief of symptoms. Two months after surgery the patient had return of her left sided claudication and duplex revealed occlusion of the bypass. She underwent thrombolysis which was unsuccessful. Three months after the initial operation she had return of her right sided claudication and duplex revealed occlusion of the right sided bypass. She then underwent a hypercoagulable workup which revealed antiphospholipid syndrome for which she is now undergoing medical management. She continues to claudicate.

Discussion: Popliteal artery occlusions in a young adult is an uncommon finding. When radiologic findings are inconsistent with the usual non-atherosclerotic pathology autoimmune pathology should be evaluated. Herein we present a 26-year-old female with antiphospholipid syndrome presenting as bilateral popliteal occlusions. Her autoimmune disorder was undiagnosed at the time of surgical intervention with subsequent failure of her lower extremity bypasses.
Cervical Debranching for Aortic Arch Reconstruction
Alexander Fairman, MD; Benjamin Jackson, MD; Grace Wang, MD; Paul Foley, MD; Joseph Bavaria, MD; Wilson Szeto, MD; Nimesh Desai, MD; Prasanth Vallabhajosyula, MD; Ronald Fairman, MD

Summary: With the development of branched stent grafts designed for the aortic arch, and the increasing utilization of hybrid approach to arch reconstruction, there is current and future need for surgical debranching of the arch vessels. This video describes the cervical debranching of the left carotid and left subclavian arteries from the right carotid artery in a patient with prior sternotomy, to allow subsequent arch branch graft implantation for an aortic pseudoaneurysm.

Abstract: With the development of branched stent grafts designed for the aortic arch and increasing utilization of hybrid approaches to arch reconstruction, there’s current and future need for surgical debranching of the arch vessels.

An 83F presented with enlarging pseudoaneurysm distal to a prior ascending aortic repair. In order to avoid redo sternotomy we planned cervical debranching of the arch vessels prior to planned branched stent graft repair.

Under general anesthesia with EEG monitoring, a right longitudinal cervical incision and a left curvilinear cervical incision was performed. The carotid sheath was entered on the right side and on the left side the sternocleidomastoid muscle was divided to allow access to both the carotid and left subclavian arteries. Because of the bilateral carotid exposures great care was taken to identify each vagus nerve. The left omohyoid muscle was divided. Proximal and distal control of each carotid was obtained. On both sides careful dissection was performed down to the prevertebral fascia. The surgeon’s finger is passed behind the esophagus and then a blue vessel loop is passed behind the esophagus to maintain track of further passage of the dacron graft. The thoracic duct is avoided in the left cervical incision and the anterior scalene fat pad is dissected laterally and reflected medially. The left phrenic nerve is freed from the anterior surface of the anterior scalene muscle and the muscle is subsequently divided with electrocautery. The left subclavian artery is controlled proximally and distally with vessel loops. The patient is systemically heparinized and the left subclavian artery is clamped both proximally and distally with vascular clamps so as to avoid too much tension on the subclavian artery. The end of the 6mm dacron graft is anastomosed to the side of the left subclavian artery initially using a parachute technique with 6-0 prolene suture. Both clamps are distal to the vertebral artery and therefore any change in EEG signals is unusual during clamping of the left subclavian artery in this approach. After completion of the left subclavian anastomosis the left arm is reperfused and the dacron graft flushed with heparinized saline and clamped and then passed behind the anterior scalene fat pad. The left carotid artery is test clamped and as long as the EEG signals do not change it is ligated with a stapler proximally and then divided. A hole is made in the side of the dacron bypass graft with a burner so as to allow end of carotid to side of dacron bypass graft anastomosis. Prior to constructing the anastomosis the bypass graft is passed through a retroesophageal tunnel to the right side of the neck. The left carotid anastomosis is then performed again with running 6-0 prolene suture, constructing the posterior aspect of the anastomosis first. With the left carotid still clamped, the dacron graft is flushed from the left subclavian to the right side of the neck and then the left carotid is reperfused. Taking care to eliminate any air, the dacron graft is flushed with heparinized saline and then reclamped medial to the left carotid anastomosis. Again being sure that there is no EEG slowing, the right carotid artery is clamped and then clamps are rotated laterally to expose the medial aspect of the right carotid artery. A portion of the medial wall of the right carotid artery is excised to ensure a widely patent proximal anastomosis. Upon completion of the right carotid anastomosis it is unclamped and rotated posteriorly and is hidden by the sternocleidomastoid. After administering protamine, both cervical incisions are closed with multiple layers of absorbable suture but without drains.
The patient did well following this initial procedure but decision was made to recover for about a month prior to arch stent graft repair. To prevent thrombosis of her left subclavian bypass with competitive flow, an amplatzer plug was placed in the proximal left subclavian artery prior to discharge. One month later she underwent stent graft repair of her aortic arch using an investigational device with a branch into her innominate artery. The pseudoaneurysm was eliminated on completion arteriogram. This case summary demonstrates an approach to surgical debranching of the left subclavian and carotid arteries to avoid sternotomy in a place of planned arch reconstruction.
Objective: With unsustainably rising health care spending in the US, the Center for Medicare and Medicaid Services (CMS) has in recent years attempted to utilize reimbursement rates to influence utilization of less expensive care sites for covered patients, such as ambulatory surgery centers (ASC) and office-based interventions in lieu of hospital service sites. It has been suggested that cost savings have not been realized due to an increase in procedure numbers performed by physicians with ownership interests in non-hospital facilities. CMS has proposed massive reimbursement changes for 2019 office and ASC based procedures, which would reduce dialysis access angioplasty reimbursement in the ASC setting by 50%, while stenting would be increased by 33% over current levels. The clinical utility of adjunctive stenting in treating dialysis access stenosis remains controversial and highly discretionary. As a vascular group performing such procedures in both a hospital and non-hospital facility in which we have equity interest, we reviewed our use of stent placement in dialysis accesses both in the hospital and the ambulatory surgery center to determine whether site of service affected stent utilization.

Methods: A retrospective review of a prospectively maintained database was performed from 2014-2018. All patients undergoing dialysis access angiography with angioplasty and adjunctive stent placement at an ASC and our primary hospital were included in the study. Data was collected on patient demographics, insurance information, and perioperative variables.

Results: A total of 961 angioplasty or stent procedures were performed for dialysis accesses between the two sites, 397 (41%) at the ambulatory surgery center and 564 (59%) in the hospital setting. There was a significant difference between race and age at the two sites with younger minority patients more frequently being treated in the hospital and older Caucasian patients more likely to be treated in the ambulatory setting. 98.5% of Medicaid patients were treated in the hospital. Adjunctive stents were placed in 153 (27%) of cases in the hospital and in 127 (32%) cases in the ambulatory setting (p = 0.09).

Conclusion: While financial incentives have not yet had an appreciable influence on stent utilization for dialysis access within previous reimbursement paradigms, the dramatic changes proposed by CMS may well alter this dynamic and lead to substantially higher overall costs without proven clinical advantage. In other words, interventionalists would be incentivized to place stents for dialysis access and not just perform balloon angioplasty in ambulatory surgery centers. With very high failure and re-intervention rates and increasingly expensive adjuncts (drug coated balloons and stents, covered stents), the cost implications of attempts to incentivize interventionalists toward a specific type of procedure or site of care are substantial, and unintended negative consequences are likely to occur.
Objective: Traditional management of venous thoracic outlet syndrome (VTOS) has involved catheter-directed thrombolysis (CDT) followed by para-clavicular first rib resection and then delayed balloon angioplasty for persistent subclavian vein stenosis. The approaches for rib resection include transaxillary, paraclavicular (PC), and more recently, an infraclavicular (IC) approach. We report our evolving experience with the treatment of VTOS.

Methods: We reviewed our prospectively maintained computerized database to identify patients treated for VTOS. Our current strategy includes CDT using pharmacomechanical thrombectomy (Angiojet, Boston Scientific, Marlborough, MA) followed by first rib resection within 1-3 days, subclavian vein balloon angioplasty at the same setting in our hybrid operating room, and postoperative application of an anti-thrombotic pump to the affected arm with administration of clopidogrel for six weeks and oral anticoagulation for three-six months. Because of the extra time and risks involved in a supraclavicular approach, and because we did not believe that excision of the posterior part of the rib would improve outcomes, our strategy evolved over time from a PC to IC approach.

Results: 49 patients underwent first rib resection for VTOS: 11 (22%) via a PA between 1993-2000 and 38 (78%) via an IC between 2000-2018. The average age was 36 (range 16-63). The majority involved the right subclavian vein (35; 71%) and occurred in women (28; 57%). All patients underwent pre-operative CDT: 38 (78%) at our hospital, 11 (22%) elsewhere. 48 patients (98%) underwent balloon angioplasty of the subclavian vein (all immediately after rib resection at the same operative setting since 2000). A bare metal stent was placed in 2(4%) patients for persistent stenosis after angioplasty. Average length of stay (LOS) was 3.7 (+ 2.1) days. Average operative time was 2.0 hours (range 1.5-3.0) when the IC approach was used vs. 3.5 (range 2.5 – 4.5) for the PA. There were no instances of any neurologic or immediate hemorrhagic complications. One patient (2%) required chest tube placement for pneumothorax and one (2%) patient required operative drainage for a wound hematoma two weeks postoperatively. Six (12%) patients underwent repeat endovascular intervention for recurrent vein stenosis (two in patients previously stented) during follow-up (average = 38 months, range = 6-240 months). Primary and assisted primary patency rates at one year were 91% and 100%, respectively. There were no significant differences in patency rates or complications between the IC and PC approaches.

Conclusion: Our transition to an IC approach demonstrated low peri-operative morbidity and excellent subclavian vein patency rates with shorter operative times and less potential complications compared to a PC approach. Preoperative CDT with pharmacomechanical thrombectomy using the Angiojet and IC first rib resection followed by concomitant postoperative venous balloon angioplasty should be the standard strategy to treat VTOS.
Objective: Median arcuate ligament syndrome (MALS) is characterized by compression of the celiac artery, causing chronic abdominal pain, weight loss, nausea, and diarrhea. Surgical treatment includes release of the median arcuate ligament followed by either percutaneous or open surgical repair of a persistent celiac artery stenosis.

Methods: We present two cases of MALS in young patients at a community to illustrate the effectiveness of different treatment modalities in a treatment algorithm.

Results: A 20-year old female presented to the office for evaluation of persistent abdominal pain, nausea, and vomiting associated with food intolerance and weight loss severe enough to require a leave of absence from school. She had undergone two attempts of angioplasty of the celiac artery followed by laparoscopic release of the MAL and celiac plexus removal at an outside institution. Upper and lower endoscopy was repeated and she underwent cholecystectomy for biliary dyskinesia without clinical improvement. An angiogram with dynamic inspiration and expiration phases was performed, which was concerning for recurrent compression of the celiac artery. Given failure of all other treatment modalities, she was taken to the operating room for an infrarenal aorta to common hepatic artery bypass with PTFE. The patient has progressed well, and at her 3-month and 6-month post-operative visits, she was symptom-free and gaining weight.

A 55-year old male presented to the office with complaint of postprandial abdominal pain, nausea, and vomiting with weight loss of 25 lbs in 9 months. Thorough gastrointestinal workup had been performed, including upper and lower endoscopy, 24-hour pH study, esophageal manometry, and exclusion of malignancies. Diagnostic visceral ultrasound demonstrated significantly elevated velocities in the celiac artery. Dynamic angiography demonstrated compression of the celiac artery with inspiration. The patient underwent laparoscopic median arcuate ligament release. At his 3-month post-operative visit, his symptoms were resolved and he was gaining weight. Post-operative mesenteric duplex demonstrated patent celiac artery with velocities decreased from the preoperative study.

Conclusion: Diagnosis of MALS requires thorough gastrointestinal workup. While intervention typically starts with minimally invasive options, failure to control symptoms may lead to more definitive vascular reconstruction. These two cases of MALS in young patients at a community hospital demonstrate that treatment is patient-dependent but favor a minimally invasive option before pursuing aggressive means.
Repair of a Symptomatic Popliteal Vein Aneurysm via Posterior Approach
Anand Parikh, MD; Julia Glaser, MD; Venkat Kalapatapu, MD

Demographics: A 74-year-old male with history of recurrent pulmonary embolism on Xarelto, COPD, hypertension presents to the office with left leg pain behind the knee with ambulation for the past year.

History: The patient presented to the office as a referral with one year of pain with ambulation in the left leg and a history of recurrent PE currently on Xarelto without a documented source of DVT. He underwent lower extremity venous duplex imaging followed by CT angiogram with delayed images which demonstrated a fusiform true aneurysm of the left popliteal vein measuring 4.1 cm in diameter involving a 5.5 cm length of the vein.

Plan: After extensive discussion with the patient, the decision was made to proceed to the operating room for repair of the left popliteal vein aneurysm via a posterior approach to the popliteal fossa. The patient was positioned prone and a lazy-S incision was made across the popliteal fossa. The musculature overlying the popliteal neurovascular bundle was split and the popliteal vein aneurysm was dissected out sharply. Proximal and distal control was obtained at normal portions of the vein and multiple side branches were ligated. The vein aneurysm was then opened, a large portion of the wall resected, and primary venorrhaphy was performed with a running prolene suture.

Discussion: Popliteal vein aneurysms are a rare disease process with an incidence that is not well described. The etiology of these venous aneurysms is thought to be either congenital, due to traumatic AVM formation, varicose veins, inflammation, or localized venous wall degeneration, though the etiology is not always determined, as in our case. Outcomes from case reports suggest that repair of popliteal vein aneurysms be undertaken for aneurysms with a maximum diameter greater than 2 cm or for symptomatic venous aneurysms. Popliteal vein aneurysms greater than 2 cm in diameter have a greater propensity to develop complications - most frequently pulmonary embolism, followed in no particular order by thrombosis, pain due to tibial nerve compression, lower extremity swelling, and symptoms of chronic venous insufficiency. Therapeutic anticoagulation alone has not been shown to decrease the risk of pulmonary embolism, particularly in patients with thrombus burden localized to the popliteal vein. The recurrence rate in those patients presenting initially with PE found to have a popliteal vein aneurysm managed with anticoagulation alone has been reported as being as high as 80%. In these patients with thrombus burden, consideration must also be given to preoperative IVC filter placement and catheter directed thrombolysis prior to undertaking vein repair.

This patient presented with a symptomatic popliteal vein aneurysm that also met size criteria for repair, though did not have extensive mural thrombus on duplex or CTA. Although the source of his pulmonary embolism was not definitively identified on imaging, it was presumed to be from his left popliteal vein aneurysm. Options for surgical repair include tangential aneurysmectomy with lateral venorrhaphy, resection of the aneurysm with primary venous anastomosis, or interposition grafting with autologous vein preferentially over prosthetic conduit. Endovascular treatment of popliteal vein aneurysms has not yet been described. Tangential aneurysmectomy with lateral venorrhaphy, however, is the preferred technique where a clamp is placed across the base of the aneurysm, the vein is then oversewn and the aneurysm resected. This was the method by which we elected to repair this patient’s popliteal vein, taking care to not narrow the vein during venorrhaphy. In general, patients status post popliteal vein aneurysm repair should be therapeutically anticoagulated for a period of at least 3 - 6 months postoperatively to decrease the risks of recurrent PE or thrombosis.
Demographics: The patient is a 33-year-old male with a history of GSW ten years prior s/p exploratory laparotomy at that time for liver laceration and spinal cord injury c/b paraplegia, incontinence, and DVT s/p Bird’s Nest IVC filter placement who presents with one week of vague epigastric abdominal pain.

History: The patient presented with one week of worsening epigastric pain and nausea, found on CT scan to have the superomedial strut of his infrarenal Bird’s Nest IVC filter eroded through the IVC into the second portion of the duodenum with penetration into the lumen of the duodenum. CT demonstrated paraduodenal inflammation but no extraluminal gas or collection. On presentation, he was hemodynamically stable, afebrile, without elevated WBC. GI was consulted for esophagoduodenoscopy to evaluate the extent of duodenal injury, however EGD was deferred due to concern for causing further duodenal injury with insufflation. General Surgery was consulted and available for duodenal repair if required.

Plan: The patient was taken to the operating room and a right subcostal incision was made with dissection carried down bluntly through the retroperitoneal space to expose the IVC. The length of infrarenal IVC containing the filter was dissected free and the duodenum dissected sharply off the anterior surface of the IVC in the superior aspect of the wound. The eroded strut was identified exiting the IVC and into the posterior wall of the duodenum where the strut was transected flush with the caval wall and extracted from the duodenum. No gross injury was identified on the posterior wall of the duodenum and no bile staining was noted within the wound, therefore no duodenal repair was undertaken. Additionally, all other extraluminal struts and Bird’s Nest wires were trimmed flush with the caval wall using wire cutters ensuring that no sharp edges were left behind.

Discussion: Inferior Vena Cava filters are indicated for the prevention of life threatening pulmonary embolism in patients with DVT who either have a contraindication to anticoagulation or recurrent DVT despite therapeutic anticoagulation. In the setting of this patient’s spinal cord injury and abdominal trauma at the time of his GSW, the decision was made to place a permanent Bird’s Nest IVC filter. Complications of IVC filter placement include pulmonary embolism, access site thrombosis, filter migration, caval perforation, caval obstruction, and filter fracture. Perforation of the IVC by the filter is a common complication of all types of IVC filters occurring with a frequency of 19% with 8% of patients being symptomatic. The rate of caval perforation by Bird’s Nest filters, however, approaches 38% on review of case series. Of those with IVC filter perforation from any type of filter who present with symptoms, nearly 80% demonstrate radiographic evidence of surrounding organ penetration.

Review of the literature brought to light the difficult nature of surgical removal of the permanent Bird’s Nest IVC filter. By design, the Bird’s Nest IVC filter consists of two rigid V shaped struts which anchor the filter mechanism followed by four 25 cm long stainless steel 0.018 wires which are coiled along the anchoring mechanism within the cava to create a wire mesh filter. The literature suggests that complete surgical removal of the Bird’s Nest IVC filter is quite difficult given its permanent nature and risks tearing the cava during attempts at extraction due to the rigid nature of its anchoring mechanism. Therefore, it is recommended in cases without caval thrombus to instead leave the filter in place and trim the protruding wires flush with the caval wall. An additional concern with complete filter removal in this patient is that he will remain high risk for recurrent DVT given his spinal cord injury and paraplegia, leaving him without protection against a potentially fatal pulmonary embolism. Thus the decision was made to leave the filter in place and instead cut all protruding metal struts and wires flush with the caval wall. Postoperatively, the patient recovered well and tolerated a regular diet with resolution of his nausea and epigastric pain prior to discharge.
Occupational Radiation Exposure Among General Surgery Residents: Is it a Real Concern?
Jacob Katsnelson, MD; Danielle Pineda, MD

Background: While radiation exposure has been studied across subspecialties with regular fluoroscopy exposure during training such as interventional radiology and urology, the contribution of increasing endovascular case volume toward occupational radiation exposure among general surgery residents is largely unknown. In this study, we sought to compare occupational radiation exposure during vascular and non-vascular rotations among a pool of general surgery residents at a community training program.

Methods: A single-institution prospective study was conducted among 28 general surgery residents at Abington Hospital-Jefferson Health, a 665-bed teaching hospital. All residents received training in proper use of a radiation dosimeter and minimizing exposure during fluoroscopy times. Data was collected from radiation film dosimetry badges distributed to general surgery residents on a bimonthly basis throughout the year, and radiation exposure in mRem was compared between residents rotating on vascular and non-vascular surgical services during regular four-week rotations.

Results: Seven months of data was collected. The radiation exposure among residents rotating on vascular surgery was significantly higher compared to those on non-vascular rotations and was comparable to exposure among attending vascular surgeons (mean=5.58 mSv for chief vascular resident vs 4.17 mSV among average vascular attending, control=0.23 mSv). In contrast, occupational exposure among residents did not reach quantifiable levels above controls on non-vascular rotations.

Conclusion: Increasing endovascular case volume among vascular procedures leads to measurable occupational radiation exposure among general surgery residents rotating on the vascular surgery service compared to routine exposure during other clinical rotations. Data collection for this project is ongoing. The results of this study will be used to identify institution-specific practices which can minimize exposure and improve radiation safety adherence among training physicians.
Outcomes of patients undergoing carotid endarterectomy with concomitant coronary disease

Background: The optimal operative timing strategy for patients with severe carotid artery disease and coronary artery disease requiring bypass grafting is still unknown. It is controversial as to whether it is safe to perform carotid endarterectomy prior to coronary revascularization. Although carotid endarterectomy first, coronary revascularization first, and simultaneous operation paradigms have been suggested, there are no current consensus guidelines to direct clinical management. We hypothesized that with high-quality cardiac anesthesia, carotid interventions can be safely performed in the setting of concomitant coronary disease.

Methods: We performed a retrospective analysis from 2010 to the present of patients who underwent coronary artery revascularization within one year after undergoing carotid endarterectomy. Primary outcomes included stroke, myocardial infarct, and death. Stroke was defined as a change in neurologic exam on post-operative evaluation. MI was defined by elevations in cardiac enzymes triggered by either ischemic changes on routine post-operative EKG or new onset chest pain. All procedures were performed using dedicated cardiac anesthesiologist.

Results: Twenty-three patients who underwent carotid endarterectomy within one year prior to their coronary revascularization were identified. Mean patient age was 71 years, ranging from 61 to 82. Patients were 70% male (16 men and 7 women). Patients were stratified in to early (n=14, within 7 days of CEA), mid (n=6, within 3 months) and late (n=3, within one year) with respect to coronary revascularization. Routine post-operative EKG’s were performed on all patients with no noted ischemic changes. No patients experienced post-operative changes in their neurological function. There were no occurrences of stroke, MI, or death noted in either the immediate peri-operative period or between carotid and coronary surgeries. No significant differences were noted among all three cohorts.

Conclusion: Managing patients with concomitant coronary and carotid artery disease can be a challenging undertaking as the timing of intervention is controversial. Preliminary data suggests that performing carotid endarterectomy in patients with concomitant coronary disease can be done safely at institutions with dedicated cardiac anesthesia. Further studies are needed to elaborate on CEA timing in conjunction with coronary revascularization.
Anatomic Variation of the Phrenic Nerve and Brachial Plexus Encountered During 100 Supraclavicular Decompressions for Neurogenic Thoracic Outlet Syndrome with Associated Post-Operative Neurologic Complications
Scott R. Golarz, MD; Joseph M. White, MD

Objectives: The objective of this study is to characterize phrenic nerve and brachial plexus variation encountered during supraclavicular decompression for neurogenic thoracic outlet syndrome (NTOS) and identify associated post-operative neurologic complications.

Methods: A multicenter retrospective review was performed to evaluate anatomic variation of the phrenic nerve and brachial plexus from November 2010 to July 2018. After initial characterization, two groups were identified: variant anatomy (VA) group and standard anatomy (SA) group. Complications were analyzed and compared between the two groups.

Results: Supraclavicular decompression for NTOS was completed in 100 patients. Any anatomic variation of the standard course or configuration of the phrenic nerve and, or brachial plexus was encountered in 47 (47%) patients. Phrenic nerve anatomic variations were identified in 28 (28%) patients. These included: 9 duplicated nerves, 6 lateral accessory nerves, 8 medially, and 5 laterally. Brachial plexus anatomic variation was found in 34 (34%) patients. The most common variant configuration of a fused middle and inferior trunk was identified in 25 patients. Combined phrenic nerve and brachial plexus anatomic variation was demonstrated in 15 patients. The VA group and SA groups consistent of 47 and 53 patients, respectively. Transient phrenic nerve injury with post-operative elevation of the ipsilateral hemidiaphragm was documented in 3 patients in the VA group and 6 patients in the SA group (p=0.49). Permanent phrenic nerve injury was identified in 1 patient in the VA group (p=0.47) and none in the SA group. Transient brachial plexopathy was encountered in 1 patient in the SA group (p=1.0) with full recovery to normal function.

Conclusions: Anatomic variability of the phrenic nerve and brachial plexus are encountered more frequently than previously reported. While the incidence of nerve injury is low, surgeons operating within the thoracic aperture should be familiar with variant anatomy in order to reduce post-operative complications.
Objective: The aim of this study was to evaluate patterns of inferior vena cava (IVC) filter insertion and retrieval in a granular, national dataset.

Methods: A review of all IVC filter procedures entered into the national VQI registry between January 2012 and August 2018 was performed. Data collected included demographics, venous thromboembolism (VTE) risk factors, indications for filter placement, and presence and timing of retrieval. Trend analysis and multivariable logistic regression were performed to evaluate factors associated with failure to retrieve the filter.

Results: During the study period, 8,050 IVC filters were inserted. The mean age was 62.6±16.7 years, there were 52.2% males, and 59.5% were placed for major indications while 14.8% were placed for relative indications and 25.7% were placed for prophylaxis. The overall filter retrieval rate was 34.5%. The clinically relevant retrieval rate (excluding those filters placed with permanent intent or patients who died before follow up) was 57.1%. Trends in filter placement and retrieval are represented in Figure 1. The total number of filter placements and retrievals increased from 2013 to 2015. However, beginning in 2015 there was a significant decline in filter placement (p=.009) whereas the number of filter retrievals remained relatively stable (p=.243). Importantly, the clinically relevant filter retrieval rate significantly increased throughout the years of the study from 36.2% in 2013 to 78.4% in 2018 (p=.004). The average time to filter retrieval also decreased from 138.5±126.7 days in 2015 to 90.9±50.9 days in 2018 (p<.001). In addition to age and baseline medical comorbidities (CHF, COPD, diabetes, malignancy, smoking), recent trauma (OR=2.41, 95% CI 1.62,3.58), new follow up DVT (OR=2.34, 95% CI 1.67,3.28), and long-term filter complications (OR=2.30, 95% CI 1.62,3.27) all independently predicted failure to retrieve the IVC filter. Factors found to be protective from filter non-retrieval were discharge home after filter placement (OR=0.50, 95% CI 0.42,0.59), use of anticoagulation at follow up (OR=0.60, 95% CI 0.52,0.69), and relative (OR=0.81, 95% CI 0.68,0.98), or prophylactic indication for filter placement (OR=0.53, 95% CI 0.30,0.94).

Conclusions: These results show both a decline in overall IVC filter placement in 2015 with a steady and significant rise in clinically relevant filter retrieval rate from 2013 to 2018. These data reflect a change in practice nationally with a more conservative stance toward filter placement and more aggressive approach for filter retrieval.
Introduction: Many applicants dual apply to different surgical specialties. Level of interest in a specialty is consistently cited as one of the most important factors used by program directors to evaluate applicants for 0+5 integrated vascular surgery programs (IVS). The purpose of this study was to examine trends in dual application submission and to determine the percentage of applicants to IVS with vascular as their true preference.

Methods: Electronic Residency Application Service (ERAS) Statistics for non-international medical graduates from 2011 to 2017 were mined for trends in dual applications between IVS and other surgical specialties. Dual application percentage, range, and standard deviation were determined. National Residency Match Program (NRMP) Results and Data from 2011 to 2018 were used to identify US Seniors who ranked IVS as his or her preferred choice--defined as ranking vascular as the only choice or first-choice specialty, compared to those who ranked a specialty other than vascular first. This data was also collected for orthopedic surgery, neurosurgery, otolaryngology, obstetrics and gynecology, integrated cardiothoracic surgery, and integrated plastic surgery.

Results: Between 2011 and 2017, IVS applicants most often dual applied to IVS and general surgery (87%), followed by IVS and: preliminary surgery (71%), plastic surgery (22%), orthopedic surgery (19%), neurosurgery (17%), otolaryngology (16%), obstetrics and gynecology (12%), and urology (3%). The percentage of the applicant pool exclusively ranking IVS rose over the study period from 6% in 2011 to 33% in 2018. Those ranking only IVS had a higher match rate (range 77-100%) versus those dual applying (range 56-73%). Between 2011 and 2018, an average of 14% of IVS applicants who submitted rank lists to the NRMP ranked a specialty other than vascular as his or her first preference (range 7-23%, SD 5%). Only integrated cardiothoracic surgery had a higher percentage of applicants ranking a different specialty as his or her true preference at 25% (range 18-36%, SD 7%). Nearly all (97-99%) applicants to orthopedic surgery, neurosurgery, otolaryngology, obstetrics and gynecology, and plastic surgery ranked that specialty as his or her true preference (Figure 1).

Conclusion: IVS applicants were most likely to dual apply to general surgery and IVS. Those ranking exclusively IVS had a consistently higher match rate than those ranking IVS and another specialty. Compared to other surgical specialties, those who submitted rank lists to the NRMP for cardiothoracic and IVS had the highest likelihood of ranking another specialty higher. Care must be taken when evaluating applications to determine the applicant’s level of interest in vascular surgery as a career.
Figure 1: Percentage of applicants submitting rank lists to the NRMP with the listed specialty not listed first on their rank list.
Objective: Drug-eluting stents (DES) are highly efficacious for interventions on coronary saphenous vein graft bypasses, with improved patency over angioplasty and bare metal stenting. We have used these coronary stents in failing lower extremity bypass grafts with aggressive or refractory stenotic lesions, and present the experience at a single institution.

Methods: All patients who underwent DES (coronary stent) placement in an infrainguinal vein bypass graft from 2012 to 2017 were identified through operative records. Demographic, treatment, and follow-up data were extracted retrospectively from the medical record. Wilcoxon signed-rank and rank-sum tests were used to compare the reintervention-free intervals for paired and unpaired data, respectively.

Results: A total of 22 DES were placed in 18 lower extremities. Median age at the time of bypass was 64 (range 49-84). All patients required an infrageniculate distal anastomosis, and used greater saphenous vein. Following bypass, patients underwent a mean of 3.3 ± 2.4 interventions. Forty-five percent of reinterventions were for recurrent ischemic symptoms (n= 27), while 55% were reintervened upon for asymptomatic, but concerning surveillance duplex findings. Reinterventions included plain balloon angioplasty (PTA, n=27), drug coated balloon angioplasty (n=6), cutting balloon angioplasty (n=5), bare metal stenting (n=8), and DES placement. DES were placed for initial (n=13) or recurrent stenoses (n=9). Half of all DES were placed immediately following PTA that had yielded unsatisfactory residual stenosis on completion angiogram. All attempted DES placements were technically successful, and required no additional interventions at time of placement. The median time-to-reintervention or time-to-last available duplex demonstrating patency (if no additional reintervention occurred) trended in favor of DES over standard endovascular interventions, but was not statistically significant (7.7 months, interquartile range [IQR] 3.7-13.8 vs. 4.8 months, IQR 1.8-9.7; P=0.22). On subgroup analysis of patients with DES placed for a recurrent stenosis after a preceding standard endovascular intervention (n=9 stents), time-to-reintervention was significantly longer following DES compared to that of the preceding standard intervention (median 7.1 months, IQR 3.6-10.4 vs. 3.8 months, IQR 1.8-9.8, P=0.01).

Conclusions: DES provided acceptable durability for lower extremity bypass stenoses, and was a helpful adjunct for patients with unacceptable immediate post-PTA stenosis on completion angiogram. Furthermore, in the subgroup of patients with DES placed for recurrent stenosis after standard interventions, DES had significantly increased durability compared to those standard interventions.
OBJECTIVE: Treatment of advanced peripheral artery disease (PAD) is predicated on endovascular and surgical revascularization. Lesions may be unreconstructable due to anatomic factors, extent of disease, or medical comorbidities. In such cases, lumbar sympathectomy (LS) may slow disease progression and improve symptoms. Our study reviews outcomes of patients with unreconstructable PAD treated with chemical LS.

METHODS: In this single-center, retrospective study, the electronic medical record (EMR) was queried for patients with confirmed PAD that underwent chemical LS from Sep 2017 to Sep 2018. Baseline demographic, medical, and surgical characteristics were tabulated. Evaluations based on our institutional protocol for PAD (Figure 1), which includes baseline symptomatology, ambulatory status, surgical risk assessment, and radiologic findings, were reviewed for each patient. Finally, clinical outcomes, including level of pain, narcotic requirements, and complications within 1 month, were assessed post-procedure.

RESULTS: 3 patients, two men and one woman, were identified. Amongst the 3 patients, mean age was 65.3 years (59-69), and mean BMI was 19.2 (17.5-22.2). All patients had a history of smoking and hypertension. Other comorbidities included end-stage renal disease, cardiomyopathy, chronic obstructive pulmonary disease (COPD), and atrial fibrillation. One patient had previous common femoral to popliteal arterial bypass of the affected limb. One patient had multiple previous endovascular angioplasty procedures and common femoral to popliteal arterial bypass of the affected limb. All 3 patients presented with unilateral rest pain, were ambulatory at baseline, but were considered non-candidates for revascularization based on CT-angiography (CTA) and formal angiographic findings. After chemical LS, all patients initially reported improvement in pain. One patient reported recurrent rest pain and subsequently underwent above the knee amputation within 1 month post-procedure. All 3 patients had a reduction in narcotic use post-procedure.

CONCLUSION: LS may improve symptoms and reduce narcotic requirements in patients with unreconstructable PAD. Future studies should focus on longer-term follow-up and delineate which specific factors may be associated with improved outcomes after LS.
Figure 1: Peripheral Artery Disease (PAD) Protocol

Confirmed PAD based on Non-invasive testing (PVR, ABI, duplex US)

Symptomatology

- Asymptomatic
- Intermittent Claudication
- Rest pain or ulceration

Risk Reduction Strategies
- Smoking cessation
- Diabetes management
- Hypertension management
- Hyperlipidemia management
- Anti-platelet therapy

Disease Progression

Surgical Candidate Assessment
- Ambulatory Status
- Medical clearance and surgical risk

Ambulatory and Appropriate Risk

Localization and Extent of Lesion
- CT-Angiography (CTA)
- Magnetic Resonance Angiography (MRA)
- Conventional Angiography

Reconstructable

Revascularization
- Endovascular angioplasty
- Surgical bypass

Unreconstructable

Symptom Management
- Consult pain management
- Lumbar sympathectomy

Persistent Pain

Limb Amputation
- Above knee
- Below knee
- Foot