1. **Early and Delayed Rupture After Endovascular Abdominal Aortic Aneurysm Repair (EVAR): Results From A 10-Year Multicenter Registry**

Leah Candell, MD, Lue-Yen Tucker, Philip Goodney, MD, Steven Okuhn, MD, Bradley Hill, MD, Ann Rhoades, RN, Robert Chang, MD
General Surgery, University of California, San Francisco- East Bay, Oakland, CA; The Division of Research, Kaiser Permanente, Oakland, CA; Dartmouth-Hitchcock Medical Center, Lebanon, NH; The Permanente Medical Group, San Francisco, CA; The Permanente Medical Group, Santa Clara, CA; Kaiser Permanente, Oakland, CA; The Permanente Medical Group, South San Francisco, CA

Discussant: Benjamin Starnes, MD

OBJECTIVES: Rupture after EVAR is a function of long-term graft durability and function. We describe our ten-year experience with rupture after EVAR.

METHODS: Between 2000 and 2010, 1,736 patients with AAA underwent EVAR in a large, regional integrated health care system and 20 cases of rupture after EVAR were identified. We examined risk factors associated with "early" (< 30 days after the initial EVAR) and "late" (≥ 30 days following the initial EVAR) rupture.

RESULTS: The overall follow-up rate was 92%, and the median follow-up was 2.7 years (IQR 1.2-4.4 years). Among the 20 ruptures, 70% were male, mean age was 79 years, AAA size at initial EVAR was 6.3cm, and 6 patients underwent primary EVAR for rupture (n=3) or symptomatic (n=3) presentation. Of the 20 ruptures after primary EVAR, 25% (5/20) were "early" ruptures, all occurring within 2 days following the primary EVAR. Of these five patients, 4 had intraoperative adverse events leading directly to rupture, with 1 type I and 1 type III leak.. Of the 5 "early" ruptures, 4 underwent endovascular repair and 1 was repaired open, resulting in 2 perioperative deaths. Among the remaining 15 patients, the mean time to "delayed" rupture was 36.6±27.5 months. (Table). Most patients had AAA sac increases prior to rupture with some patients having known endoleaks or having undergone reintervention. At the time of delayed rupture 12 of 15 patients were found to have new endoleaks. 6 patients did not undergo repair, while 9 underwent redo EVAR and 5 had open repair. For those patients who underwent repair for delayed rupture, survival at 30 days and 1 year were 61.5% and 38.5%, respectively. Multivariate analysis identified age > 80 (HR 3.5, CI 1.1-11.0, P<.05), and urgent EVAR (HR 7.1, CI 2.1-24.6, P<.01) as significant predictors of delayed rupture.

CONCLUSIONS: Rupture after EVAR is a rare but devastating event and mortality after repair is high. The majority of delayed cases showed late AAA expansion, thereby implicating acute device-related failures as the cause of rupture in these patients and mandating vigilant surveillance. Future efforts are needed to identify more sensitive predictors of rupture and graft durability after EVAR.

Characteristics of 20 Ruptures After EVAR

Characteristic	Early (n=5)	Delayed (n=15)	p value (fisher's exact)
Sac Expansion	0/5 (0%)	13/15 (86%)	0.001
Known Endoleak (type)	2/5, 40% (1 type 1, 1 type 3)	6/15, 40% (2 type I, 5 type II, 1 type III (some had more than one leak)	0.99
Endoleak at time of rupture (type)	n=2 (1 type I, 1 type III)	n=12 (8 type I, 1 type II, 3 type III)	0.500
Prior attempt at endoleak repair	0	4/15 (26%) (1 redo EVAR, 3 angiograms)	0.233
Endovascular repair at time of rupture presentation	4/5 80%	9/15 (60%)	0.576
Open repair at time of rupture presentation	1/5 (20%)	5/15 (33%)	0.516
CMO status at time of rupture presentation	0/5	6/15 (40%)	0.121
30-day survival	60%	61.5%	NS
1 -year survival	40%	38.5%	NS

§2. **A Modern Series of Acute Aortic Occlusion**

Jeffrey D. Crawford, MD, Kenneth Perrone, BS, Erica L. Mitchell, MD, Gregory J. Landry, MD, Timothy K. Liem, MD, Amir F. Azarbal, MD, Gregory L. Moneta, MD
General Surgery, Oregon Health and Sciences University, Portland, OR

Discussant: Mark Morasch, MD

OBJECTIVE: Acute aortic occlusion (AAO) is rare with the last large series published in 1998 which included patients dating back to the 1980's. These studies report that 50% of AAOs secondary to embolization with an approximate mortality rate of 50%. We reviewed our recent experience with AAO to identify current etiologies and outcomes in a modern era.

METHODS: CPT codes were used to identify patients with AAO from 2005-2012 from a prospectively maintained surgical database. AAOs secondary to trauma, dissection or endograft occlusion were excluded.

RESULTS: We identified 22 patients with AAO as outlined in Table 1. 17 presented with isolated occlusion and 5 with occlusion extending above the renal arteries. Significant lower extremity neurologic deficits were noted in 12 patients, 6 with complete paralysis. Mean time from symptom onset to diagnosis was 36 hours (range 6-72 hours). 16 (73%) presented to our institution as a transfer. Etiology was aortoiliac thrombosis in 17 (77%) cases, embolic occlusion in 1 and indeterminate in 4. Extra-anatomic bypass was performed in 14 patients, thromboembolectomy in 4 and aortobifemoral bypass in 3. One patient died prior to intervention. Acute renal failure developed in 14 patients (68%) and 8 had rhabdomyolysis. Fasciotomy was performed in 14 (68%) extremities and 9 extremities required amputation (41%). All cause mortality was 41% with all deaths occurring within 3 months of AAO.

CONCLUSIONS: AAO is an infrequent but devastating event. Our experience demonstrates that the etiology of AAO the etiology has shifted from embolic to aortoiliac thrombosis. Despite advances in vascular surgery over the past decades, however, the morbidity and mortality remain significant with a high rate of limb loss, acute renal failure, rhabdomyolysis and death. Contributing factors to poor outcomes continue to be delays in diagnosis and the need for highly skilled tertiary centers.

§ = Best Trainee Paper Award

Table 1: Patient Characteristics	
	N=22 (%)
Age at Diagnosis (median)	66.8
Male	12 (55)
PAD	13 (59)
CAD	13 (59)
CVA/TIA	5 (23)
HTN	17 (77)
CHF	5 (23)
Diabetes	9 (41)
Smoker	16 (76)
Thrombophilia	5 (23)
Atrial fibrillation	4 (18)

3. **Early Experience With Fenestrated Endografts Compared To the Snorkel Technique: Lessons Learned**

George Lee, MD, Venit Varu, MD, Venita Chandra, MD, Ronald Dalman, MD, Jason Lee, MD
Division of Vascular Surgery, Stanford University, Stanford, CA

Discussant: Brian DeRubertis, MD

OBJECTIVE: Recent FDA approval of custom fenestrated endografts has increased endovascular options for patients with short neck or juxtarenal AAAs. We sought to compare the early learning curve at a single institution of fenestrated repair versus the snorkel technique.

METHODS: From 2009-2013 we performed 52 consecutive snorkel procedures for juxtarenal AAAs in an IRB approved prospective cohort, and since summer 2012 gained access to the FDA-approved custom fenestrated device. Patient demographics, imaging, and operative techniques were compared between the first 15 cases done for each of the Sn-EVAR and f-EVAR techniques.

RESULTS: Table I summarizes the pre-, intra-, and post-operative data for both techniques. Patient demographics and AAA morphology on preoperative imaging were similar between the groups. Operative time tended to be similar in the 3-4 hour range, with more fluoroscopy time and less contrast used on f-EVAR compared to Sn-EVAR ($P<0.05$). Larger delivery systems for f-EVAR required a much higher rate of iliac conduits.

CONCLUSION: A very similar technical skill set is necessary to successfully perform both Sn-EVAR and f-EVAR. A significant portion of the learning curve for both procedures FEVAR lies in the preoperative planning of fenestrations and the cannulation of branch vessels. Similar patient and operative outcomes between the two techniques early in the experience indicates both techniques will likely have utility in the treatment of high-risk patients with complex anatomy.

Table I.	Snorkel (n=15)	FEVAR (n=15)
Age (years)	75.8	77.4
Male/Female	11/4	10/5
AAA Size (cm)	6.58 (5.5-8.4)	6.2 (4.7-10.5)
Target Vessel Success	24/24	27/28
Target vessel patency	24/24	25/28
Fluoroscopy Time (min)	66	99.1
Contrast (mL)	170.5	123.4
EBL (mL)	400	650
OR time (min)	268.13	282
Median ICU LOS (days)	1.0 (0-6)	1.5 (0-7)
Median Total LOS (days)	4 (2-10)	6(4-24)
30-day mortality	0	0
Endoleaks		
Type I	1	0
Type II	3/15	3/15
Type III	1/15	2/15
Iliac Conduit	0/15	6/15
30 Day Re-intervention	0/15	1/15

§4. **Mid-Term Changes In Renal Function Following Snorkel Repair of Juxtarenal Aneurysms**

Vinit N. Varu, MD, Kenneth Tran, Venita Chandra, MD, George K. Lee, MD, Ronald L. Dalman, MD, Jason T. Lee, MD
Stanford University, Stanford, CA

Discussant: Jeffrey Ballard, MD

OBJECTIVES: The snorkel approach for EVAR has shown to be a safe and viable alternative to open repair for juxtarenal AAAs with good short-term outcomes. Concerns about long-term durability and renal branch patency of this technique have been raised with increasing availability of fenestrated devices. We sought to evaluate renal function changes in patients undergoing Sn-EVAR.

METHODS: Patients who underwent Sn-EVAR from 2009-2012 were included in this analysis. Creatinine values were obtained throughout the patient's pre-, peri-, and post-operative course. GFR was estimated using the simplified modification of diet in renal disease (MDRD) formula. Chronic renal insufficiency was defined as pre-op serum creatinine >1.5 mg/dl. Postoperative renal dysfunction was stratified by two methods, creatinine increase >0.5 mg/dl as well as with the previously validated RIFLE classification system utilizing GFR.

RESULTS: 43 consecutive patients underwent Sn-EVAR (32 double renal, 11 single renal) for jAAA. Mean follow-up time was 23 months. Mean aneurysm size was 6.6 cm (range 5.3-10.5 cm) and unable to be treated with standard EVAR (mean neck length 1.7mm). Six (13%) patients had baseline chronic renal insufficiency. 75 renal snorkel stents were successfully placed with a 2y primary patency of 95%. Mean baseline, maximum post-operative, and latest follow up creatinine were 1.20, 1.62, and 1.45 respectively ($p < .05$). Mean baseline, maximum post-operative, and latest follow up GFR were 57.4, 46.3, and 49.5, respectively ($p < .05$). Seven patients (15.6%) developed chronic renal insufficiency based on creatinine levels alone. 13 patients (29%) had >25% decline in GFR (mild renal dysfunction), while 2 patients (4%) had a >50% decline (moderate renal dysfunction). No patients had >75% decline in GFR (severe renal dysfunction) or required long term dialysis. All-cause mortality at latest follow-up was 11%.

CONCLUSIONS: Midterm renal function changes for patients undergoing Sn-EVAR for jAAAs is favorable compared to published reports of open repair and f -EVAR. The majority of patients did not experience decline in renal function, and those that did have changes were classified as mostly mild. Sn-EVAR should continue to be considered an endovascular option for complex AAAs, especially in high-risk operative candidates.

§ = Best Trainee Paper Award

5. **Dynamic Tailoring of the "Crack and Pave" Technique In EVAR Cases With Prohibitive Iliac Artery Anatomy**

Craig Weinkauf, MD, PhD, Miguel Montero-Baker, MD, Joseph L. Mills, Sr., MD
Vascular Surgery, University of Arizona, Tucson, AZ

OBJECTIVE: Tortuous, highly calcified, severely stenotic or occluded iliac vessels may render endovascular repair of aortic aneurysms problematic or unsafe. Retroperitoneal conduit is a solution to this problem but has surgical risks and is not feasible in highly calcified vessels (Image 2A). A promising alternative is the "Pave and Crack" technique. This typically consists of 10-12mm intraluminal conduit (endoconduit) deployment in iliac vessels with coverage of the internal iliac artery (IIA). We present 3 cases from our institution and propose a method of appropriately selecting endoconduit diameter that addresses the increasing variety of aneurysm exclusion devices.

METHODS & RESULTS: Case 1: A 7.4mm (minimum diameter) left CIA and 6.8mm right CIA were predilated to 9mm and lined with 10x5mm Viabahn and 8x39mm Atrium stent grafts, respectively. After 10 mm balloon dilation of these endoconduits, a 22F bifurcated device was deployed for successful aneurysm exclusion.

Case 2: A 6.5mm diameter EIA was predilated to 8mm and lined with a 10x50mm Viabahn stent graft that was postdilated to 9mm. A 22F aortouniliac device was successfully passed and deployed, but the endoconduit was inadvertently pushed into the aneurysm sac and subsequently excluded as "endotrash."

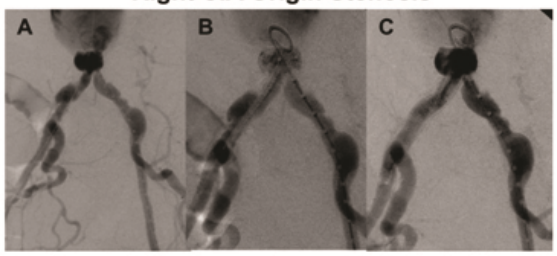
Case 3: A severely stenotic CIA (5.8mm) and EIA (4.2mm) were initially predilated to 7mm and 5mm, respectively, and subsequently lined with 10x5mm and 10x10mm Viabahn stents, sparing the IIA. After postdilation to 10mm, a 24F Medtronic bifurcated device passed through these endoconduits for successful aneurysm exclusion.

CONCLUSIONS: These cases reveal two key points: the relevance of endoconduit diameter selection and the safety of maintaining internal iliac artery (IAA) perfusion without dissection or rupture. We propose that arbitrarily defaulting to 10-12mm endoconduit is unnecessary. Rather, we suggest a dynamic approach in which operators select endoconduit size by adding 2.7mm to OD. This may result in the use of endoconduits < 10mm (table 1). Furthermore, recent data show that iliac dissection during EVAR may occur in as many as 38% of patients. This surprisingly high incidence suggests that innovative approaches to circumnavigate complicated iliac anatomy using endoconduits may be underutilized.

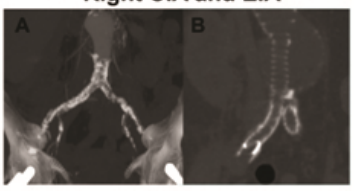
Table 1. AAA exclusion device OD guide

	OD (Fr) per Aortic Neck Diameter			
	18-22mm	*23-28mm*	*29-32mm*	*Contralateral limb*
Trivascular	14 (4.7mm)	14 (4.7mm)	14 (4.7mm)	13-15
Endologix	17 (5.7mm)	17 (5.7mm)	17 (5.7mm)	9
Medtronic	18 (6mm)	20 (6.7mm)	20 (6.7mm)	14-16
Gore	18 (6.0mm)	18 (6.0mm)	20 (6.7mm)	12-18
Cook	18 (6.0mm)	20 (6.7mm)	22 (7.3mm)	14-16

Right CIA Origin Stenosis



Highly Calcified and Stenotic Right CIA and EIA



6. **Custom-Made Fenestrated Stent Graft For Infrarenal Aortic Aneurysm Repair With Coexistent Horseshoe Kidney**

Wai-Ki Yiu, MBBS, PhD, FRCS, Yiu-Che CHAN, Albert C Ting, Stephen WK Cheng
Department of Surgery, The University of Hong Kong, Hong Kong

Horseshoe kidney may cause technical and access problems during open aortic aneurysm repair, and standard endovascular repair procedures risk renal ischaemia due to the accessory renal arteries coverage. We report a patient with a 5.4cm infrarenal aortic aneurysm and horseshoe kidney, with a large accessory renal artery supplying most of the right moiety and isthmus of horseshoe kidney arising from the sac. In order to prevent renal malperfusion, endovascular repair using a custom made bifurcated stent graft (26mm x 112mm) with a single fenestration intended for the accessory renal artery (Cook Zenith, Bloomington, IN, USA) was performed. An Atrium balloon-expandable covered stent 6x 22mm (Atrium Medical Corporation, NH, USA) was deployed through this fenestration into the accessary renal artery. The procedure was successful with renal preservation and successful exclusion of the aneurysm at 3-months' CT scan. To our knowledge, this is one of the first reports in the published literature of this technique.

7. **The "Periscope" Technique Successfully Lengthens the Distal Landing Zone During TEVAR**

Vinit Varu, MD, Venita Chandra, MD, Eric Bluemn, MD, Michael D. Dake, MD, Jason T. Lee, MD
Stanford University, Stanford, CA

OBJECTIVE: We describe our early experience with the "periscope" technique to extend the distal landing zone and successfully treat distal thoracic pathology in patients with inadequate distal seal zones near the mesenteric vessels.

METHODS: Four consecutive patients with planned endovascular repair of complex TAA extending near mesenteric and renal arteries were reviewed. In the periscope configuration, which is similar to an upside-down snorkel/chimney approach, parallel stent-grafts adjacent to the TEVAR device were placed into the mesenteric and renal vessels from the contralateral femoral approach.

RESULTS: Six periscope grafts (4 SMA, 2 in solitary renal arteries) were utilized in four patients (mean age 72y). Mean aneurysm diameter was 69.5 mm (range, 59-85 mm), and the "periscope" configuration improved the distal seal zone from a diameter of 45mm and length of 0mm to a more appropriate landing zone of 33mm diameter and 28mm length. Technical success was 100% and all patients are alive at latest followup (mean 15.1 months, range 9-23). The only morbidity was reoperation for femoral access occlusion. Post-operative follow-up imaging revealed all six periscopes to be patent. One small type Ib and one type II endoleak have been observed without aneurysm sac enlargement. All aneurysms have regressed with mean sac change of -4.7mm.

CONCLUSIONS: In select high-risk patients opting for an all-endovascular approach of distal thoracic pathology, the "periscope" technique is successful in extending the landing zone into juxtamesenteric and juxtarenal anatomies to provide successful aneurysm exclusion. Long-term follow-up is obviously necessary to assess for continued protection from aneurysm rupture, but at this point it appears to be safe and effective until fenestrated/branched grafts become more widely available.

8. **Occlusive and Aneurysmal Disease, A Novel Role For the Endologix Abdominal Endograft**

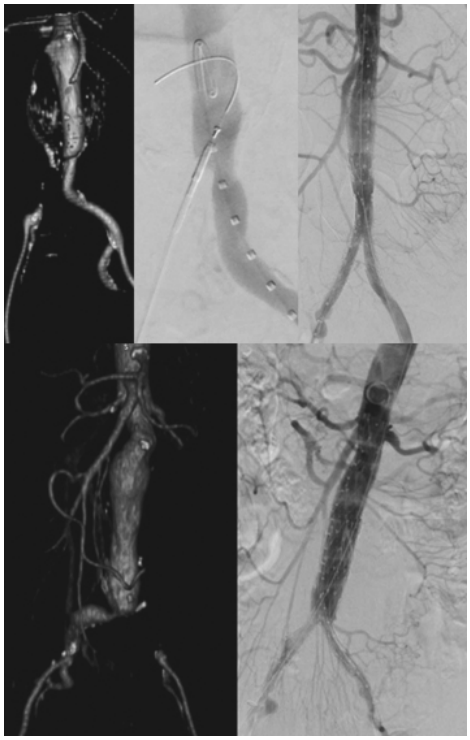
Omid Jazaeri, MD, Jeniann Yi, MD, Paul Rochon, MD, Rajan Gupta, MD, Joshua Greenberg, MD, David Kuwayama, MD, Mark Nehler, MD
Surgery, University of Colorado School of Medicine, Aurora, CO

OBJECTIVE: Coexisting aorto-iliac occlusive disease is not uncommon in patients undergoing treatment for aorto-iliac aneurysms. We have preferentially used the Endologix abdominal endograft in these patients given the graft's unique properties including a bifurcation-sparing nature and low profile delivery. We aimed this study at reviewing our single-center experience in this homogenous cohort of patients affected by claudication, CLI, and aneurysmal disease treated with an Endologix abdominal endograft.

METHODS: A retrospective review of all endovascular aorto-iliac aneurysms repaired with an Endologix device was perfomed at a single institution between January 2008 and April 2013. This revealed 51 patients who were treated with the Endologix device for aorto-iliac aneurysms who had coexisting aorto-iliac occlusive disease. Patient demographics, procedural details, and clinical follow-up were reviewed.

RESULTS: All 9 (100%) of the patients had claudication and 3 (33%) had CLI. One patient presented with an aortic rupture and the remaining 8 patients were elective. Successful deployment of the endovascular device was achieved in all 9 (100%) patients. There was no 30-day mortality or re-intervention within 1 year. Of the 9 patients, 3 (33%) had complete iliac occlusions which were all crossed utilizing an Outback re-entry device. The remaining 6 (66%) patients all had iliac stenoses and 2 (22%) also had aortic stenoses. Preprocedural and postprocedural ABIs were available in 8 of 9 patients. Mean bilateral pre-procedure ABI was 0.70 which increased to 0.86 post-procedure.

CONCLUSIONS: Significant coexisting arterial disease may be encountered in patients with aortic or iliac aneurysms. Identification of coexisting arterial diseases is essential to help tailor treatment for coexisting occlusive and aneurysm disease. The Endologix abdominal endograft has properties that perform well in this patient population in our single-center review.



§9. Risk Factors For 30 Day Hospital Readmission In Patients Undergoing Treatment For Peripheral Artery Disease

Sukgu M. Han, MD, Bian Wu, MD, Charles M. Eichler, MD, Linda M. Reilly, MD, Shant M. Vartanian, MD, Michael S. Conte, MD, Jade S. Hiramoto, MD
Division of Vascular and Endovascular Surgery, University of California, San Francisco, CA

Discussant: John Lane, MD

OBJECTIVE: Early hospital readmission among vascular surgery patients has become a focus for the restructuring of Medicare's reimbursement system; however, risk factors for these readmissions remain poorly characterized. We aim to identify factors associated with 30 day readmission after peripheral artery interventions.

METHODS: Retrospective analysis of 175 consecutive patients discharged between 1/1/2011-7/31/2012 who underwent treatment for lower extremity peripheral artery disease, which included open and endovascular aortoiliac procedures, infrainguinal revascularizations, and amputations. Data on demographics, comorbidities, length of stay, type of operation performed, and functional status were acquired from the electronic medical record.

RESULTS: 37/175 (21%) patients were readmitted within 30 days of discharge; 7/37 (19%) readmissions were planned. There were no significant differences in demographic characteristics, co-morbid conditions, length of hospital stay, or discharge functional status between the readmitted and non-readmitted groups (Table). Readmitted patients were more likely to have undergone an urgent operation (p=0.02). In a multivariate logistic regression model, urgency of operation (OR:3.42, 95% CI:1.35-8.67) and either chronic kidney disease or end stage renal disease (OR: 3.71, 95% CI: 1.39-9.91) were significantly associated with increased risk of 30 day readmission. Diabetes mellitus was associated with a lower risk of readmission (OR:0.32, 95%CI:0.12-0.83). The most common reasons for readmission were infection, either of the surgical site or index limb (18/37=49%) followed by persistent nonhealing wounds or rest pain in the index limb (11/37=30%). Graft failure requiring re-intervention accounted for 3/37(8%) of readmissions.

CONCLUSIONS: 30 day readmission is frequent after peripheral artery interventions, with the majority of these related to the index limb. Urgent operative intervention and compromised renal function appear to be risk factors for early hospital readmission.

§ = Best Trainee Paper Award

Table. Patient Characteristics			
	Nonreadmission Group	Readmission Group	p-value
Total	138	37	
Age	69.0±11.4	68.7±11.4	0.87
Male gender	67%	54%	0.15
Race			0.33
White	93 (67%)	23 (62%)	
Black	12 (9%)	5 (14%)	
Hispanic	15 (11%)	2 (5%)	
Asian	10 (7%)	6 (16%)	
Others	8 (6%)	1 (3%)	
Diabetes Mellitus	69 (50%)	14 (38%)	0.18
Hypertension	113 (83%)	33 (89%)	0.33
Coronary Artery Disease	54 (39%)	14 (37%)	0.86
Congestive Heart Failure	17 (12%)	4 (11%)	0.8
Hyperlipidemia	78 (57%)	18 (49%)	0.39
Stroke	19 (14%)	4 (11%)	0.64
Chronic Kidney Disease	22 (16%)	12 (33%)	0.02
End Stage Renal Disease	13 (9%)	6 (16%)	0.24
Chronic Pulmonary Obstructive Disease	24 (17%)	7 (19%)	0.83
Smoking	93 (67%)	21 (57%)	0.23
Venous Thromboembolism	8 (6%)	2 (5%)	0.93
Atrial Fibrillation	15 (11%)	5 (14%)	0.65
Length of Stay (days)	7.74	7.65	0.65
Urgency of Operation	24 (17%)	13 (35%)	0.02
Functional Status at Discharge			0.08
Ambulatory	120 (87%)	28 (76%)	
Wheelchair-bound	14 (11%)	5 (13%)	
Bedbound	4 (3%)	4 (11%)	

§10. **Lower Extremity Autogenous Vein Bypass For Critical Limb Ischemia Is Not Adversely Affected By A Failed Endovascular Procedure**

Vincent J. Santo, III, MD, Phong Dargon, MD, Amir Azarbal, MD, Timothy Liem, MD, Erica Mitchell, MD, Gregory Landry, MD, Gregory Moneta, MD
Surgery, Oregon Health and Science University, Portland, OR

Discussant: Joseph Mills, MD

OBJECTIVE: It has been reported a failed endovascular intervention adversely affects results of lower extremity bypass (LEB). We reviewed rates of prior endovascular intervention in patients undergoing LEB with autologous vein for critical limb ischemia (CLI) to determine effects on graft patency, limb salvage and amputation free survival (AFS).

METHODS: Review of consecutive autologous vein LEBs performed for CLI between 2005 and 2012 at a tertiary care academic medical center.

RESULTS: Overall there were 311 autologous vein LEBs performed for CLI; 70% for tissue loss. TASC D or C lesions were present in 61% and 25%, respectively. The greater saphenous vein was used as a conduit in 83% and the distal target was infra-popliteal in 60%. 30-day mortality was 3.5%. One and 5-year primary patency was 61% and 45%. One and 5-year secondary patency was 88% and 65%, with 23% requiring an intervention to maintain patency. Five-year limb salvage was 90% and 5-year AFS was 49%.
Sixty patients (19%) had undergone a prior ipsilateral endovascular intervention (PEI) and 251 were felt to be unsuitable for an endovascular intervention (NPEI). PEI and NPEI patients had similar demographics and prevalence of atherosclerotic risk factors. One-year primary and secondary patency were 61% and 87% for PEI patients and 60% and 89% for NPEI patients, P=NS. Three-year secondary patency was 76% (PEI) and 68% (NPEI), P=NS. Three-year limb salvage was 94% (PEI) vs. 89% (NPEI), P=NS. Three-year AFS was 53.6% (PEI) vs. 59.1% (NPEI), P=NS.

CONCLUSIONS: Overall operative mortality, patency rates and limb salvage for autologous vein LEB in CLI patients continue to be excellent in the endovascular era and are not necessarily affected by a prior failed ipsilateral endovascular procedure. Long-term survival remains poor in CLI patients requiring LEB.

§ = Best Trainee Paper Award

§11. **Endovascular Therapy Is Effective Treatment For Focal Stenoses In Failing Infrapopliteal Grafts**

Gregory G. Westin, MAS, Ehrin J. Armstrong, MD, MSc, MAS, Satinder Singh, MD, Haseeb Saeed, MD, William C. Pevec, MD, John R. Laird, MD, David L. Dawson, MD
University of California, Davis, Sacramento

Discussant: Charles Eichler, MD

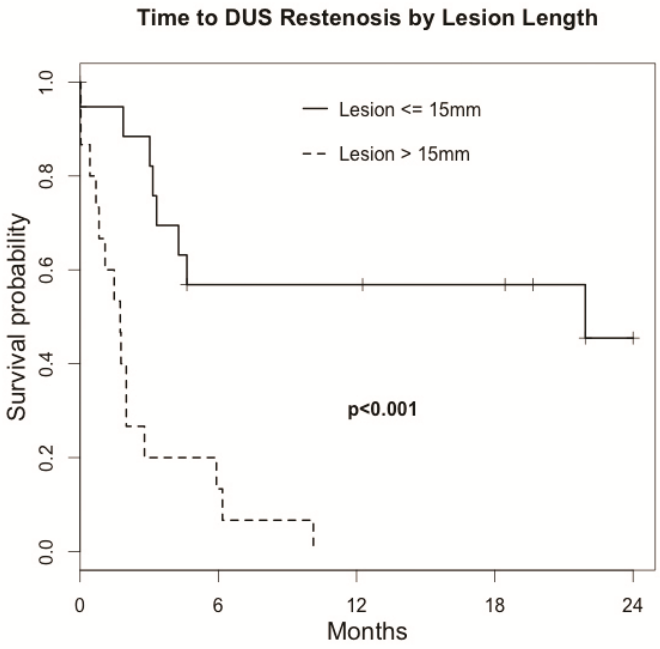
OBJECTIVE: To evaluate the efficacy of endovascular therapy in failing infrapopliteal bypass grafts to maintain patency and preserve limbs.

METHODS: This is a retrospective review of endovascular procedures to preserve graft patency. Data were derived from a registry of catheter-based procedures for peripheral artery disease and review of records and angiographic images. Of 1554 arteriograms performed from 2006 to 2012, there were 44 interventions in 35 patients for failing bypass vein grafts to infrapopliteal target vessels. The first intervention for each patient was used in this analysis. Duplex ultrasound scanning (DUS) was routinely used within 30 days and at 3-6 month intervals for graft surveillance.

RESULTS: Interventions were performed for recurrent symptoms of critical limb ischemia in 43% and for stenoses identified by DUS in 57%. Procedural techniques included cutting balloon angioplasty (74%), conventional balloon angioplasty (14%), stent placement (9%), and laser atherectomy and thrombectomy (3%). Procedural success was achieved in 34 of 35 cases (97%). There were no procedure-related complications, amputations, or deaths within 30 days. Residual stenosis was detected by DUS in seven patients; one had early endovascular re-intervention and one had early surgical graft revision. Median follow-up time was 531 days.

Kaplan-Meier analysis showed limb salvage rates of 93% at both 12 and 24 months; continued graft patency rates without need for re-intervention were 29% and 24%. Receiver operating characteristic analysis identified that a lesion length of 1.5cm maximized sensitivity and specificity in predicting restenosis (C statistic: 0.81); the restenosis rate for patients with lesions >1.5cm was 100% at one year, and for lesions ≤1.5cm was 43% at one year and 54% at two years ($p<0.001$ by log rank test).

§ = Best Trainee Paper Award



CONCLUSIONS: In this single-center experience with endovascular therapies to treat failing infrapopliteal bypass grafts, 93% of limbs were preserved, but over 70% of patients developed graft restenosis within 12 months. In particular, stenoses longer than 1.5cm did very poorly with endovascular treatment. These data suggest that interventions to restore or prolong graft patency are effective in preventing limb loss and that close follow up with vascular laboratory surveillance is essential.

12. **2,500,000 Troubled Soles: Ten-Year Analysis of Diabetic Foot Infections In the United States**

Grant H. Skrepnek, PhD, David G. Armstrong, DPM, MD, PhD, Joseph L. Mills, Sr., MD
The University of Arizona, Tucson, AZ

Discussant: TBA

OBJECTIVE: Assess charges, case complexity and use of revascularization among inpatient hospital admissions for diabetic foot infections (DFIs) and associated amputations in the U.S. over 10 years.

METHODS: Inpatient discharge records from the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project were used in this retrospective cohort study spanning 2001-2010. We reviewed all-listed diagnoses of inpatient DFIs, stratified by open bypass (Open) or endovascular therapy (EVT) and major (above ankle) or minor amputation. Revascularization, length of stay (LOS), case complexity and hospital charges were analyzed on a per admission basis.

RESULTS: During the study period, 2.5 million inpatient DFI cases were observed, of which 412,051 (16.5%) involved amputation (34.8% major, 61.2% minor). Overall, 211,534 (8.5%) of DFI cases underwent revascularization (43.5% Open, 51.1% EVT, 5.4% both). From 2001 versus 2010, the volume of Open procedures decreased 34.9%, while EVT volume rose 297.1%. Some 6.7% of the 143,470 major amputations involved revascularization during the same hospital stay (29.8% Open, 63.5% EVT, 6.7% combination) versus 15.1% of the 268,520 minor amputations (44.9% Open, 44.2% EVT, 6.9% combination). In amputation-only cases, from 2001 versus 2010, Open volume fell 27.3% but EVT increased 280.3%. Minor amputations increased 48.5%, but major amputations only rose 7.7%. Notably, an increasing case-mix severity was seen for amputations with associated vascular procedures, with a 25.5% increase in unadjusted mean charges ($104,839 vs. $131,554, US2012). However, mean LOS decreased 22.5% (18.4 vs. 14.2 days, $p<0.05$). Inpatient amputation-related mortality was 1.8%, falling by 19.1% from 749 (2.2%) in 2001 to 606 (1.3%) in 2010.

CONCLUSIONS: This nationally representative investigation found that DFI admissions are common, long, and ever more costly (> $100,000/case), likely due to increasing case severity mix. More DFI patients are undergoing revascularization (8.5% per admission), with a dramatic shift from Open bypass to EVT. Despite these unfavorable factors, hospital mortality and LOS have fallen significantly. Major amputation for DFI also appears to be flattening, with a marked rise in minor amputations (High:Low ratio = 0.57).

13. **Mid-Term Outcomes of Neuroischemic and Ischemic Wounds Treated By A Multidisciplinary Limb Salvage Service**

Shant M. Vartanian, MD, Kene Ofili, DPM, Kristin Robinson, DPM, Charles M. Eichler, MD, Jade S. Hiramoto, MD, Alex Reyzelman, DPM, Michael S. Conte, MD
University of California, San Francisco, San Francisco, CA

Discussant: Niten Singh, MD

OBJECTIVE: Multidisciplinary limb salvage teams have been shown to decrease the frequency of major amputations by increasing the rate of revascularization procedures and minor amputations. The outcomes of wound healing, recurrence and ambulatory status in multidisciplinary amputation prevention clinics are assumed to be improved but are not routinely reported. This study investigates the mid-term outcomes of ischemic and neuroischemic wounds treated at our multidisciplinary limb salvage clinic.

METHODS: A retrospective review of patients treated at a single institution multi-disciplinary limb salvage clinic over 12 consecutive months. Only patients with ischemic or neuroischemic wounds were included in the analysis. Patient demographics, wound characteristics, procedural details, clinical outcomes and ambulatory status were reviewed. Clinical endpoints under study included time to wound healing, reulceration rate and ambulatory status.

RESULTS: Over the study period there were 141 new patients and 901 clinic visits. 80 patients were treated for neuroischemic or ischemic wounds. In 64% of patients (51/80) wounds were present for > 6 weeks before referral. Previous vascular surgical history was present in 34% (27/80) and 23% (18/80) had a previous minor amputation. 40% of wounds (32/80) were limited to the toes or the forefoot whereas 21% (18/80) involved the rearfoot or ankle. A total of 62 vascular interventions were performed with an equal distribution of endovascular and open revascularizations. 56% of wounds (45/80) were fully healed over the observation period. The average time to fully healed was 16 weeks. Rearfoot or ankle wounds were predictive of failure to heal (OR 0.32, $p < 0.05$, 95% CI 0.10 - 0.99). 16% of patients (13/80) developed a new wound on the ipsilateral leg during follow up. On initial evaluation 56% (45/80) of patients were fully ambulatory without assistance. After treatment, 13% of patients (10/80) had a net deterioration in their ambulatory status.

CONCLUSIONS: Multidisciplinary limb salvage teams effectively heal wounds and maintain ambulatory status in patients with ischemic and neuroischemic wounds. Patient specific factors, such as rearfoot or ankle wounds, can adversely effect on the outcome. Even with high quality care, 16% of patients can be expected to have a recurrence.

§14. **Split Thickness Skin Grafts In High Risk Extremity Wounds: Helpful or Heretical?**

Jessica F. Rose, Jennifer Pappalardo, Joseph L. Mills, David G. Armstrong
University of Arizona, Tucson, AZ

Discussant: York Hsiang, MD

OBJECTIVES: The use of split thickness skin grafts (STSG) in people with chronic wounds has often been considered undesirable because of the perceived high incidence of failure, especially when applied to neuropathic patients with plantar diabetic foot wounds. The purpose of this study was to report the outcomes of STSG for chronic lower extremity wounds.

METHODS: We carried out a retrospective chart review of all consecutive patients undergoing STSG for chronic lower extremity wounds performed by all vascular and podiatric surgeons at our institution from 2007 to April 2013.

RESULTS: A total of 94 patients received STSG for chronic wounds; 70% were male, with a mean age of 61 years. 66 were performed in people with diabetes and 28 were on patients with venous leg ulcers or other chronic non-diabetic wounds. Sixty-six patients (70%) healed their wounds; 20% required revision, 9% went on to heal after revision; 5% failed to heal and required major limb amputation.

Among the 66 patients with diabetes, 46 (70%) patients healed primarily after STSG without revision. Forty of these diabetic patients (60%), all but one of whom was ambulatory, had plantar wounds treated with STSG, and 65% of these healed primarily. Nine patients with plantar wounds STSG required revision, 4 healed after revision. The other wounds were managed with local wound care. Only one plantar wound resulted in a major limb amputation.

CONCLUSION: Primary STSG was associated with successful healing in the majority of plantar and non-plantar chronic wounds of the lower extremity, even in patients with diabetes and attendant neuropathy.

§ = Best Trainee Paper Award

15. **Ex Vivo Renal Artery Reconstruction Is the Treatment of Choice For Complex Renal Artery Pathology**

Sung W. Ham, MD, Fred A. Weaver, MD
University of Southern California - Division of Vascular Surgery, Los Angeles, CA

Discussant: Christian deVirgilio, MD

OBJECTIVE: Evaluate long-term outcome of renal revascularization using ex vivo renal artery reconstruction for complex renal artery pathology.

METHODS: From 1987 - 2012, 23 patients (17 women, mean age 45) with complex renal artery lesions underwent open renal revascularization using ex vivo technique. Underlying disease included fibromuscular dysplasia with aneurysm (11), atherosclerotic aneurysm (6), Takayasu arteritis (3), other (3). Outcomes analyzed included primary, primary assisted and secondary patency rates, antihypertensive medication requirements, renal function/preservation, and mortality. Late graft patency, renal size and cortical thickness were analyzed by serial renal duplex ultrasound examinations.

RESULTS: Twenty-four kidneys in 23 patients were revascularized using ex vivo renal artery reconstructive techniques. Perioperative complications were limited to two patients requiring reoperation for bleeding. Renal function did not change and there were no in-hospital deaths. Over mean follow-up of 44 months, a single bypass graft occluded requiring a redo bypass, which was performed with renal preservation. Primary, primary assisted and secondary patency rates were 94%% at 1 and 5 years. Compared to preoperative values, systolic/diastolic blood pressure and the number of antihypertensive medications were reduced ($P<.05$) in the 18 patients with hypertension. Late renal function was preserved as measured by no change in both serum creatinine and eGFR compared to preintervention values ($p=0.25$, $p=0.35$, respectively). In addition, there was no difference in treated kidney size or renal cortical thickness on follow-up compared to preoperative measurements ($p=0.15$, $p=0.62$, respectively). No patient required dialysis. There were 3 late deaths, none related to the renal procedure, providing 1 and 5-year actuarial survival of 94% and 85%, respectively.

CONCLUSIONS: Ex vivo renal artery reconstruction for complex renal artery pathology confers a benefit in blood pressure, while preserving renal mass and function. This technique should be considered the treatment of choice for complex renal artery pathology.

16. **The Low Mortality of Renal Artery Aneurysms (RAA): Is Current Treatment Too Aggressive?**

Jill Q. Klausner, B.S., Michael Harlander-Locke, B.S., Adam Plotnik, MD, Evan Lehrman, MD, Brian G. DeRubertis, MD, Peter F. Lawrence, MD
University of California Los Angeles, Los Angeles, CA

Discussant: Fred Weaver, MD

OBJECTIVE: Most studies recommend repair of RAA > 2 cm diameter in asymptomatic patients, but other studies have shown that RAA > 2 cm remain clinically silent over a number of years. We hypothesized that rupture and death in patients with asymptomatic RAA is low, and that current recommendations for RAA treatment at 2 cm may be too aggressive.

METHODS: Retrospective review of all RAA treated at a tertiary care medical center from 2002-2012.

RESULTS: Fifty-nine RAA were identified in 40 patients (mean age= 62; M: F = 17:23); 32 were saccular, 7 fusiform, and 5 bilobed. Thirty-seven aneurysms were asymptomatic (ARAA), with the rest being identified during workup for difficult-to-control hypertension (n=11), hematuria (n=5), or flank pain (n=3). Aneurysm location included the main renal artery bifurcation (n=36), main trunk (n=8), primary branch (n=6), pole artery (n=4), and secondary branch (n=1). Ten ARAA were operated on (mean RAA diameter = 2.4 ± .1 cm, range: 2-3 cm), with the remaining 27 ARAA being managed conservatively (mean RAA diameter = 1.4 ± 0.1 cm, range: 0.6-2.6 cm). Operative management of ARAA included resection and patch angioplasty (n=8), resection with end-to-end anastomosis (n=1), resection with patch and reimplantation (n=1) and plication (n=1). Mean ARAA patient hospital LOS = 5 days, with a 0% morbidity and mortality rate at 12 mo follow-up. Non-op ARRA patients were followed for up to 14 yrs (mean= 3 yrs), with no rupture and 0% mortality. Mean RAA growth rate of patients with multiple imaging studies was 0.7±0.2 mm/yr. No ARAA > 2 cm managed non-operatively ruptured (mean follow-up 46 mo).

CONCLUSIONS: The rate of aneurysm rupture and death in our untreated RAA patients is zero, the growth rate is 0.7±0.2 mm/yr, and RAA > 2 cm remained clinically silent for more than 3 years. We may currently be too aggressive in treating asymptomatic RAA.

§17. **Vascular Reconstruction During Major Oncologic Pancreatic Resections**

Carlos Pineda, MD, Venita Chandra, MD, Geoff Krampitz, MD, George A. Poultsides, MD, Jeffrey A. Norton, MD, E. John Harris, Jr., MD
Vascular Surgery, Stanford University Medical Center, Stanford, CA

Discussant: David Rigberg, MD

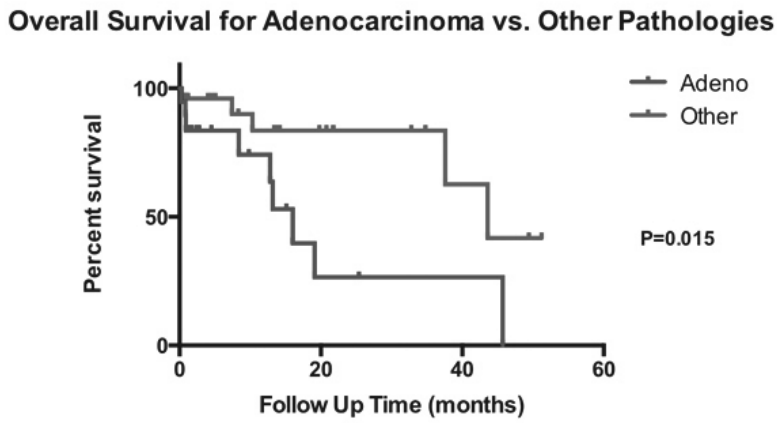
OBJECTIVE: There is growing evidence that major vascular reconstruction performed during pancreaticoduodenectomy for malignancy may increase local resectability without increasing morbidity or mortality. The purpose of this study was to evaluate our experience with vascular reconstructions during major pancreatic resections.

METHODS: We performed an IRB approved review of patients with planned and unplanned vascular surgery involvement during major pancreatic resections over an 8 -year period. We analyzed patient demographics, operative techniques, reconstruction patency, and early and late morbidity and mortality.

RESULTS: Forty-four patients were included in the study. Eighteen (41%) cases were unplanned intraoperative consults, and 7 cases only involved vascular assistance with dissection without reconstruction. Average age of the patients was 64, median operative blood loss was 1.5 liters, and mean operative time was 7.5 hours. Of the 37 patients who underwent vascular reconstruction, 31(84%) involved portal or superior mesenteric vein, 5 involved the superior mesenteric artery, 3 involved hepatic artery and one involved aortic repair. The majority of reconstructions were either primary repair (29%) or superficial femoral vein graft (32%). Sixty six percent of patients had patent vascular reconstructions on last follow up (mean f/u 50 weeks). Peri-operative mortality was 4%. Median survival for all patients was 37.6 months. Patients with adenocarcinoma (Figure) had a significantly decreased survival compared to other pathologies (16 vs. 43.6 months, p=.015), although still higher than mean historical survival rates of patients with unresectable pancreatic adenocarcinoma (3-9 months). Post-operative complications related to vascular procedure occurred in 7 (16%) patients. Preoperatively planned vascular involvement showed a trend to improved short-term mortality (11% vs.0%, p=.08).

CONCLUSIONS: Vascular reconstruction during major pancreatic resections provides good patency with acceptable vascular-related morbidity, and can be considered as an option to increase local resectability and extend survival. Preoperative vascular planning should be considered.

§ = Best Trainee Paper Award


Overall Survival for Adenocarcinoma vs. Other Pathologies
Adeno
Other
P=0.015
Percent survival
100
50
0
0
20
40
60
Follow Up Time (months)

18. **Survey of the Initial Cohort of Graduating Integrated 0+5 Residents and Vascular Fellows: Experiences During the Job Hunt**

Benjamin D. Colvard, MD, Murray Shames, MD, Andres Schanzer, MD, John Rectenwald, MD, Rabih Chaer, MD, Jason T. Lee, MD
Vascular Surgery, Stanford, Stanford, CA; University of South Florida, Tampa, FL; University of Massachusetts, Worcester, MA; University of Michigan, Ann Arbor, MI; University of Pittsburgh Medical Center, Pittsburgh, PA; Stanford, Stanford, CA

Discussant: Linda Reilly, MD

OBJECTIVE: The first two integrated vascular residents in the United States graduated in 2012, and in 2013 eleven more will enter the job market. The purpose of this study was to compare the job search experiences of the first cohort of 0+5 graduates to their counterparts completing 5+2 fellowship programs.

METHODS: An anonymous, web-based, 15-question survey was sent to all graduating integrated residents in 2013, as well as the corresponding 5+2 graduating fellows within the same institution. Survey response was nearly 70%.

RESULTS: Survey responses are summarized below in the table. Overall there was not a significant difference between the training cohorts for open or endovascular cases. Research time during the entire training cohort was similar between residents and fellows. Nearly all graduates were extremely satisfied with their training program and had positive experiences during their job searches in terms of starting salaries, numbers of offers, and desired practice type. Integrated 0+5 residents were more likely to prefer and accept offers in academic and mixed practices compared to private practices ($P<0.05$).

CONCLUSION: Although longer-term data is needed to understand the addition of integrated residents to the vascular surgery job force, preliminary survey results demonstrate a positive and similar training and job offer experience for 2013 graduates when comparing 0+5 residents with 5+2 fellows. The continued growth and expansion of integrated 0+5 VS residency positions is thus far justified by the comparative success in the job searches of these graduates.

		0+5 graduates (n=9)	5+2 graduates (n = 16)
Sex	Male	77%	81%
	Female	23%	19%
Dedicated Research Time		33%	25%
Open Case Volume	150-200	11%	31%
	>200	89%	69%
Endovascular Case Volume	200-300	11%	19%
	>300	89%	81%
Preferred Type of Practice	Academic	55%	44%
	Private	0%	25%
	Mixed	45%	31%
Interview offers received	1-6	88%	60%
	7 or more	12%	40%
Interviews attended	1-3	55%	50%
	>4	45%	50%
Job offers received	1-2	62%	61%
	3 or more	38%	39%
Salary	$200k – $300k	62%	46%
	$300k - $400k	13%	38%
	>$400k	25%	15%
Type of Practice	Academic	62%	50%
	Private	0%	41%
	Mixed	38%	9%
Satisfaction with Position	Very Satisfied	63%	58%
	Satisfied	25%	16%
	Somewhat satisfied	12%	16%
	Neutral	0%	10%
	Dissatisfied	0%	0%

19. **Objective Intra-operative Assessment of AV Fistula Creation by Surgical Residents Does Not Correlate with Subjective Technical Skills Evaluation**

Edward Gifford, MD, Samuel Schwartz, MD, Patrick Chisum, BS, Amy Kaji, MD, PhD, Bruce Stabile, MD, Christian de Virgilio, MD
Department of Surgery, Harbor-UCLA Medical Center, Torrance, CA

OBJECTIVE: Assessment of surgical resident technical skills has been historically performed by subjective faculty evaluations (SFE) that are provided to the resident in a delayed fashion. In an effort to improve the accuracy and the feedback of technical skills, we instituted an objective intra-operative skills assessment (OISA) for arteriovenous fistula creation (AVF). The purpose of this study was to determine the correlation of SFE assessments to the OISA.

METHODS: Categorical third year general surgery residents were objectively evaluated by a single faculty during the creation of arteriovenous fistulas (AVF).Types of technical errors were explained and demonstrated to the resident prior to starting the AVF. The AVF was created using a standardized arteriotomy. Each technical error made was recorded in real time, as was the time needed to complete the anastomoses. The OISA report was provided to the resident immediately after the AVF. Concurrently, the SFE of technical skill were collected for the same residents over the postgraduate (PG) years 1-3. Pearson correlation coefficients were generated for comparisons of OISA and SFE.

RESULTS: An OISA was performed for 42 AVF performed by five PGY 3 residents. Mean anastomosis time was 20.5 minutes. Mean number of technical errors per AVF was 17.2. The same 5 residents had a total of 185 SFE assessments during their PG years1-3, including 33 in the PG year 3, with a mean score of 7.1 (scale 1-9). The SFE failed to correlate with either the time of anastomosis or the number of errors in the OISA (R = -0.01 and 0.07, respectively).

CONCLUSIONS: SFE of residents technical skill does not correlate with OISA performed during the creation of AVF. Technical skills established in our OISA study provide an objective method to give immediate feedback to residents and to track improvement, both increasingly vital components in the evaluation of surgical trainees.

Correlation Coefficients for SFE and OISA Assessments		
Variable	OISA: anastomosis time	OISA: # of technical errors
SFE score in PGY 1-3	R= -0.01, p=0.9	R= 0.07, p=0.7
OISA: # of technical errors	R= 0.72, p<0.0001	
SFE score in PGY 3 only	R= -0.03, p=0.9	R= -0.32, p=0.08

20. **Erosion of Central Venous Stent Into Neck: A Case Report and Literature Review of Complications With Central Venous Stent**

Luke X. Zhan, MD, PhD, Elizabeth Lee, Zachary Taylor, Joseph L. Mills, Karou Goshima
Department of Surgery, University of Arizona, Tucson, AZ

Endovascular stents are being increasingly deployed throughout venous system. One of most common applications is in endovascular treatment of central venous stenosis. Though effective, a few complications are recognized, typically perforation, migration, thrombosis and re-occlusion. We report a case of a 37-year-old male who presented with erosion and migration of central venous stent into neck, resulting in chronic wound. Imaging studies demonstrated that the distal portion of the stent terminated in the right innominate vein and SVC. It remained patent with rich venous collaterals formed around it. Distal portion eroded through subclavian vein into neck, resulting in skin necrosis, chronic wound and wound infection. Surgical management involved neck dissection, excision of migrated portion of the stent, wound debridement, delay wound closure and reconstruction with omohyoid muscle flap to cover the closed end of remaining stent and tissue defect. We reviewed current literature on central venous stent related complications. To our best knowledge, this represents the first report of an extraluminal cental venous stent erosion into neck causing chronic neck wound. Creative surgical excision and reconstruction with neck muscle flap resulted in satisfactory outcome in the management of this complication.

21. **Multimodal Therapy In the Treatment of A Venolymphatic Malformation of the Axilla and Chest Wall In An Infant**

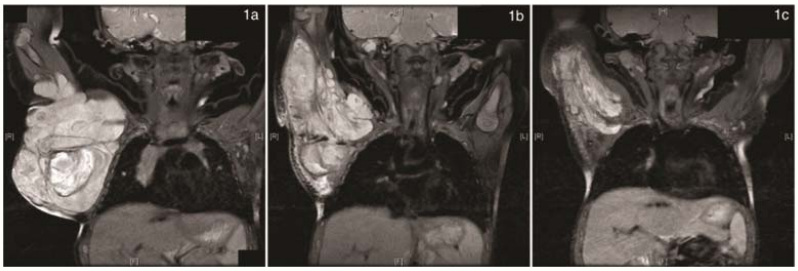
Colton C. Gits, BA, Stephen C. Nelson, MD, Brad A. Feltis, MD, Jason Q. Alexander, MD
Minneapolis Heart Institute Foundation, Minneapolis, MN; Children's Hospitals and Clinics of Minnesota, Minneapolis, MN

OBJECTIVE: Vascular malformations are normally benign, but in rare cases they can cause challenging and potentially life-threatening complications. Preliminary evidence suggests the mammalian target of rapamycin (mTOR) inhibitor sirolimus may be effective in the treatment of vascular malformations. We present a staggered multimodal approach to the treatment of a very large complex symptomatic venolymphatic malformation in a female infant.

METHODS: We report the case of a female infant suffering from restricted arm mobility and severe consumptive coagulopathy associated with a massive venolymphatic malformation of the axilla and chest wall (1a, CT image). We planned a novel combination of surgical debulking followed by sirolimus therapy. Immediate and follow-up CT imaging and physical examinations were used to assess the diseased burden over time. The severity of coagulopathy was monitored with platelet count and fibrinogen level measurements.

RESULTS: The patient underwent planned partial surgical resection of the mass at approximately 5.5 months of age, and sirolimus therapy was initiated after her wounds healed at 7 months of age. CT imaging was consistent with reduced diseased burden after surgery (1b) and during the course of sirolimus therapy (1c, after three months of therapy). Hematologic measurements reached and maintained normal levels without the support of blood products at 12 months of age, and normal limb functionality was restored. Medical therapy will continue as long as there is observed clinical benefit. There were no apparent adverse side effects of sirolimus therapy.

CONCLUSIONS: While vascular malformations must be managed on an individual basis, this case presents a potentially promising method to treat those with severe complications. A staged surgical and medical approach restored normal limb function and resolved critical consumptive coagulopathy in an infant. The optimal choice for medical therapy requires further study, but sirolimus appears to be a promising option.


1a
1b
1c

22. **Potential Association of A Single Nucleotide Polymorphism in the CDNK1B Gene and Carotid Plaque Fibrous Cap Status By MRI**

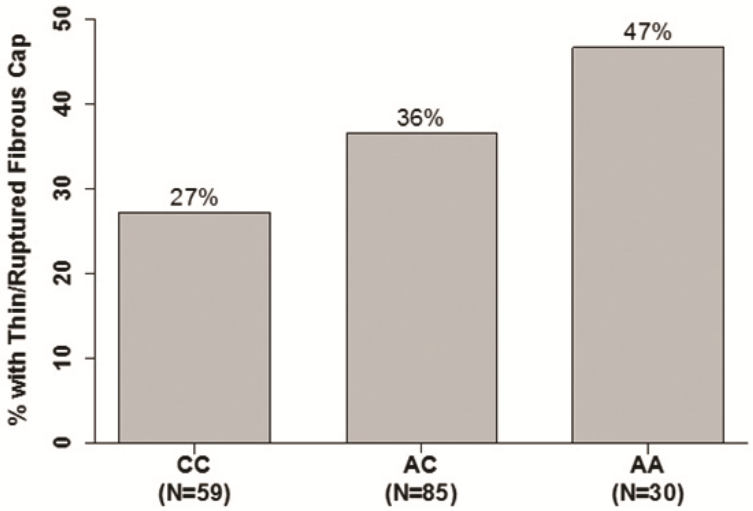
Thomas S. Hatsukami, MD, Gail P. Jarvik, MD, PhD, Daniel S. Hippe, M.S., Jane E. Ranchalis, Alexander W. Clowes, MD
Surgery, University of Washington, Seattle, WA

OBJECTIVE: Studies have shown that individuals with a thin or ruptured fibrous cap on carotid magnetic resonance imaging (MRI) are at greater risk for transient ischemic attack or stroke. Autopsy studies document a similar relationship between cap rupture and myocardial infarction (MI). Recent evidence suggests that a single nucleotide polymorphism in the promoter region of the CDKN1B gene, a cell cycle regulator, is associated with a two-fold increased risk of MI. These studies indicate that the -838A allele is associated with increased CDKN1B expression and decreased proliferation of vascular smooth muscle cells (SMC). Reduction in SMC proliferation may result in decrease in the thickness of the fibrous cap, setting the stage for cap rupture. The objective of this study is to test that hypothesis that the -838A allele of the CDKN1B gene is associated with the presence of a thin or ruptured fibrous cap on carotid MRI.

METHODS: 276 subjects with 16-79% carotid stenosis by ultrasound were recruited for the study. Carotid MRI scans were performed on a 1.5 T scanner (Signa Horizon EchoSpeed, GE Healthcare, Milwaukee, WI). The index artery was analyzed by reviewers blinded to clinical and genetic information. Carotid plaque composition and fibrous cap status were recorded using previously published criteria. The trend between number of A alleles and the presence of a thin or ruptured fibrous cap was assessed using logistic regression under a codominant genetic model.

RESULTS: Of the 276 carotid arteries, 42 (15%) were excluded due to insufficient image quality and 60 subjects did not agree to sample collection for genotyping, leaving a total of 174 arteries for analysis. Sixty-one (35%) of the plaques had a thin or ruptured cap. Figure 1 summarizes the prevalence of thin/ruptured fibrous cap by genotype. There was a trend toward increasing prevalence of thin/ruptured caps with each A allele, but this was of marginal statistical significance ($p=0.062$) in this small sample.

CONCLUSIONS: These preliminary data suggest a trend toward increasing prevalence of thin/ruptured caps in carotid plaque associated with the -838C>A polymorphism of the CDKN1B gene that warrants further study in a larger cohort. Furthermore, this study demonstrates the utility of MRI for examining the pathogenesis of the high-risk atherosclerotic plaque.


% with Thin/Ruptured Fibrous Cap
0
10
20
30
40
50
27%
36%
47%
CC
(N=59)
AC
(N=85)
AA
(N=30)

23. **Leveraging the Electronic Medical Record To Implement An Abdominal Aortic Aneurysm Screening Program In A Large Integrated Health Care System**

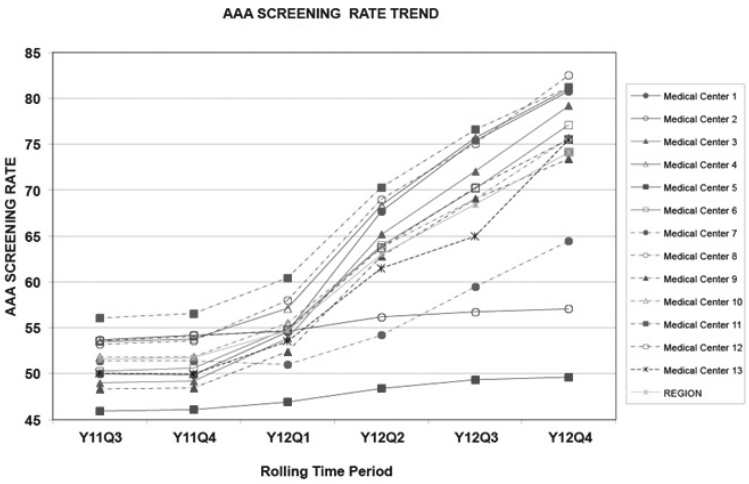
Robert J. Hye, MD, Andrea Smith, RN, Gary H. Wong, MD, MPH, Southida Vansomphone, PhD, Ronald D. Scott, MD, Michael H. Kanter, MD
Surgery, Kaiser Permanente, San Diego, CA; Kaiser Permanente, Pasadena, CA; Kaiser Permanente, West Los Angeles, CA

Discussant: Ronald Dalman, MD

OBJECTIVES: Screening for Abdominal Aortic Aneurysm (AAA) reduces aneurysm related mortality. US Preventive Services Task Force (USPTF) and American Heart Association (AHA) have recommended screening in high risk groups since 2005. Since 2007, Medicare has covered a one-time screening ultrasound for new male enrollees with a familial or smoking history. Nevertheless, in the United States, screening has remained underutilized. Review of patients with ruptured AAA in our system in 2009 showed the vast majority were undiagnosed yet met USPTF and AHA screening guidelines. To reduce the number of preventable AAA ruptures and deaths in our health plan members, we implemented an AAA screening program using our electronic medical record (EMR). This study describes the design, implementation and early results of that screening program.

METHODS: Men aged 65 -75 with any history of smoking were targeted for screening. Medical records were reviewed electronically to exclude patients with known aneurysms, repaired aneurysms and individuals with an abdominal imaging study within 10 years that would have diagnosed an AAA. Best Practice Alerts (BPA) were created in the EMR so when an appropriate patient is seen, office staff and providers are prompted to order an abdominal ultrasound. AAA was defined as aortic diameter 3 cm or greater and ultrasound reports contained a standard template providing guidance for management when an aneurysm was identified. Newly identified AAA were triaged for Vascular Surgery consultation or follow-up. The number of screening exams and AAA identified were tabulated by our Screening and Safety Net Program.

RESULTS: In a population of 3.6 Million, 64,848 patients met screening criteria and 54.7% were excluded from the BPA. In the first 8 months after starting the BPA, 12,614 abdominal ultrasound or CT scans were performed and 1335 new AAA diagnosed. Screening rates have increased at all medical centers and the percentage of unscreened patients has been reduced from 45.3% to 25.9% system wide.



CONCLUSION: In an integrated Health Care System using an EMR, AAA screening can be implemented with a dramatic increase in screening exams and yield of previously undiagnosed AAA. Further analysis is required to assess the impact of the screening program on AAA rupture rate and cost-effectiveness in our system.

24. **Fate and Follow Up of Patients With Small and Intermediate Diameter Abdominal Aortic Aneurysms In A Screening Program**

LeAnn A. Chavez, MD, Kevin C. Chun, B.S., Kai Y. Teng, B.S., Kiana M. Samadzadeh, B.S., Eugene S. Lee, MD, PhD
University of California, Davis, Sacramento, CA; Sacramento VA Medical Center, Sacramento, CA

Discussant: Dennis Bandyk, MD

OBJECTIVE: An AAA screening program implemented in 2007, remains active today. During screening, many patients with aortic diameters of 3.0-5.4 cm were identified. The purpose of our study is to investigate the fate of patients diagnosed with an aorta too small for repair.

METHODS: Data were extracted through a regional Veterans Affairs Service Network to identify all veteran males 65-75 years of age who smoked greater than 100 cigarettes during their lifetime. Patients meeting screening criteria were evaluated for an AAA as part of the patient's health maintenance. An aortic diameter of 3.0 cm to 3.9 cm was considered to be a SMALL AAA, whereas INTERMEDIATE AAA was an aortic diameter 4.0-5.4 cm. Follow up rates, rate of aortic expansion, and risk factors for expansion were evaluated. Chi squared analysis and two-tailed t-test were used to compare groups. A P-value <.05 was considered significant.

RESULTS: A total of 9,751 patients (71.5 ± 5.6 SD years of age) were screened for an AAA over a 5 year period from January 1, 2007 to December 31, 2011. A total of 698 patients were identified with an aneurysm (7.1%). Five-hundred-nineteen patients had an aortic diameter of 3.0-5.4 cm upon initial screening; 13 aneurysms were repaired and 31 had follow up imaging less than 6 months after initial screening. During study period, 47.8% (227/475) patients had a follow up image study completed more than 6 months after initial screening. The average expansion rate for SMALL AAA was 0.16 cm/year versus INTERMEDIATE AAA with 0.22 cm/year (P<.71). No significant differences were found in risk factors between groups.

Aortic Diameter Size (cm)	N (227)	Screening AAA Size (cm)	Follow Up AAA Size (cm)	Average Follow Up (yrs)	Percent follow up >6months	Expansion Rate (cm/yr)
3.0 - 3.9	157	3.4	3.7	2.1	157/362 (43.4%)	0.16
4.0 - 5.4	70	4.5	4.9	1.8	70/113 (61.9%)	0.22
P-Value	-	-	-	-	0.04	0.71

CONCLUSIONS: The long-term implementation of an AAA screening effort has led to the diagnosis of a significant number of patients with small and intermediate diameter aortas with lacking data-driven recommendations for long term follow up. Our data suggest that follow up among patients with small to intermediate sized aneurysm are substantially low. Expansion rates are variable and risk for expansion need to be further elucidated.

25. **Endoleaks Following EVAR: Long-Term Outcome and Clinical Significance**

Eddie Blay, Jr, BA, Vinit Varu, MD, Lisa Sun, MS, Wei Zhou, MD
Surgery, Stanford University, Stanford, CA; Duke University, Durham, NC; Stanford University, Stanford, CA; St. Jude Medical, Palo Alto, CA

Discussant: David Dawson, MD

OBJECTIVES: EVAR is considered the standard therapy for most patients with AAA. Endoleak is a well-known EVAR-related complication that requires long-term follow-up. However, patient follow-up is often challenging outside clinical trials. We sought to evaluate the incidence and the effect of endoleaks in a VA health care system where long-term follow-up is ensured.

METHODS: We retrospectively evaluated 213 consecutive patients who received EVARs at a referral VA medical center. Age, aneurysm size, patency of lumbar and IMA, and follow-up evaluations were recorded. Type of endoleak, date of detection and intervention were also documented. Patients who had less than 1-year follow-up were excluded. Student's t test and spearman correlation were used for data analysis.

RESULTS: A total of 180 patients were included in the analysis with a mean follow-up of 51 months. 35 were excluded due to death within 1 year of EVAR (n=14), lost to follow-up (n=5), or too early for 1 year CT (n=14). 52 (28.9%) patients had endoleaks. The mean diagnosis time for type I (n=12) and type III (n=4) endoleaks was 46 and 21 months post-EVAR and the majority (62.5%) were diagnosed > 1 year following EVAR. All type I and III endoleaks received secondary interventions except one who presented with aneurysm rupture. Type II endoleak was detected in 37 patients on an average of 14 months following EVAR and 39.4% of which were detected > 1 year post EVAR. Patients without documented endoleak had significant decrease in aneurysm size compared to the preoperative size (4.78 vs. 5.65cm, $P<0.001$), while those with type II endoleak had increase compared to the preop (5.82 vs. 5.66cm). Importantly, 51.4% of the patients with a type II endoleak had significant AAA enlargement (0.75cm). No significant correlation between the size of IMA or lumbar to AAA enlargement among the patients with a type II endoleak was seen. 9 patients with type II endoleak received secondary interventions.

CONCLUSIONS: We demonstrated that endoleak often appears long after EVAR despite the normal initial imaging and that type II endoleak is frequently associated with long-term aneurysm enlargement requiring reinterventions. This study underscores that type II endoleak is not benign as previously thought and that vigilant long-term surveillance following EVAR is critical.

26. **No Difference In Mortality After Inter-Facility Transfer For Patients With Ruptured Abdominal Aortic Aneurysm**

Matthew W. Mell, MD, MS, N. Ewen Wang, MD, Doug E. Morrison, MS, Tina Hernandez-Boussard, PhD MPH
Surgery, Stanford University, Stanford, CA

Discussant: Ellen T. Farrokhi, MD

OBJECTIVE: Patients receiving inter-facility transfer to a higher level of medical care for ruptured abdominal aortic aneurysms (rAAA) are an important minority that are not well characterized and typically omitted from outcomes and quality indicator studies. Our objective was to compare patients transferred for treatment of rAAA with those treated without transfer, with particular emphasis on quality of care.

METHODS: We linked longitudinal data from 2005-2010 HCUP State Inpatient Databases and Emergency Department Databases from California, Florida, and New York. Patients were identified using ICD-9-CM codes. Our main outcome variables were mortality, length of stay (LOS), and cost. Data included discharge information on both the transfer-out and transfer-in hospital. We used univariate and multivariate analysis to identify variables independently associated with transfer and in-hospital mortality.

RESULTS: Of 4413 rAAA patients identified with intent to treat, 819 (18.6%) were transferred prior to receiving definitive care. Of those transferred, 134 (16%) died without undergoing AAA repair. Risk-adjusted in-hospital mortality did not differ by transfer status (45.7% vs. 43.1%, p=0.2), but LOS (median 10 vs. 9 days, p=0.008), and hospital costs ($158,000 vs. $146,000, p=0.04) were higher for those transferred. By multivariate analysis, age (OR 0.98, 95% CI 0.97 - 0.99, p<0.001) private insurance vs. Medicare (OR 0.59, CI 0.46 - 0.77, p<0.001), and co-morbidity (OR 0.93, CI 0.89 - 0.97, p=0.003) were negatively associated with transfer. Weekend presentation (OR 1.28, CI 1.08 - 1.52, p=0.005) was positively associated with transfer.

CONCLUSIONS: Mortality was similar for patients transferred for rAAA repair compared with those not transferred, although 16% of transferred patients died without receiving definitive repair. Transferred patients used significantly more hospital resources. Improving systems and guidelines for inter-facility transfer may improve the quality of care received by these patients and decrease associated hospital resource utilization.

27. **Early and Late Outcomes Following Abdominal Aortic Aneurysm Repair Requiring A Suprarenal Cross-Clamp**

Sarah M. Wartman, MD, Karen Woo, MD, Andrew Yaeger, BS, S. Grace Huang, MD, Vincent Rowe, MD, Fred A. Weaver, MD
University of Southern California, Los Angeles, CA

Discussant: Christopher Owens

OBJECTIVE: To analyze the early and late outcomes of patients who require a suprarenal aortic cross-clamp during elective open repair of an abdominal aortic aneurysm (AAA).

METHODS: Patients from 1998-2011 who required a suprarenal aortic cross-clamp during elective open AAA repair were reviewed. Data abstracted included demographics, comorbidities, preoperative, perioperative, and late renal function; late interventions related to AAA repair, and late mortality. A decrease in renal function was defined as a >30% decline in eGFR as compared to the pre-operative value. Primary outcomes included renal function, intervention free survival and overall survival.

RESULTS: One hundred eighty-six patients underwent open AAA repair; 63 of whom required a suprarenal cross-clamp. Mean age was 72 with 81% being male. Mean preoperative creatinine was 1.2 mg/dl and mean preoperative eGFR was 65 ml/min/1.73m2. Location of the aortic cross-clamp was suprarenal (36), supramesenteric (18), and supraceliac (9). Perioperatively, 15(24%) patients experienced a significant decrease in eGFR and three patients required hemodialysis. Five patients had full recovery of renal function by discharge. In hospital, 30-day morbidity/ mortality were 25%/3% respectively. At a mean follow-up of three years, six patients had an eGFR significantly less than the preoperative value. Late interventions related to the AAA repair were required in eight patients. Indications included: wound complication (3), anastomotic aneurysm (2), incisional hernia (1), anastomotic graft stenosis (1), and proximal aortic dilatation (1). Overall 5-year intervention free survival was 61% and overall survival 79%. Intervention free survival was decreased by perioperative pneumonia (P=.01) and enhanced by antiplatelet (P=.05) use whereas overall survival was decreased by COPD (P=.03) and perioperative pneumonia (P=.001).

CONCLUSIONS: A quarter of patients requiring a suprarenal cross-clamp during open AAA repair experience renal dysfunction. Late graft related complications are few with preoperative and perioperative pulmonary function negatively impacting intervention-free and overall patient survival.

28. **EVAR Continues To Cost More Than Open AAA Repair**

Misty D. Humphries, MD, Bjoern D. Suckow, MD, Joshua T. Binks, Carrie McAdam-Marx, PhD, Larry W. Kraiss, MD
Vascular Surgery, University of California-Davis, Sacramento, CA, University of Utah, Salt Lake City, UT, University of Pittsburgh, Pittsburgh, PA

OBJECTIVE: Endovascular aortic aneurysm repair (EVAR) is now established as first line treatment for infra-renal aortic aneurysms in the United States. Recent data from randomized trials suggest elective EVAR is cost effective compared to open AAA repair (oAAA). Cost analysis for urgent aneurysm repair has not been reported. We evaluated the cost of EVAR and oAAA in both elective and urgent settings in our center.

METHODS: All infrarenal AAA repairs performed from 2004-2010 were retrospectively reviewed (n=172). Clinical characteristics of patients receiving EVAR and oAAA repair were compared. Direct costs, payments, and direct cost margin for the index inpatient episode were obtained from the hospital for all patients. Subsequent financial information including clinical, radiologic, and procedural cost was also available for 52 patients who had received all follow-up care in our institution for one year (EVAR = 34, oAAA = 18).

RESULTS: Overall, elective EVAR patients were older than oAAA patients but EVAR patients had significantly shorter lengths of stay, regardless of urgency (Table). Urgent AAA repair occurred more often by oAAA than EVAR ($p < 0.001$; $\chi 2$). There were no other significant clinical differences between EVAR and oAAA patients. For elective patients, EVAR costs were greater than for oAAA. There was a trend toward lower costs in EVAR vs oAAA patients being treated urgently. The hospital experienced a negative cost margin more often after elective EVAR vs oAAA. Negative cost margins were less frequent following urgent repair but still occurred twice as often in EVAR vs oAAA patients. Cost margins remained negative in all EVAR patients followed for one year in our institution.

CONCLUSIONS: At a tertiary academic institution, costs for elective EVAR are significantly higher than oAAA. EVAR may be relatively more cost effective in urgent situations. Negative cost margins were more common in EVAR patients and one year follow up with imaging in the same institution did not result in a positive margin.

Elective vs. Urgent Aneurysm Repair						
Indication		Elective			Urgent	
	EVAR	oAAA	p-value	EVAR	oAAA	p-value
n	66	37	--	21	48	--
Mean Age (yrs)	75	67	<0.001	72	72	0.94
Median LOS (days, IQR)	4 (1,4)	9 (7,17)	<0.001	6 (2, 8)	16 (9, 30)	<0.001
Median Direct Cost-Index Hospitalization ($, IQR)	21054 (19758, 24749)	15939 (12205, 29910)	0.01	27178 (22675, 38954)	48236 (17476, 73242)	0.22
Patients with Negative Cost Margin (%)	17 (26%)	2 (5%)	<0.01	3 (14)	3 (6)	0.36

29. **Percutaneous Aortic Dissection Flap Fenestration For the Treatment of Functional Severe Claudication**

Miguel F. Montero-Baker, Magdiel Trinidad-Hernandez
University Medical Center, Tucson, AZ

A 49-year-old man with past medical history of spontaneous type A Aortic dissection 3 months prior, was referred to Vascular Surgery outpatient clinic for severe lifestyle-limiting claudication on the left.

His past medical history includes ascending aortic valve sparing repair and essential hypertension. His father died at a young age from a presumed aortic syndrome.

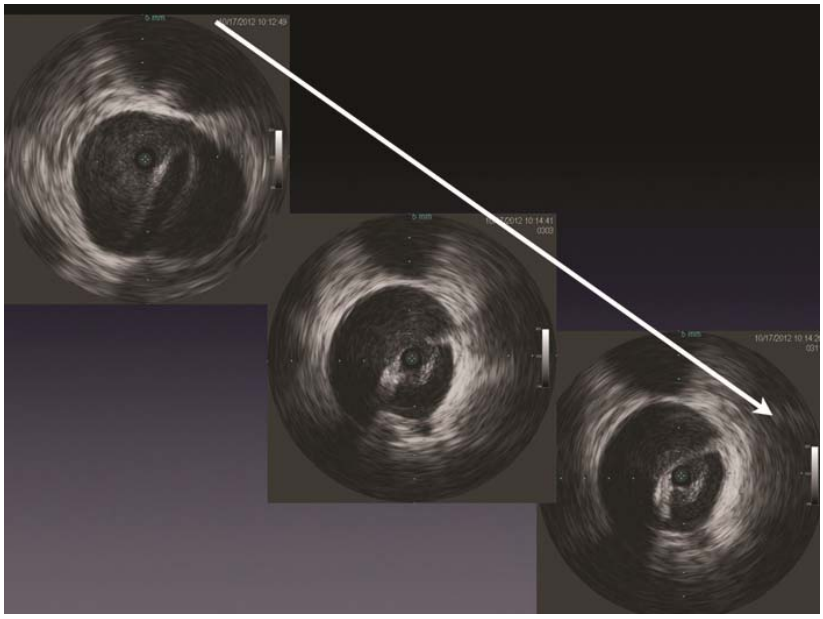
Physical examination revealed a well-healed median sternotomy and normal cardiopulmonary auscultation. There were no bruits in the abdomen. His left femoral pulse was diminished in contrast to the right. A discrete bruit was discovered above the left groin. Non-invasive vascular testing revealed a baseline ankle-brachial index of 0.92, which dropped to 0.40 within 3 minutes of excercise testing.

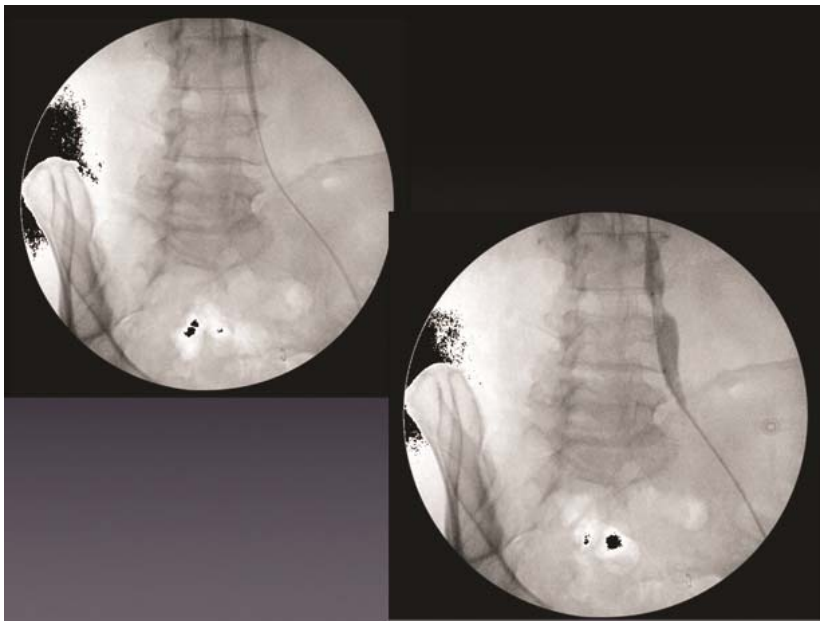
CTA revealed an intact surgical repair of the ascending aorta and a stable dissection across the entire aorta extending into the left common iliac artery. There was compression of the internal lumen of the left common iliac artery by the false lumen without a re-entry site at this level.

After discussing with patient, we agreed to attempt an endovascular fenestration with the objective to create a distal re-entry site and subsequent equilibration of pressure gradients.

Procedure: Ultrasound guided left Common Femoral access was achieved, and a 6 french sheath secured. A 0.035'' hydrophilic floppy wire was advanced into the true lumen. IVUS was used to confirm true lumen wire placement, as well as the functional collapse at the level of the common iliac artery. The wire was exchanged for a 0.014´´ support wire and the Outback ® re-entry catheter was advanced in a retrograde fashion to approximately 4cm above the iliac bifurcation. Utilizing the catheter´s radiopaque markers/guidance system, the hollow needle was projected forward managing to perforate across the aortic flap. At that time, the wire was advanced into the false lumen and the re-entry device removed. The wire was promptly exchanged to a 0.035``support wire and multiple balloon dilatations were accomplished uneventfully to a maximum of 18 mm.

The next morning, we encountered a symmetrical femoral pulse exam. Repeat non-invasive stress testing demonstrated an ABI > 0.99 which did not change with exercise testing. Remarkably, the patient referred that his usual symptoms had completely resolved.





30. **Iliac Artery Inflow For High-Risk Cerebral Revascularization**

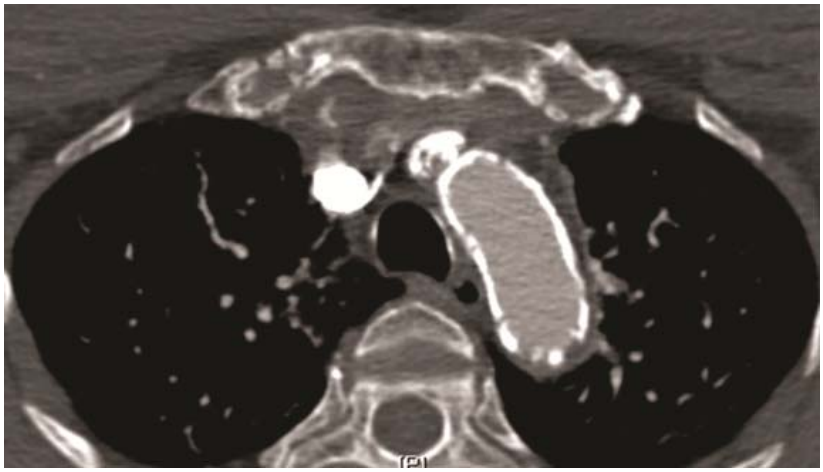
Joshua I. Greenberg, MD, Jason T. Lee, MD, Christopher K. Zarins, MD
Vascular Surgery and Endovascular Therapy, University of Colorado Denver, Anschutz Medical Campus, Aurora, CO; Stanford University Medical Center, Stanford, CA

BACKGROUND: Chest irradiation produces a number of sequelae including severe calcification of the ascending aorta and proximal supra-aortic branches. Multivessel supra-aortic branch revascularization typically requires ascending aortic inflow when extra-anatomic bypass is inadequate. This case describes a procedure tailored to the high risk patient with a hostile ascending aorta.

CASE REPORT: A 66 year-old male presented with severe vertigo and syncope, particularly when performing overhead activities. The patient also suffered from oxygen-dependent pulmonary hypertension and had been treated with high-dose chest and neck radiation for thyroid cancer 50 years prior. The patient had a history of bilateral staged replacement of severely calcified pre-occlusive common carotid arteries with Dacron interposition grafts.

CTA and duplex demonstrated severe calcific arch disease with proximal bilateral common carotid near occlusions, proximal subclavian artery stenoses, and retrograde vertebral artery flow. Endovascular attempts at traversing the calcified stenoses were unsuccessful, and an ascending aortic inflow source was not feasible due to complete calcification of the ascending aorta and aortic arch (Figure). A left common iliac artery to left subclavian artery bypass and left subclavian artery to right common carotid artery bypass was performed with 8 mm PTFE. The patient recovered well and was rapidly discharged home. His symptoms of cerebrovascular insufficiency resolved and the grafts remain patent 18 months post-operatively.

CONCLUSION: After radiation exposure, calcium salts are increasingly found in scarred intima and media. This is the first case report of iliac artery inflow for supra-aortic branch revascularization in a patient with a hostile ascending and thoracic aorta. Iliac artery inflow might also prove useful for other indications such as total aortic arch debranching for thoracic endograft placement in high risk patients.



NOTES

31. **Mid-Term Outcomes of Covered vs. Bare Metal Balloon Expandable Stents For Aortoiliac Occlusive Disease**

Misty Humphries, MD, Ehrin Armstrong, MD, John Laird, MD, Jessica Paz, William Pevec, MD
Vascular Surgery, University of California-Davis, Sacramento, CA

Discussant: TBA

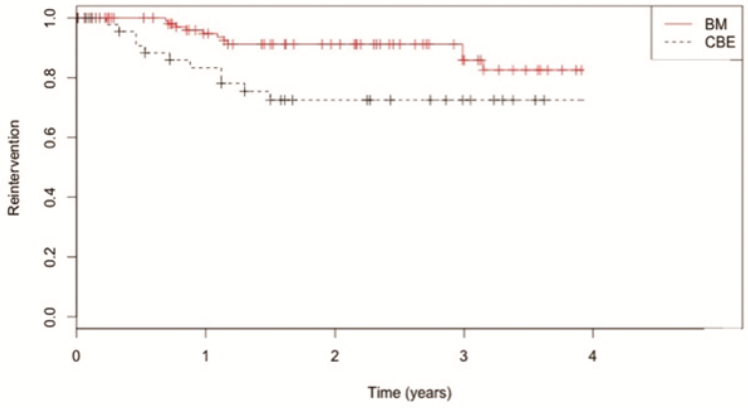
OBJECTIVE: Randomized trials and registries suggest that covered balloon expandable stents have better short-term patency than bare metal (BM) balloon expandable stents in the treatment of common iliac artery disease. This study was performed to evaluate mid-term outcomes of bare metal vs. covered balloon expandable stents for treatment of aortoiliac (AI) occlusive disease.

METHODS: All AI endovascular interventions for symptomatic peripheral arterial occlusive disease performed at a single institution from 2006-2012 were reviewed. Patients that underwent stent placement in the common iliac arterial segment were included in the analysis. Demographic data, TransAtlantic Inter-Societal Classification (TASC), stent type, patency, and all re-interventions for each limb were compared.

RESULTS: 188 procedures in 124 patients were performed for treatment of de novo distal aorta and/or common iliac artery stenosis. Bare metal balloon expandable stents were used in 135 arteries, and covered balloon expandable stents were used in 53 arteries. There was no difference in age, gender, or TASC classification between the two groups. Table 1. Median follow up was 1.7 years (interquartile range 0.6, 3.0). There was no difference in overall primary or primary assisted patency between the two groups. Table 2. Secondary patency was significantly better in the covered stent group, however, common Iliac arteries treated with covered stents were more likely at 1 year and beyond to require repeat aortoiliac intervention (hazard ratio (HR), 2.6 ; 95% CI 1.13-6.0; P=0.02). Figure 1. TASC classification did not predict need for reintervention in either group.

CONCLUSIONS: In the current study, covered stents have improved secondary patency over bare metal stents for treatment of AI occlusive disease, at the expense of increased reinterventions. The difference in secondary patency may be due to more focal, edge restenosis in covered stents vs. diffuse restenosis in bare metal stents.

Freedom from Reintervention of Bare Metal vs. Covered Balloon Expandable Stents



Bare	135	83	58	32
Covered	53	32	20	11

Demographic characteristics of treated lesions				
	Overall	Bare Metal	Covered	p-value
Age (mean± sd)	64 ± 11	64 ± 12	65 ± 11	0.5
TASC A (%)	54 (45)	39(43)	15 (52)	0.57
TASC B	56 (30)	41 (30)	15 (28)	0.99
TASC C	41 (22)	30 (22)	11 (21)	0.98
TASC D	36 (19)	24 (18)	12 (23)	0.58

Patency of treated lesions				
n= 188	Overall	Bare Metal	Covered	p-value
Primary Patency (%)	121 (75)	86 (75)	35(74)	0.99
Primary Assisted Patency	136 (84)	93 (82)	43 (91)	0.18
Secondary Patency	140 (87)	94 (82)	46 (98)	0.02

32. **The Diagnostic Triad of Orphan Heel Syndrome: Posterior Tibial and Peroneal Artery Occlusive Disease, Poorly Controlled Diabetes and Renal Failure**

Zack Taylor, Sr., MD
Vascular Surgery, University of Arizona, Tucson, AZ

Discussant: Mark Langsfeld, MD

OBJECTIVES: Large heel ulcers represent enormous challenges. Limb preservation is difficult in these patients, who often suffer from diabetes, renal failure and calcified, distal arterial occlusive disease. Traditional non-invasive studies including ankle-brachial indices and toe-pressures may not accurately predict healing. The purpose of this study was to assess the value of traditional non-invasive studies, limb salvage rate and healing time in patients with full thickness heel ulcers.

METHODS: From 2009-2011, a single interdisciplinary limb salvage unit evaluated 21 consecutive patients with deep heel ulcers requiring operative debridement. Pertinent comorbidities including diabetes and renal insufficiency were noted. Investigators blinded to the clinical course reviewed all studies. Wound healing times and limb salvage rates were calculated.

RESULTS: Among the 21 patients, 10 (48%) had CKD (7 on dialysis; 3 Stage 3/4 CKD); 18/21 (86%) were known diabetics at the time of presentation; all patients had HgbA1c > 9 and in 8/21, HgbA1c exceeded 11. Serum albumin levels were uniformly low (range 1.4-4). 66.7% had normal ABIs (Range 0.8 to 1.2). ABIs were non-compressible in 23.8% of patients. Only two patients had low ABIs (0.28 and 0.39). Healing occurred in 13/21 patients over a mean of 251 days (range 42-540); the remainder died of comorbidities before healing (1), underwent major amputation (3), or were lost to follow up (4). ABIs and TPs did not correlate with healing. Eight patients with normal forefoot perfusion by noninvasive testing had severe heal malperfusion by angiography; 53% (10) patients underwent angiography and 7 underwent revascularization, primarily endovascular.

CONCLUSION: In this patient group, the heel is frequently ischemic even in the presence of a palpable DP pulse and normal forefoot noninvasive testing. This is due to an unusual pattern of occlusive disease that disproportionately involves the posterior tibial and pedal arch vessels, (the heel circulation is compartmentalized from the forefoot) a condition termed orphan heel syndrome. It is also associated with uncontrolled diabetes and renal failure. Even with aggressive care, healing times are prolonged. Early angiography and heel revascularization is recommended in functional patients with this clinical triad.

33. **Adjunctive Dexamethasone Infusion Into the Adventitia of the Femoro-Popliteal Artery To Enhance Clinical Efficacy Following Endovascular Revascularization: A Proof of Concept First In Man Study**

Christopher D. Owens, Warren Gasper, Hugh F. Alley, Karen C. Chong, Joseph H. Rapp, Michael S. Conte, Kirk Seward, Marlene S. Grenon
University of California, San Francisco, San Francisco, CA; Mercator MedSystems, San Leandro, CA

Discussant: Gregory Landry, MD

OBJECTIVE: Restenosis following peripheral intervention is in part an inflammatory disease. We hypothesize that a non-stent based local drug delivery of the anti-inflammatory corticosteroid dexamethasone (DEX) would mitigate intervention-associated inflammation and thus improve long-term arterial patency.

METHODS: This was an investigator initiated pilot study to determine if percutaneous adventitial drug delivery was safe and feasible in human peripheral arteries. Following successful intervention, an adventitial micro-infusion catheter (MIC) was advanced over a 0.014" wire to the treated segment. Its micro-needle was deployed into the adventitia to deliver DEX (4 mg/ml) mixed with contrast agent providing fluoroscopic visualization. The safety outcome was freedom from vessel dissection, thrombosis or extravasation, while the primary efficacy outcome was duplex-determined binary restenosis defined as PSVR >2.4 of the treated segment.

RESULTS: 21 patients with Rutherford classification 2-5 enrolled in this study and followed for a median of 335 days. Mean age was 65.9 and 57.1% were diabetic. Treated lesion length was 8.7 ± 5.2 cm and 48% were chronic total occlusions. 80% of treated lesions were in the distal SFA/popliteal artery. The average pre-operative Rutherford score was 3.77±.8. All lesions were treated by balloon angioplasty with provisional stenting for suboptimal result. 11.5 ± 5.7 mg of dexamethasone was injected into the adventitia of the treated lesions. There was 100% technical success of drug delivery and no procedural or drug-related adverse events. Rutherford score at last available follow-up was .46 ±.74, P<.001 and ABI improved from .68 ± .15 to .95 ±.18, P<.001. Post-procedural C -reactive protein (CRP) was not significantly different from baseline CRP, P=.13. Two patients developed binary restenosis of the index lesion during the follow-up period.

CONCLUSIONS: Adventitial drug delivery via the MIC is a safe and feasible alternative to intimal-based methods. These preliminary data suggest that perivascular DEX treatment may improve outcomes following angioplasty to the distal femoro-popliteal segment. Further study is warranted to establish efficacy for anti-inflammatory treatment following angioplasty.

34. **Demographic and Echocardiographic Predictors of Anatomic Site and Outcomes of Interventions For Cardiogenic Peripheral Emboli**

Gregory Landry, MD, Rakendu Shukla, Timothy Liem, MD, Erica Mitchell, MD, Amir Azarbal, MD, Greg Moneta, MD
Oregon Health & Science University, Portland, OR

Discussant: Roy Fujitani, MD

OBJECTIVE: The association between demographic and echocardiographic findings with the site of cardiogenic peripheral embolization is not known. We sought to determine if cardiogenic emboli have a random distribution or if there are factors that predict site of embolization, limb salvage and mortality.

METHODS: Upper (UE) and lower extremity (LE) emboli were evaluated over a 6 year period. Demographic (age, gender, smoking, medical comorbidities) and echocardiographic data were analyzed to determine predictors of embolic site. All patients underwent surgical revascularization. Limb salvage and mortality were compared with Kaplan-Meier analysis.

RESULTS: 160 patients (72 male, 88 female) with presumed cardiogenic emboli were identified, 56 UE (35 right, 21 left) and 104 LE (42 right, 44 left, 18 bilateral). Men had significantly higher LE emboli than females (76% vs. 56%) and females more UE (44% vs. 24%, p=0.01). No other demographic factors were statistically different. UE patients were more likely to have atrial fibrillation on admission (50% vs. 30%, p=0.04), while there was a trend towards LE patients having a higher percentage of aortic or mitral valvular disease (47% vs. 31%, p=0.06). 30 day limb salvage was higher for UE compared to LE (100% vs. 88%, p=0.008) There was a trend toward higher 30 day mortality in the LE group (14% vs. 5%, p=0.08). One year mortality in both groups was approximately 25%.

CONCLUSION: UE emboli are more frequent in women and patients with active atrial fibrillation. LE emboli are more frequent in men and patients with valvular disease, and are associated with increased 30 day limb loss and mortality. These findings suggest gender- and cardiac-specific differences in patterns of blood flow leading to preferential sites of peripheral embolization.

35. **Beyond Arterial Stenosis: Walking Disability In PAD Patients Is Related To Arterial Endothelial Function**

Christopher D. Owens, Hugh F. Alley, Karen C. Chong, Jade S. Hiramoto, Michael S. Conte, Joseph H. Rapp, Marlene S. Grenon
University of California, San Francisco, San Francisco, CA

Discussant: Larry Kraiss, MD

OBJECTIVE: Patients with peripheral artery disease (PAD) have varying degrees of walking disability that do not completely correlate with ankle brachial index (ABI) or angiographic anatomy. We hypothesized that endothelial function (EF) is an independent predictor of symptom severity in PAD patients.

METHODS: This was a prospective cohort study of PAD patients (N=100) presenting to a vascular surgery clinic. All patients received ABIs and brachial artery flow-mediated, endothelium-dependent, vasodilation (FMD) to assess arterial EF. PAD severity was assessed by the clinical Rutherford score. Demographic, biochemical and physiologic parameters were entered into regression equations to determine association with disease severity.

RESULTS: Mean age was 66.3 ±8.2 and 43% had diabetes. Mean FMD was 7.3% indicating impaired EF. EF progressively declined as Rutherford score increased, P<.0001. Diabetes mellitus, albumin, CRP, homocysteine, total cholesterol, and hgbA1c, were all associated with Rutherford score, all P<.05. After multivariable regression, EF P <.0001, ABI P<.0001, and total cholesterol P=.033 were predictive of walking disability. Combined, EF, ABI, and total cholesterol account for 50% of the variability in Rutherford scores. However EF and ABI were not correlated indicating that they are independent predictors of disability. When the cohort was restricted to claudicants N=81, EF was equally predictive of walking disability. Homocysteine was inversely associated with EF, P=.024. Patients with hyperhomocysteinemia (>15 μmol/l), N=41, had lower EF P=.04 and higher Rutherford scores P=.017 than those without.

CONCLUSION: Symptom severity in PAD is multifactorial, reflecting both impaired hemodynamics and vascular dysfunction. This is the first demonstration that walking disability in PAD is associated with arterial EF. Endothelial dysfunction in this cohort may be related to homocysteine-dependent mechanisms by reducing bioavailable nitric oxide.

36. **Prospective Evaluation of Tissue Perfusion In Patients With Peripheral Arterial Disease Using Laser-Assisted Fluorescent Angiography**

Venita Chandra, MD, Mohamed Zayed, MD, PhD, Elizabeth Hitchner, MS, Vinit N. Varu, MD, Oliver Aalami, MD, Wei Zhou, MD
Vascular Surgery, Stanford University Medical Center, Stanford, CA

OBJECTIVE: Laser-assisted fluorescent angiography (LAFA) has been used by many specialties to evaluate end organ tissue perfusion. We hypothesize that LAFA can be a valuable tool to qualitatively and quantitatively assess distal perfusion in patients with peripheral arterial disease (PAD). Using this technology we prospectively evaluated PAD patients pre- and post-vascular interventions.

METHODS: Patients undergoing interventions for PAD were prospectively recruited into this IRB approved pilot study. Plantar pedal perfusion was analyzed pre- and post-vascular intervention using the SPY Elite® LAFA system (Lifecell Corporation©). Topographical and fluorescent images were obtained for each patient pre- and post-vascular intervention (Figure). Peak pedal perfusion and ingress slope (rate of inflow) were derived from the recorded images. Ankle brachial indices (ABIs) were also evaluated pre- and post-intervention. Statistical analysis was performed using Student's T-test and Pearson correlation.

RESULTS: Twenty-seven patients with PAD comprised the study population, with an average age of 68. The majority of patients had Rutherford class 5 critical limb ischemia (55%) and one vessel tibial runoff (61%). The majority of patients underwent endovascular femoral and popliteal interventions (88%). Post-intervention significant increases were seen in pedal fluorescent ingress slopes (P=0.03) and a similar increase in ABIs (P=0.001). Peak pedal perfusions increased in 66% of patients by an average of 45.8%. Both peak pedal perfusion and ingress slope correlated with post-intervention ABI (R2=.56 and R2=.58, respectively). Peak pedal perfusion and ingress slope also demonstrated a moderate correlation (R2=.75).

CONCLUSIONS: This prospective pilot study demonstrates feasibility and utility of LAFA in the peri-operative evaluation of PAD patients. Qualitative and quantitative fluorescent images provide real-time and objective assessments of pedal tissue perfusion. LAFA-derived peak pedal perfusion and ingress slope provide objective measurements of tissue perfusion that correlate with conventional methods using ABIs. With further study, we anticipate that this technology may be a helpful adjunct for intra-operative decision making and predicting wound healing capacity.

37. **Superficialization of the Brachial Artery: An Appraisal of Its Value For Vascular Access**

Takashi Nakamura, MD, Kotaro Suemitsu, MD, Junichi Nakamura, MD
Division of Vascular Surgery, Osaka Rosai Hospital, Sakai, Osaka, Japan; Division of Nephrology, Kinki Central Hospital, Itami, Hyogo, Japan; Temma Nakamura Clinic, Osaka, Japan

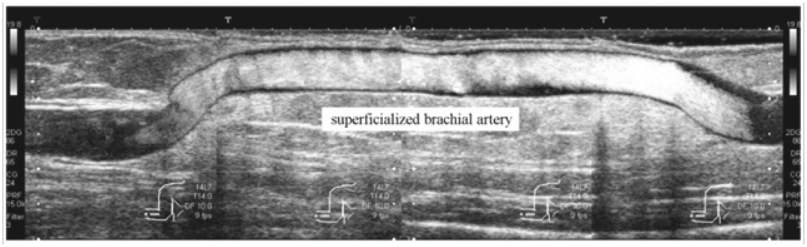
Discussant: Nicolas Nelken, MD

OBJECTIVE: The Japanese Society for Dialysis Therapy recommends superficialization of the brachial artery (BA) as an alternative vascular access (VA) technique in patients for whom a conventional internal shunt (AVF or AVG) cannot be created. Although 2-3% of Japanese hemodialysis patients undergo this procedure, it is not well recognized worldwide. We report here our experience with the procedure, as well as indications, durability, and morbidity.

METHOD: The technique involves exposure of the BA and ligation of the side branches, then fixing it beneath the skin at the upper arm. Cannulation of the BA is performed 2 weeks or more after surgery and it is used as an outflow route, with any vein in an upper extremity utilized for blood return, including the hand if sites in the arm are not accessible. We retrospectively reviewed our cases of superficialization of the BA for VA.

RESULTS: From 2005-2008, a total of 24 patients [11 females (46%), average age 69 years (range 39-84 years)] underwent superficialization of the BA, of whom 8 (33%) had diabetes. The indications were (1) impaired cardiac function (n=13), (2) no other prospect for AVF or patient refused prosthetic graft implantation (n=5), (3) severe upper extremity arterial disease or ischemic steal syndrome requiring AVF closure (n=3), (4) venous hypertension with central vein occlusion (n=2), and (5) repeated AVF thrombosis due to heparin-induced thrombocytopenia (n=1). The mean follow-up period was 28 months. Serious complications were seen in 1 patient with an infected pseudoaneurysm formation associated with a BA puncture, which necessitated BA ligation, while we also had difficulty finding a vein for blood return in 5 patients. The rate of superficialized BA patency as a functioning VA was 95% and 66% at 1 and 3 years, respectively.

CONCLUSIONS: Superficialization of the BA was found to be a simple and safe technique, with acceptable durability and complication rate in selected Japanese hemodialysis patients. We consider that this shuntless VA permits adequate blood flow and has theoretical advantages for some patients, particularly those with impaired cardiac function, though the availability of a return vein is a prerequisite for a functioning VA.


superficialized brachial artery

38. **Long-Term Outcomes With Arteriovenous Fistulas In A Pediatric Population**

Sarah M. Wartman, MD, Karen Woo, MD, David Rosen, MD, Wayne S. Gradman, MD, Vincent Rowe, MD
University of Southern California, Los Angeles, CA; Children's Hospital Los Angeles, Los Angeles, CA; Cedars-Sinai Medical Center, Los Angeles, CA

Discussant: Robert Hye, MD

OBJECTIVE: Kidney Disease Outcome Quality Initiative guidelines recommend permanent access in dialysis patients aged 0-19 who are greater than 20kg and unlikely to be transplanted within one year. Unfortunately, greater than 80% of these patients currently dialyze through a permanent catheter and are exposed to the associated risks and shortcomings. With a clear imperative to increase the incident use of permanent access in pediatric patients, our objective is to examine the long-term outcomes of pediatric arteriovenous fistulas (AVF).

METHODS: An updated retrospective review was performed of all arteriovenous fistulas created in a hemodialysis population aged 0-19 at a single institution from 1999 to 2012. Data abstracted included age, weight, etiology of renal failure, time on dialysis, central venous catheter history, and transplantation history. Data was analyzed to determine the influence of these variables on primary and secondary patency.

RESULTS: A total of 101 AVF in 93 patients were performed during the study period. Mean age was 14 years (range 3-19yr), 65 patients (70%) were male, and mean weight was 51kg (range 12-131kg). Sixty-six patients (82%) were already on hemodialysis at the time of fistula creation, with a mean length of dialysis dependence of 18 months. At the time of surgery, 78% of patients had a previous central venous catheter, and 24% had 2 or more catheters. 43 radiocephalic fistulas, 29 brachiocephalic fistulas, 20 basilic vein transpositions, and 9 femoral vein transpositions were performed. Mean follow up was 2.5 years. Two-year and 4-year primary and secondary patency rates were 83% and 92%, and 65% and 83%, respectively. Increasing age was correlated with improved primary patency (P=.02), but had no impact on secondary patency. Weight, etiology, catheter location and catheter history were not significantly associated with primary or secondary patency. Sixty-eight patients (75%) received a renal transplant in the post-operative period, with a mean time to transplant of 556 days.

CONCLUSIONS: Arteriovenous fistula creation is indicated in the pediatric hemodialysis population and provides favorable long-term patency rates. Although time to transplant is shorter for pediatric patients, focused efforts should be made to mirror the Fistula First success in the adult population.

39. **Thoracic Outlet Syndrome In High Performance Athletes**

Venita Chandra, MD Benjamin Colvard, MD, Christine Little, Cornelius Olcott, IV, MD, Jason T. Lee, MD
Vascular Surgery, Stanford University Medical Center, Stanford, CA

Discussant: Hugh Gelabert, MD

OBJECTIVE: Repetitive upper extremity use in high performance athletes is associated with the development of neurogenic and vascular TOS. Surgical therapy in appropriately selected patients can provide relief of symptoms and protection from future disability. We sought to determine whether athletes treated for TOS can return to their prior high performance level.

METHODS: We reviewed competitive athletes treated for venous or neurogenic TOS from 2000-2012. Patient demographics, workup, and treatment approaches were analyzed. nTOS patients were assessed with quality of life surveys using the previously validated mini-QuickDASH (QD) scale (0-100, 100=worse). Return to full athletic activity was defined as returning to prior competitive high school, collegiate, or professional sports.

RESULTS: 38 competitive athletes (mean age 21, 45% female) were treated during the study period; 12 baseball players, 11 swimmers, 5 water polo players, 4 rowers, 2 volleyball players, 2 synchronized swimmers, one wrestler and one diver. 25 (65%) of the athletes presented with nTOS and 13 (34%) had Paget Schroetter Syndrome (PSS). All PSS patients underwent standard treatment of thrombolysis followed by first rib resection. Most nTOS patients were treated according to a highly-selective algorithm beginning with TOS-specific physical therapy. Based on symptom improvement after PT, 64% of the nTOS athletes ultimately underwent first rib resection and brachial plexus neurolysis. Return to full competitive athletics was achieved in 79% of all patients, including 100% of the PSS patients and 72% of the nTOS athletes. In the nTOS cohort successfully returning to sports, six (33%) were treated only with PT. If the athlete underwent surgery for nTOS, 75% returned to full competitive levels. Mean QD scores improved from pre-op 36 to post-op 12, indicating minimal disability. Recurrence of symptoms was noted in two nTOS (8%) and two PSS (15%) athletes.

CONCLUSIONS: Standardized treatment algorithms and aggressive TOS-specific physical therapy are key components to minimizing disability in this special cohort of TOS patients. The majority of athletes treated for neurogenic and venous TOS can successfully return to competitive sports at their prior high performance level.

40. **Axillo-Subclavian Vein Thrombosis or Paget Schroetter Syndrome: Outcomes of Alternative Surgical Approaches**

Janice N. Thai, MD, Magdiel Trinidad-Hernandez, MD, Joseph L. Mills, MD
Vascular Surgery, University of Arizona Health Sciences Center, Tucson, AZ

Discussant: Hugh Gelabert, MD

OBJECTIVES: Axillo-subclavian vein thrombosis is an uncommon presentation of thoracic outlet syndrome. Treatment varies widely and includes first rib resection (FRR) alone, lysis and FRR + open surgical venous reconstruction, and FRR followed by endovascular therapy (EVT) for residual stenosis. This study reviewed our experience with alternative management algorithms.

METHODS: We retrospectively reviewed all venous TOS (vTOS) patients undergoing operation from 08/1995 - 11/2012. Charts were reviewed and patients divided into two groups. Group I patients underwent thrombolysis followed by FRR + open venous reconstruction. Group II patients underwent thrombolysis and FRR, +/- subsequent EVT. Patients were distributed evenly between acute (< 2 weeks) and chronic (> 2 weeks) presentations.

RESULTS: Twenty-two vTOS patients initially underwent thrombolysis. Mean age was 28.7 years (range 18-55); 13 (59%) were men. Group I (12/22=55%) patients were treated with open venous reconstruction: 10 patch angioplasty, 1 IJ turndown, and 1 femoral vein interposition graft. All had FRR, except one, who had medial claviculectomy. Group II (10/22=45%) consisted of 9 patients who underwent FRR. One required PTA for residual stenosis post FRR; 7 had subsequent venography showing no residual compression. One patient had no FRR as the post-lysis venogram failed to showed compression. Symptoms were relieved in 21/22 (95.5%) patients. Mean follow-up was 336 days (range 0-1153). Perioperative complications occurred in 9 (75%) Group I patients, including recurrent thrombosis requiring EVT in 2, chest wall hematoma or hemothorax requiring drainage in 6 and vein harvest site hematoma in 1. These complications contributed to a 33% readmission rate. Among Group II patients, complications included recurrent thrombosis in 1 patient who was lost to follow-up and readmission for hemothorax requiring drainage in another.

CONCLUSIONS: FRR alone with EVT for residual compression and a more aggressive approach with FRR + venous reconstruction afforded equal symptomatic relief. Direct open venous reconstruction was associated with longer hospital stay, higher readmission rate, and higher perioperative complication rate than TOS decompression alone.

Subject	Acute or Chronic	Type of Rib resection and Reconstruction	Post-op Complication	LOS post FRR
1	Acute	FRR, infraclavicular	Thrombosed axillary-subclavian vein	4
2	Acute	FRR, infraclavicular, partial sternotomy, patch venoplasty	Hemothorax post op	4
3	Acute	FRR, infraclavicular, partial sternotomy patch venoplasty	**Readmission** for L apical extrapleural hematoma, chest tube insertion	2
4	Acute	FRR, transaxillary	**Readmission** for R hemothorax, pigtail catheter	3
5	Acute	FRR, infraclavicular, repair of prox subclavian vein using patch venoplasty	**Readmission** after first thrombolysis/thrombectomy for recurrent DVT	8
6	Acute	FRR, infraclavicular, repair of subclavian vein using patch venoplasty	Subdermal hematoma, bedside drainage	2
7	Acute	FRR, infraclavicular, repair of prox subclavian vein using patch venoplasty	Intra and extrapleural hematoma post op	8
8	Acute	Medial claviculectomy, subclavian vein resection, IJ turn down w anastomosis	none	7
9	Acute	FRR, transaxillary	none	1
10	Acute	FRR infraclavicular, repair of prox subclavian vein using patch venoplasty	none	6
11	Acute	FRR, infraclavicular, repair of prox subclavian vein using patch venoplasty	none	2
12	Chronic	FRR, infraclavicular, intraop venogram	none	1
13	Chronic	FRR infraclavicular	none	1
14	Chronic	FRR, infraclavicular, repair of subclavian vein using patch venoplasty	**Readmission**: Chest wall hematoma, and thrombosed subclavian vein, GSV harvest site hematoma	3
15	Chronic	FRR supraclavicular and infraclavicular	none	3
16	Chronic	FRR, transaxillary	none	2
17	Chronic	FRR transaxillary 3/31/08, venogram and balloon angioplasty subclavian vein 5/30/08	none	1
18	Chronic	FRR transaxillary 8/4/08, venogram 8/25/08	none	1
19	Chronic	NO RIB RESECTION performed due to negative venogram	None	
20	Chronic	FRR, infraclavicular, repair of prox subclavian vein using patch venoplasty	none	3
21	Chronic	FRR, infraclavicular, repair of prox subclavian vein using patch venoplasty	none	1
22	Chronic	FRR infraclavicular, axillary subclavian replacement with interposition femoral vein graft	**Readmission** for thrombosed interposition vein graft	4

41. **Intravenous Ultrasound (IVUS) Identifies Stenosis In Venographically Normal Appearing Veins At the Thoracic Outlet**

Sharon C. Kiang, MD, Hugh A. Gelabert, MD, Brian G. DeRubertis, MD, David A. Rigberg, MD, Steven M. Farley, MD, Jessica B. O'Connell, MD, Juan C. Jimenez, MD, Peter F. Lawrence, MD
Vascular Surgery, UCLA, Los Angeles, CA

OBJECTIVE: The evaluation of subclavian vein compression at the thoracic outlet has relied on venography. The use of IVUS to assess the subclavian vein in a three-dimensional capacity may provide a more sensitive method to identify stenosis.

METHODS: The subclavian veins of patients undergoing evaluation for venous thoracic outlet syndrome (vTOS) were evaluated by venography and IVUS in both the symptomatic and asymptomatic limbs. IVUS evaluation included measurement of area (mm2) at the lateral margin of the first rib (S1) and at the site of maximal compression (S2). Additional IVUS measurements included dimensions (mm): anterior-posterior (AP) and cranial-caudal (CC) at S1 and S2. Venography evaluation included determination of CC ratio between S1 and S2. Percent stenosis of areas determined by IVUS were calculated. The ratio of change in the AP and CC dimension between S1 and S2 were evaluated and compared to the change of CC ratio by venography.

RESULTS: Twenty-seven limbs from 14 patients were evaluated by venography and IVUS for vTOS. Nine limbs from 7 patients were found to have venographically normal appearing veins. IVUS detected an average area stenosis of 59%±14 (range 34.2%-73.9%) in venographically normal appearing veins. The ratio of change in AP dimension by IVUS between S1 and S2 is 2.34, while the CC dimension is 1.44. This compares to a change in CC ratio seen on venography of 1.09.

CONCLUSION: IVUS is highly sensitive in identifying changes in venous dimension and detects the presence of significant stenosis in vengraphically normal appearing veins at the thoracic outlet. The greatest change in venous diameter measured by IVUS occurs in the AP plane and is not seen on venography. This more accurate means of assessing venous compression may be clinically significant.