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1. Risk of renal failure and death when renal arteries are involved in endovascular aortic aneurysm repair

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Abstract:

Objective/Introduction:
Endovascular abdominal aortic repair may involve incorporation of renal arteries. Revascularization after intentional or unintentional renal artery coverage is not always technically successful and loss of a single renal artery may result in the need for postoperative dialysis. To compare outcomes after endovascular aneurysm repair (EVAR) stratified by renal artery involvement (RAI).

Methods:
Patients in the Vascular Quality Initiative (VQI) registry were analyzed (2009-2018). Exclusion criteria were preoperative dialysis, missing RAI variable, and repair above the superior mesenteric artery. Repair type cohorts were defined as: 1) no RAI (NRAI), 2) RAI with revascularization (RAI-R), 3) RAI and no revascularization (RAI-NR). A sensitivity analysis was performed by excluding ruptured presentation. The primary outcome was postoperative dialysis. Secondary outcomes were 30-day mortality, dialysis at follow-up, postoperative renal function, and 2-year survival. Multivariate analysis was used to determine independent predictors of postoperative dialysis. Two-year survival analysis was performed using Kaplan-Meier log-rank test.

Results:
Of 54,020 patients in the EVAR and TEVAR/complex EVAR modules in the VQI, 25,724 met criteria for inclusion (24,879 NRAI, 733 RAI-R, 112 RAI-NR). Demographics and comorbidities were similar between groups. RAI-NR were more frequently ruptured or symptomatic. Postoperative dialysis was higher in RAI-NR (0.7% NRAI vs. 2.2% RAI-R vs. 17% RAI-NR, p<.0001) as were 30-day mortality and dialysis at follow-up. On multivariate analysis, RAI-R (OR 2.2, p=.03) and RAI-NR (OR 5.9, p<.0001) were independent predictors of postoperative dialysis and remained so after excluding ruptures: RAI-R (OR 3, p=.003) and RAI-NR (OR 22.3, p<.0001). Other independent predictors of postoperative dialysis were worse preoperative renal function symptomatic presentation, any preoperative/intraoperative blood transfusion, and larger blood loss (≥200 mL). Excluding ruptures, overall survival at 2-years on Kaplan-Meier was lower in RAI-NR (92% NRAI vs. 89% RAI-R vs. 80% RAI-NR, p=.004).

Conclusions:
RAI is highly predictive of the need for postoperative and permanent dialysis following EVAR. RAI without revascularization is associated with lower overall survival. These risks should be taken into consideration with planning and performing EVAR and should be weighed against the risks of open repair when considering treatment options.

2. Branch vessel patency after thoracic endovascular aortic repair for type B aortic dissection

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Abstract:

Objective/Introduction:
Thoracic endovascular aortic repair (TEVAR) for type B aortic dissections is used to promote false lumen (FL) thrombosis and favorable aortic remodeling, but its impact on occlusion of FL origin branch vessels has not been widely described. We compare FL versus true lumen (TL) branch vessel patency after TEVAR.

Methods:
Patients treated by TEVAR for type B aortic dissection in zones 2-5 in the Vascular Quality Initiative from 2009 to 2018 were evaluated. The primary outcome was postoperative branch patency. Secondary outcomes were need for branch vessel intervention, preoperative origin, and postoperative patency of individual branch vessels (celiac, superior mesenteric artery, renal arteries, and iliac arteries). A subset analysis was performed comparing acute and chronic dissections.

Results:
Of 11,774 patients, 1,484 met criteria for analysis. The left renal was the most common to have FL origin (21.6%), whereas right and left common iliac arteries were the most likely to originate off both lumens (BLs; 22% and 24%). Branch vessels that originated from the TL, FL, BLs, or were obstructed had postoperative patency rates of 99%, 99%, 99%, and 87% ($P < 0.0001$). Branch vessel treatment was performed in 5% of patients. The right (2.5%) and left (2.8%) renal arteries were the most frequently obstructed branches postoperatively. On multivariate analysis, preoperatively obstructed branches (odds ratio 0.03, $P < 0.0001$) were negatively associated with postoperative branch patency and branch vessel treatment (odds ratio 3.8, $P = 0.004$) was positively associated with postoperative patency. FL or BL origin, number of zones covered by TEVAR, urgency, dissection chronicity (acute versus chronic), and demographics

were not independently associated with patency. These findings remained unchanged in the subset analysis of only acute dissections.

Conclusions:
Branch vessel patency rates after TEVAR for a type B aortic dissection are high and are not significantly different for FL or BL origin vessels compared with TL vessels. Branches that are patent before TEVAR almost always remain patent after TEVAR, but branch vessel stenting may be required in less than 5%.

3. Association of upper extremity and neck access with stroke in endovascular aortic repair

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Abstract:

Objective/Introduction:
Upper extremity and neck access is commonly used for complex endovascular aortic repairs. We sought to compare perioperative stroke and other complications of (1) arm/neck (AN) and femoral or iliac access versus femoral/iliac (FI) access alone, (2) right- versus left-sided AN, and (3) specific arm versus neck access sites.

Methods:
Patients entered in the thoracic endovascular aortic repair/complex endovascular aortic repair registry in the Vascular Quality Initiative from 2009 to 2018 were analyzed. Patients with a missing access variable and aortic arch proximal landing zone were excluded. The primary outcome was perioperative in-hospital stroke. Secondary outcomes were other postoperative complications and 1-year survival. Kaplan-Meier curves and log-rank test were used for survival analysis.

Results:
Of 11,621 patients with 11,774 recorded operations, 6691 operations in 6602 patients met criteria for analysis (1418 AN, 5273 FI). AN patients had a higher rate of smoking history (83.6% vs 76.1%; P < .0001), and prior stroke (12.6% vs 10.1%; P = .01). Operative time (280 ± 124 minutes vs 157 ± 102 minutes; P < .0001), contrast load (141 ± 82 mL vs 103 ± 67 mL; P < .0001), and estimated blood loss (300 mL vs 100 mL; P < .0001) were larger in the AN group, indicative of greater complexity cases. Overall, AN had a higher rate of stroke (3.1% vs 1.8%; P = .003) compared with FI and on multivariable analysis AN access was found to be an independent risk

factor for stroke (odds ratio, 1.97; P = .0003). There was no difference in stroke when comparing right- and left-sided AN access (2.8% vs 3.2%; P = .71). Stroke rates were similar between arm, axillary, and multiple access sites, but were significantly higher in patients with carotid access (2.6% vs 3.5% vs 13% vs 3.7%; P = .04). AN also had higher rates of puncture site hematoma, access site occlusion, arm ischemia, and in-hospital mortality (7.1% vs 4.2%; P < .0001). At 1 year, AN had a lower survival rate (85.1% vs 88.1%; P = .03).

Conclusions:
Upper extremity and neck access for complex aortic repairs has a higher risk of stroke compared with femoral and iliac access alone. Right-sided access does not have a higher stroke rate than left-sided access. Carotid access has a higher stroke rate than axillary, arm, and multiple arm/neck access sites.

4. Impact of infrainguinal bypass tunneling technique on patency and amputation in patients with limb ischemia

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Disclosures: None

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Abstract:

Objective:
To investigate the association of tunneling technique on patency and amputation in patients undergoing lower extremity bypass for limb ischemia.

Method:
The National Vascular Quality Initiative database infrainguinal bypass module from 2008-2017 was queried for analysis. We excluded non-greater saphenous vein grafts, grafts using multiple segments, indication of aneurysmal disease, bypass locations outside of femoral to below knee popliteal artery or tibial arteries, and those missing data on the tunneling type and limb ischemia. The main exposure variable was type of tunneling subcutaneously versus subfascially. Our primary outcomes were primary patency and amputation. Secondary outcomes included primary-assisted patency and secondary patency. Univariate and multivariate logistic regression models were employed.

Results:
A total of 5497 bypasses (2835 subcutaneous and 2662 subfascial) were included. Age, race, graft orientation (reversed/non-reversed), bypass donor and recipient vessels, harvest type, end stage renal disease, smoking, coronary artery bypass graft, congestive heart failure, P2y12 inhibitor at discharge, surgical site infection at discharge and indication (rest pain/tissue loss/acute ischemia) were associated with tunneling technique ($P<0.05$). Multivariate analyses demonstrated tunneling type was not associated with primary patency, primary-assisted patency, secondary patency or major amputation ($P>0.05$).

Conclusions:
Compared to subfascial tunneling, superficial tunneling technique is not associated with primary patency or major amputation in limb ischemia patients undergoing infrainguinal bypass with single segment greater saphenous vein.

5. The Distribution of Open and Endovascular Abdominal Aortic Surgeries in the Vascular Quality Initiative by Hospitals and Surgeons

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Introduction:
The endovascular era of Vascular Surgery has dramatically decreased the number of open aortic surgeries across the United States. While volume guidelines and centralization of open aortic surgeries has sought to improve patient care, limited data exists regarding the contemporary nationwide distribution of open aortic cases. We evaluated the distribution of both open and endovascular aortic cases in the Vascular Quality Initiative (VQI) at both the hospital and surgeon level.

Methods:
We queried the VQI registry from 2014-2019 for all adult patients undergoing endovascular repairs of infrarenal abdominal aortic aneurysms (AAAs) or open aortic surgeries for AAAs or aorto-iliac/femoral occlusive disease. We calculated (1) the median hospital and surgeon volume of all endovascular and open aortic cases, (2) the minimum number of hospitals and surgeons to represent one-fifth (20%) and one-half (50%) of all open aortic cases in the registry, and (3) any change in the proportion of hospitals and surgeons that did not report any open aortic cases from 2014-2016 relative to 2017-2019.

Results:
We identified 51,691 patients, where 39,271 (76%) underwent EVARs and the remaining 12,420 (24%) underwent open aortic surgeries, all performed by 1802 surgeons at 329 hospitals. The median hospital volume of all aortic cases was 22 cases/year (IQR 11-41) and surgeon volume was 5 cases/year (IQR 2-9). Ten hospitals (3.0%) with the highest open aortic volumes performed one-fifth (21%) of all open aortic surgeries, while 39 hospitals (16%) performed half (51%) of all open aortic surgeries. Thirty-eight surgeons (2.1%) with the highest open aortic volumes performed one-fifth (20%) of all open aortic surgeries, while 171 surgeons (9.5%) performed half (50%) of all open aortic surgeries. The proportion of hospitals not performing any open aortic cases grew from 16% in 2014-2016 to 27% in 2017-2019. Similarly, the

proportion of surgeons not performing any open aortic cases grew from 28% to 38% during those time periods. Throughout the study period, these hospitals and surgeons that only performed EVARs and no open aortic surgeries performed approximately one-tenth (9.1%) and one-sixth (16%) of all EVARs.

Discussion:

A very small proportion of hospitals and surgeons currently perform a disproportionally large number of open aortic surgeries. Additionally, the proportion of hospitals and surgeons not performing any open aortic surgeries is growing. These findings suggest that while open aortic surgery may be decreasing in number, they are becoming more centralized to fewer hospitals and surgeons in the Vascular Quality Initiative, having implications for patient care and the training of vascular surgery residents and fellows.

6. Low-Volume Surgeons Performing Open Abdominal Aortic Surgery Have Similar Outcomes Independent of Hospital Volume

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Introduction:
As the number of open abdominal aortic surgeries has decreased in the past few decades, the volume-outcomes relationship for these operations has become more pronounced, both at the surgeon and hospital level. The aim of this study was to evaluate whether lower volume surgeons have better outcomes when operating at higher volume hospitals for open aortic surgeries.

Methods:
We queried all patients undergoing open repairs of abdominal aortic aneurysms or aorto-iliac/femoral occlusive disease in the 2012 to 2019 Vascular Quality Initiative registry. Using the Leapfrog Volume Expert Panel guideline, we included patients by low-volume surgeons (<7 cases/year) and dichotomized hospitals into low-volume (<10 cases/year) and high-volume (≥10 cases/year). Outcomes included 30-day perioperative mortality, complications, and failure-to-rescue (death after a major postoperative complication). We used multivariable logistic regressions to evaluate the outcomes among elective or urgent repairs after adjusting for patient demographics and operative factors.

Results:
We identified 11,469 patients who underwent open aortic surgeries (52% abdominal aortic aneurysms, 48% aorto-iliac/femoral occlusive disease) by 1218 low-volume surgeons across 249 hospitals. One-third (33%) of all cases were performed at low-volume hospitals and the remaining two-third (67%) occurred at high-volume hospitals. Overall outcomes were 3.8% for 30-day perioperative death, 35% for complications, and 9.9% for failure-to-rescue. After adjustment, there was no significant difference in outcomes between low-volume surgeons operating at low-volume hospitals versus low-volume surgeons operating at high-volume

hospitals: death (aOR 1.17 [95%-CI 0.91-1.51]), complications (aOR 1.01 [0.88-1.15]), failure-to-rescue (aOR 1.10 [0.84-1.43]). Similarly, low-volume surgeons who operated at hospitals that had at least one high-volume surgeon did not have different outcomes relative to their counterparts: death (aOR 1.15 [95%-CI 0.86-1.53]), complications (aOR 1.00 [0.84-1.18]), failure-to-rescue (aOR 1.07 [0.78-1.48]). High-volume surgeons (≥7 cases/year) had lower adjusted rates of all three outcomes relative to low-volume surgeons.

Discussion:
For open abdominal aortic surgeries, low-volume surgeons had higher rates of perioperative mortality, complications, or failure-to-rescue, independent of operating at a high-volume hospital or a hospital with at least one high-volume surgeon. Several factors may explain this, including patient selection, intraoperative factors, and the underlying impact of surgeon volume on outcomes.

7. The Impact of Preoperative Pulmonary Status on Open Aortic Aneurysm Repairs

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Introduction:
While endovascular repairs of abdominal aortic aneurysms (AAAs) can be performed under less-invasive modes of anesthesia, such as moderate sedation with local anesthesia, open repairs of AAAs all require general anesthesia. Accordingly, a patient's underlying pulmonary function further impacts their postoperative outcomes. We evaluated the association between the extent of a patient's COPD status and outcomes after open AAA repairs in a clinically-robust registry.

Methods:
We identified all patients undergoing open elective or urgent repairs of non-ruptured infrarenal and juxtarenal AAAs in the Vascular Quality Initiative registry from 2013 to 2019. We categorized COPD status into three groups: requiring no medications, requiring medications, and requiring supplemental oxygen. Primary outcomes included delayed extubation (≥24 hours after surgery) and postoperative pneumonia. Secondary outcomes included 30-day mortality and one-year mortality. Multivariable logistic regressions and cox-proportional hazards models evaluated these outcomes after accounting for patient demographics, preoperative medications, intraoperative factors (i.e. proximal clamp site, visceral or renal ischemia time, retroperitoneal versus transabdominal approach), and hospital volume.

Results:
We identified 6058 patients undergoing open AAA repairs (median age 70 years, 74% male, 5% African American). Half of all patients had infrarenal proximal clamp sites (51%), followed by

clamp sites above a single renal artery (15%), supra-renal clamping (26%), and supra-celiac clamping (7.2%). One-third of all patients had COPD (33%), composed of 12% requiring no medications, 19% taking medications, and the remaining 2.2% on home supplemental oxygen. Rates of primary and secondary outcomes included: delayed extubation (11%), pneumonia (11%), 30-day mortality (4.4%), and one-year mortality (7.2%). After adjustment, there existed an increasing adverse association by underlying preoperative severity of COPD status (Table) among all four outcomes.

Table: Adjusted odds or hazards ratios evaluating outcomes by severity of preoperative COPD status after open AAA repairs

	Prolonged extubation	**Pneumonia**	**30-day mortality**	**One-year mortality**
COPD Status	Adjusted odds or hazards ratio (95%-CI)			
No COPD	Reference	Reference	Reference	Reference
COPD (not on medications)	1.20 (0.94-1.55)	1.29 (1.00-1.65)	0.95 (0.63-1.42)	1.05 (0.79-1.39)
COPD (requiring medications)	1.31 (1.08-1.58)	1.71 (1.43-2.04)	1.14 (0.83-1.56)	1.24 (0.94-1.64)
COPD (with supplemental oxygen)	1.99 (1.29-3.09)	3.04 (1.96-4.27)	1.78 (0.99-3.21)	2.22 (1.50-3.27)

8. Impact of Surgeon and Hospital Volume on Perioperative Outcomes after Open Aortic Surgery

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Objectives:
While prior studies have provided mixed results with respect to the association between hospital volume and outcomes after open aortic surgeries, few have also accounted for surgeon volume. This study (1) evaluated overall surgeon and hospital annual volumes for open aortic surgeries and (2) assessed their association with postoperative outcomes.

Methods:
We queried the 2012-2019 Vascular Quality Initiative to identify all patients undergoing open abdominal aortic aneurysm repairs or aorto-iliac/femoral reconstructions for occlusive disease. We evaluated surgeon and hospital volumes using two categorizations, first by both quintiles of patients and then second by Leapfrog's Volume Expert Panel (surgeons: ≥7/year, hospitals: ≥10/year). Outcomes included: 30-day mortality, overall complications, and failure-to-rescue (death after a major complication). For each outcome among elective or urgent repairs, we performed a multivariable logistic regression that adjusted for both surgeon and hospital volume, along with patient, clinical, and operative characteristics.

Results:
We identified 15,666 patients, where 8619 (55%) had open abdominal aortic aneurysm repairs and 7047 (45%) had aorto-iliac/femoral bypasses, performed by 1283 surgeons across 250 hospitals. Median surgeon volumes were 2.0 cases/year (IQR 1.0-3.3) and hospital volumes were 6.0 cases/year (IQR 3.0-12.6). When adjusting for both surgeon and hospital volume quintiles, the lowest-volume surgeons (but not lowest-volume hospitals) were associated with

worse outcomes relative to their counterparts: 30-day mortality (aOR 1.56 [95%-CI 1.09-2.25]), complications (aOR 1.40 [1.15-1.71]), and failure-to-rescue (aOR 1.75 [1.15-2.64]). When evaluating volume using Leapfrog criteria, only 65 (5.1%) surgeons met the volume guideline, performing 4197 (27%) open aortic surgeries, while 84 hospitals (34%) met the volume guideline and performed 11,795 (75%) open aortic surgeries. Again, surgeons (but not hospitals) who failed to meet Leapfrog volume criteria had higher adjusted odds of all three outcomes (Table): 30-day mortality (aOR 1.47 [1.12-1.91]), complications (aOR 1.24 [1.07-1.42]), and failure-to-rescue (aOR 1.59 [1.13-2.22]).

Conclusions:
There exists marked nationwide variation in both surgeon and hospital volumes of open aortic cases, with surgeon volume having a greater association with postoperative outcomes relative to hospital volumes. Evidence-based volume thresholds and efforts to centralize open aortic surgery should incorporate surgeon volume in addition to hospital volume.

Multivariable logistic regressions of all outcomes after adjusting for both surgeon and hospital volumes.

Leapfrog criteria	**30-day mortality**	**Complications**	**Failure-to-rescue**
	Odds ratios (95%-CI)		
Surgeon volume			
<7/year	**1.47 [1.12-1.91]**	**1.24 [1.07-1.42]**	**1.59 [1.13-2.22]**
≥7/year	Reference	Reference	Reference
Hospital volume			
<10/year	1.17 (0.92-1.50)	1.00 (0.87-1.14)	1.11 (0.86-1.43)
≥10/year	Reference	Reference	Reference

9. Lack of Adherence to Vascular Access Creation Guidelines Results in Decreased Survival

Authors:
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Objectives/Introduction:
Current guidelines from the Society for Vascular Surgery (SVS) and the National Kidney Foundation's Kidney Disease Outcome Quality Initiative (NKF-KDOQI) recommend referral to vascular surgery and creation of permanent hemodialysis (HD) access in patients with advanced chronic kidney disease stage 4 (GFR=15-25) if a vein is suitable for arteriovenous fistula (AVF) creation. Despite this, it is estimated that over half of patients initiating HD do so via catheter-based access. The objective of this study was to evaluate adherence to these guidelines by physicians who perform HD access creation.

Methods:
The Vascular Quality Initiative (VQI) HD access data set was queried to identify patients who received an AVF as their initial surgical access from 2011-2019. Patients were categorized by their glomerular filtration rate (GFR) and defined as early (GFR=15-25 mL/min/1.73m2) or late (GFR R<15 mL/min/1.73m2 or on HD) AVF creation in relation to adherence with national guidelines. Patients with arteriovenous graft were excluded. Demographics and comorbidities were compared between groups. Multivariate logistic regression models and Kaplan-Meier curves were created to identify factors associated with early AVF creation as well as differences in survival and primary patency between groups.

Results:
Of the 24,787 patients who received an AVF as their first surgical access, only 4,074 (16.4%) were in the early AVF creation group. The early AVF creation rate decreased over time from 17.7% in 2011 to 12.4% in 2019 (P<.0001). Notably, 53.6% (n=13,288) of patients were on HD at the time of initial AVF creation. Early AVF creation patients were more likely to be male (63% vs 58.2%,P<.0001) or insured (97.8% vs 95.4%,P<.0001) and less likely to be African American (27.7% vs 31.9%,P<.0001). Multivariate logistic models demonstrated that female birth sex (OR=0.8, 95%CI=0.74-0.87) and uninsured status (OR=0.64, 95%CI=0.49-0.85) were independently associated with decreased odds of early AVF creation. Patients who underwent late AVF creation had no significant difference in primary patency at 6 months (72% vs 68%, p=0.166; Figure 01), however, were noted to have worse 1-year survival (88% vs 90%,p=.01; Figure 02) when compared to those who underwent early AVF creation.

Conclusions:
Despite an emphasis on timely HD access creation, most incident AVFs are created later than clinical guidelines recommend, particularly in female and uninsured patients. This delay does

not worsen AVF primary patency, however, it is associated with decreased survival. Potential factors such as access to specialty care and geographic variations in care should be studied to facilitate improved outcomes in this vulnerable population.

FIGURE 1 – Primary Patency for Early vs Late Creation

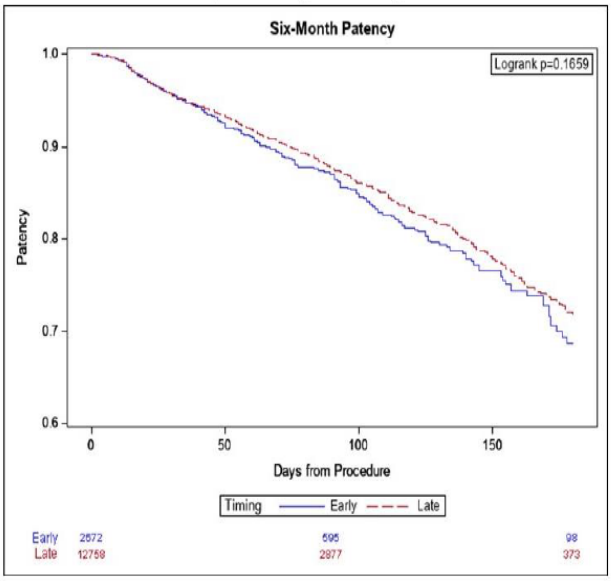
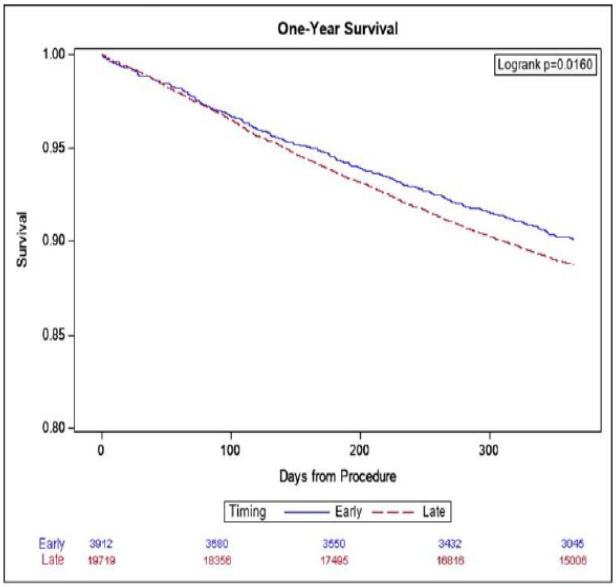


FIGURE 2 – Kaplan-Meier 1-Year Survival Curve



10. Patency of Femoropopliteal Interventions Is Independent of Stent Type

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Abstract

Objectives:
The selection of endovascular treatment for patients with advanced femoropopliteal (FP) occlusive disease is mostly based on operator preference due to a lack of comparative studies and clinical trials. The aim of this study is to compare the patency of bare metal stents, drug eluting stents, and covered stents in the treatment of patients with severe FP occlusive disease.

Methods:
All procedures in patients undergoing treatment for isolated FP occlusive disease in the Vascular Quality Initiative (VQI) peripheral vascular interventions (PVI) registry were reviewed. Patients were stratified into three groups based on the stent type used: bare metal stents (BMS), covered stents (CS) and drug eluting stents (DES). Baseline characteristics and outcomes of the three groups of patients were compared. Multivariable analysis to determine factors independently associated with primary patency was performed.

Results:
Total of 8318 patients and 8718 procedures had complete data available and were analyzed. The CS group have had more smokers and prior infrainguinal or inflow procedures. CS were used more frequently in TASC C/D and longer FP lesions. One-year primary patency, mortality, or major amputation appeared no different among the groups. The reintervention rate at 1 year was slightly higher in CS group. A separate analysis comparing DES and BMS showed no difference in primary patency. On multivariable analysis of the entire cohort, decrease in primary patency was associated with CLTI (OR 0.49, CI 0.42-0.56), dialysis (OR 0.48, CI 0.39-0.59) treatment length more than 25 cm (OR 0.62, CI 0.54-0.69), CHF (OR 0.59, CI 0.5-0.69)), diabetes (OR 0.82, CI 0.72-0.94), and age (OR 0.9, CI 0.98-0.99)). White race was associated with increased primary patency (OR 1.2, CI 1.06-1.47). Stent type was not associated with primary patency.

Conclusion:
There was no effect of stent type on patency or major amputation rates when used for treating femorpopliteal occlusive disease. Stent grafts are utilized in the treatment of more complex FP lesions with slightly increased reintervention rates. Randomized comparative clinical trials may be needed to further delineate the utility of different stent types in treatment of advanced femoropopliteal lesions.

11. Interventions to optimize follow up after lower extremity revascularization

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Abstract

Objective:
Patients with peripheral arterial disease (PAD) require lifelong follow up and monitoring after lower extremity revascularization (LER). Loss to follow up (LTFU) following LER has been associated with worse outcomes and mortality. However, reasons for LTFU remain unclear, and strategies to improve retention rates are not well studied. We sought to identify patients with LTFU following LER, and develop interventions to optimize compliance.

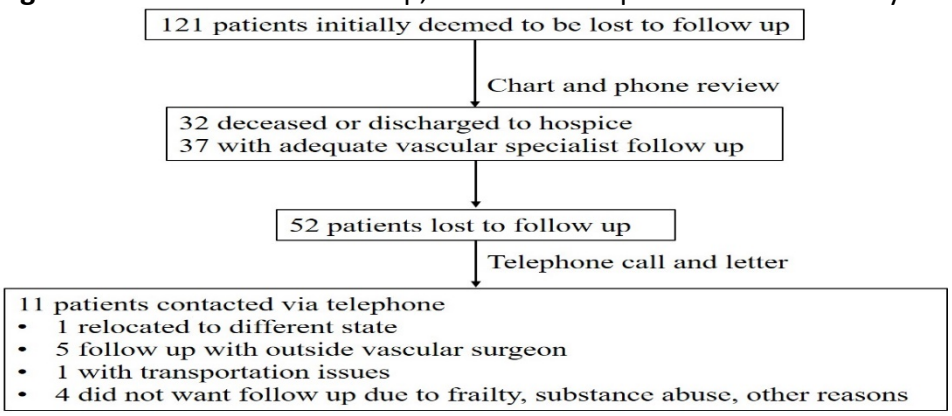
Methods:
All patients who underwent LER in 2016 (PVI, suprainguinal, and infrainguinal VQI modules) and were LTFU based on our center's VQI report were identified. After chart review, those determined to be still eligible were contacted by telephone and had letters sent to them to encourage follow up with the treating vascular specialist. A brief telephone survey was conducted with patients who were reached by telephone. Vascular specialist follow up was then tracked over a three-month period to determine the efficacy of the intervention.

Results:
There were 713 patients who underwent LER at our institution in 2016, of which 121 (17%) were electronically labeled as LTFU. Further review of the records demonstrated that 32 patients were deceased or discharged to hospice, and 37 patients had adequate follow up with vascular specialists within our health system, leaving a total of 52 (7.3%) patients eligible for the intervention. (Figure) The mean age of LTFU patients was 70.4 ± 12.8 years, there were 39 (75.0%) males, and 27 (51.9%) patients had a history of diabetes. There were 17 (32.7%) patients who underwent LER for claudication, 2 (3.8%) for rest pain, 27 (51.9%) for tissue loss, and 6 (11.5%) for acute limb ischemia. There were 38 (73.1%) patients who underwent an endovascular intervention and 14 (26.9%) patients underwent an open procedure. Only 11 (21%) patients could be reached by telephone. Reasons for LTFU included relocation to a different state, follow up with an outside vascular specialist, frailty, and transportation issues. Of those reached by telephone, only 6 (54.5%) patients recalled having the index procedure. After three months, only 3 patients (5.7%) of the 52 patients with LTFU were seen or had follow-up appointments scheduled, one of which had been reached by telephone.

Conclusion:

LTFU is a common problem among patients undergoing LER, but lower than anticipated in our tertiary care center due to mortality and cross-coverage of vascular care. Outreach via telephone calls and letters was low yield, but revealed significant barriers to improvement in LTFU.

Figure. Patients lost to follow up, and results of patients contacted by telephone



12. The Association Between Preoperative Functional Status and Outcomes After Open Abdominal Aortic Aneurysm Repairs

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Abstract

Objective:
Preoperative functional status is appreciated as a key determinant of decision-making when evaluating patients for complex elective surgeries. We used the Vascular Quality Initiative (VQI) to analyze the effect of being able to independently ambulate on outcomes after open abdominal aortic aneurysm (AAA) repairs.

Methods:
We identified all patients who underwent elective or urgent open AAA repairs from January 2013 to August 2019 in the VQI registry. We recorded demographic variables, comorbidities, and operative factors such as approach, operative ischemia time, proximal clamp site, and presence of iliac aneurysms. Short-term and long-term outcomes included 30-day mortality, perioperative complications, failure to rescue (defined as death after a complication), and one-year all-cause mortality. We dichotomized patients into functional versus non-functional status,

depending on their ability to independently ambulate, and used both multivariable logistic regressions and cox-proportional hazards models to evaluate outcomes.

Results:
Of 5,374 patients, 331 (6.2%) could not ambulate independently and were more likely to be older (median age 69 vs 72), female (25% vs. 38%), and have greater comorbidities. Overall outcomes were: 4.3% for 30-day mortality, 38.7% for complications, 10.2% for failure-to-rescue, and 6.9% for one-year mortality. Univariate analysis showed higher rates of all adverse outcomes in non-functional patients. On adjusted analysis, non-functional patients had increased odds of complications by 44% (OR 1.44 [95%-CI 1.10-1.89]) and one-year mortality by 49% (OR 1.49 [95%-CI 1.09-2.03]), but not failure to rescue (OR 1.04 [95%-CI 0.67-1.61]) or 30-day mortality (OR 1.21 [95%-CI 0.81-1.80]). Increased hospital volume, age, and increased operative renal ischemia time were independently associated with adverse outcomes.

Conclusions:
Non-ambulatory status was observed in a small percentage of patients undergoing open AAA repair but was associated with higher rates of post-operative complications and one-year mortality. Ambulatory capacity is one of the key determinants of outcomes following open AAA repair. In patients with poor functional capacity and ambulatory function, a conservative approach is highly recommended over invasive open surgical intervention.

13. Long-Term Survival and Outcomes Following TEVAR for Chronic Type B Aortic Dissection

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Abstract

Objective

The use of TEVAR technique to treat patients with both uncomplicated and complicated chronic Type B aortic dissections (tB-Ad) continues to rise, yet there exists limited national data evaluating outcomes and predictors of adverse events. We used prospectively collected data from the Vascular Quality Initiative (VQI) to evaluate (1) the presentation and clinical features of chronic aortic dissections, (2) the incidence of outcomes, and (3) predictors of these outcomes.

Methods:

We queried the VQI database (2011-2019) for patients undergoing TEVAR for chronic (>12 weeks) tB-Ad, dichotomizing patients into uncomplicated versus complicated (malperfusion, rupture, or rapid expansion) dissections. Outcomes included 30-day mortality, perioperative complications, and long-term survival (three years). Multivariable logistic regressions and Cox proportional hazard regressions accounted for confounding by adjusting for various factors.

Results:
We identified 535 patients treated for chronic Type B aortic dissection, a significant portion (20%) of whom had complicated dissections which included malperfusion (75%), rupture (25%), and expansion (5%). Complicated and uncomplicated dissections had similar unadjusted rates of mortality (2.6% v .9%, p=.48) and complications (17% v. 13%, p=.26), and comparable three-year survival (95% v. 88%, p=.19). Complicated dissections were associated with longer procedural time (160min v. 130min, p<.01) and tended to have more visceral vessels incorporated (3.6 v 2.9, p<.02). Patients were more like to require one-year intervention in the case of complicated dissections (17% v 4.5%, p=.04). Multivariate analyses showed higher odds of 30-day mortality were associated with CAD (OR 1.1 [95%-CI 1.0- 1.1], P=.04), severe chronic kidney disease (OR 1.1 [1.0-1.2], P<.01), and emergent presentation (OR 1.2 [1.1-1.3], P<.01). Factors associated with decreased long-term survival included emergent repair (HR 6.6 [2.1-20], P<.01) and severe chronic kidney disease (HR 5.5 [1.9-16], P<.01).

Conclusions:
A significant number of patients undergoing TEVAR for chronic tB-Ad presented for aneurysmal degeneration of chronic dissection. Most patients undergoing TEVAR for chronic dissections have favorable outcomes; however, emergent clinical presentation is associated with higher procedural mortality and late survival. Further study is necessary to identify key risks for emergent presentation to improve outcomes further.

14. Outcomes of TEVAR for Acute and Subacute Type B Aortic Dissection in The Vascular Quality Initiative

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Introduction:
Aortic dissections continue to be medical and surgical emergencies with evolving modalities of treatment. The use of TEVAR technique to treat patients with both uncomplicated and complicated acute Type B aortic dissections (tB-Ad) continues to rise, yet there exists limited national data evaluating outcomes and predictors of adverse events.

Goals:
We hypothesized that uncomplicated dissections would have better perioperative and long-term outcomes than complicated dissections. We used prospectively collected data from the Vascular Quality Initiative (VQI) to evaluate (1) the presentation and clinical features of acute aortic dissections, (2) the incidence of outcomes, and (3) predictors of these outcomes.

Methods:
We queried the VQI database (2011-2019) for patients undergoing TEVAR for acute (<2 weeks) and sub-acute (2-12 weeks) tB-Ad, dichotomizing patients into uncomplicated versus complicated (malperfusion, rupture, increased size, or expansion) dissections. Outcomes

included 30-day mortality, perioperative complications, and long-term survival (three years). Risk adjusted analyses were performed using multivariable and Cox proportional hazard regression.

Results:
We identified 1078 patients treated for tB-Ad, with 44.1% having complicated dissections including malperfusion (66%), rupture (20%), and expansion (16%). Complicated dissections had higher unadjusted rates of 30-day mortality (15% v. 5.3%, p<.01), and complications (44% v. 22%, p<.01), and lower three-year survival (75% v. 81%, p<.01). Post- operative spinal ischemia was more common in complicated dissections (11% v. 3.3 %; p<.01), as was stroke (8.2% v. 3.7%; p<.01) and acute kidney injury (5.9% v. 1.0%; p<.01). Complicated dissections required more visceral vessel incorporation (82% v. 67%, p<.01), arm or neck access (20% v. 15%, p=.02), and higher 30-day reintervention (19% v. 8.4%, p<.01). Multivariate analyses showed complicated dissections had higher odds of 30-day mortality (OR 1.0 [95%- CI 1.0–1.1], P=.01) and perioperative complications (OR 1.1 [1.1–1.2], P<.01). Factors associated with decreased long- term survival included emergent repair (HR 2.3 [1.5–3.6], P<.01), severe CKD (OR 2.2 [1.3-3.9], P<.01), and CAD (HR 2.0 [1.4– 2.9], P<.01).

Conclusions:
These data present contemporary results of TEVAR for tB-Ad, showing excellent mortality and morbidity for both uncomplicated and complicated presentations as compared to prior reports of medical and surgical therapy. In light of these findings, early aggressive intervention with TEVAR remains a necessity for complicated presentation and should be strongly considered in patients with acute uncomplicated tB-Ad.

15. Physician-modified endografts are associated with a survival benefit over parallel grafting in more extensive aortic aneurysms

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Objectives:
Physician-modified endografts (PMEG) and snorkel/chimney parallel grafting (sn/ch-EVAR) are important techniques for endovascular repair of thoracoabdominal and complex abdominal aortic aneurysms using off-the-shelf devices. However, there is little data regarding the relative efficacy and outcomes of these techniques across different aneurysm types. The objective of this study is to compare outcomes of sn/ch-EVAR and PMEG across different subtypes of complex aortic aneurysms.

Methods:
The SVS VQI TEVAR/Complex EVAR module was queried for all patients undergoing repair of an unruptured, Extent I-IV thoracoabdominal (TAAA) or juxta/pararenal aneurysm (J/PRA) from 2012 to 2020; aneurysm types were defined by repair extent as determined by proximal- and distal-most seal zones, and grouped as TAAA I-III, TAAA IV, and J/PRA for analysis. After excluding company manufactured devices, patients were differentiated based on whether they received repair with a physician-modified endograft (PMEG) or parallel grafting technique (sn/ch-EVAR). Demographic and operative characteristics were compared between sn/ch-EVAR and PMEG within each repair extent, followed by analysis of post-operative outcomes. The primary outcome was survival at 30-days and 1-year determined via Kaplan-Meier analysis with log-rank test for significance.

Results:
2305 patients met inclusion criteria (362 TAAA I-III, 451 TAAA IV, 1492 J/PRA). Thoracoabdominal repairs demonstrated improved survival with PMEG over sn/ch-EVAR at 30-days (KM survival estimates; TAAA I-III: 0.96 vs. 0.87, p=0.01; TAAA IV: 0.96 vs. 0.87, p=0.03) (Table I). This survival benefit was sustained out to 1-year in the case of TAAA I-III (KM estimates 0.85 vs. 0.75, p=0.01) (Table I, Figure 1). PMEGs had higher perioperative survival (TAAA I-III: 89% vs 96%, p=0.03; TAAA IV: 89% vs. 96.6%, p=0.002) and lower incidences of

composite stroke/death in thoracoabdominal repairs (TAAA I-III: 6.4% vs 14%, p=0.03; TAAA IV: 4.2% vs. 21.1%, p=0.002), with TAAA IV PMEG repairs also demonstrating lower major adverse cardiovascular events (MACE) (5.8% vs. 17.4%, p<0.001), and overall post-operative complications (23.4% vs. 36.3%, p=0.003) (Table II). For J/PRA repairs, there was no survival difference between the two repair techniques. In univariate analysis, PMEG repair in the TAAA I-III group was associated with reduced mortality at 1-year (HR 0.49, p=0.02), which was not statistically significant in multivariate analysis (HR 0.68, p=0.32).

Conclusions:

PMEG devices are associated with improved survival at 1-year when compared to sn-ch/EVAR in thoracoabdominal aortic aneurysm repairs, which appear more durable in more extensive repair extents. Conversely, survival is equivalent for these techniques in juxta/pararenal aneurysms in the perioperative period and up to 1-year.

(Continued below)

Table I | Kaplan-Meier survival of sn/ch-EVAR versus PMEG by aneurysm repair extent

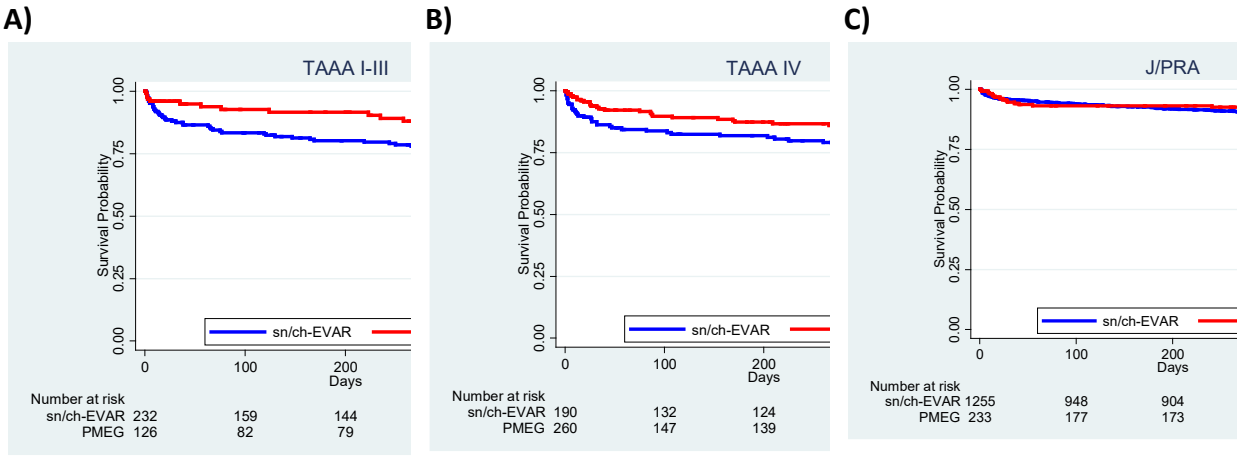
	TAAA I-III			TAAA IV			J/PRA		
	Sn/ch-EVAR (n=236)	**PMEG (n=126)**	**P-value**	**Sn/ch-EVAR (n=190)**	**PMEG (n=261)**	**P-value**	**Sn/ch-EVAR (n=1258)**	**PMEG (n=234)**	**P-value**
30-Day	0.87 (0.81-0.90)	0.96 (0.91-0.98)	0.01	0.87 (0.81-0.92)	0.94 (0.89-0.96)	0.03	0.96 (0.94-0.97)	0.94 (0.90-0.97)	0.44
1-Year	0.74 (0.67-0.79)	0.85 (0.76-0.91)	0.01	0.78 (0.71-0.82)	0.84 (0.78-0.89)	0.08	0.89 (0.87-0.91)	0.90 (0.85-0.94)	0.72
Values are Kaplan-Meier survival estimates (95% Confidence Interval) with p-values obtained via log-rank test									

Table II | Perioperative outcomes of sn/ch-EVAR versus PMEG by aneurysm repair extent

	TAAA I-III			TAAA IV			J/PRA		
	Parallel (n=236)	**PMEG (n=126)**	**P-value**	**Parallel (n=190)**	**PMEG (n=261)**	**P-value**	**Parallel (n=1258)**	**PMEG (n=234)**	**P-value**
Survival	210 (89)	121 (96)	0.03	169 (89)	252 (96.6)	0.002	1218 (96.8)	224 (95.7)	0.43
MACE	34 (14.4)	13 (10.3)	0.3	33 (17.4)	15 (5.8)	<0.001	77 (6.1)	12 (5.1)	0.6
Stroke/death	33 (14)	8 (6.4)	0.03	23 (12.1)	11 (4.2)	0.002	48 (3.8)	11 (4.7)	0.5
Any complication	94 (40)	39 (31)	0.1	69 (36.3)	61 (23.4)	0.003	259 (21)	38 (16.2)	0.1
Cardiac (CHF, MI, dysrhythmia)	42 (17.8)	13 (10.3)	0.06	36 (19)	23 (8.8)	0.002	118 (9.4)	18 (7.7)	0.4
CV (CVA, TIA)	13 (5.5)	7 (5.6)	1.0	6 (3.2)	3 (1.2)	0.2	21 (1.7)	3 (1.3)	1.0
Respiratory (PNA, reintubation)	27 (11.4)	7 (5.6)	0.07	25 (13.2)	20 (7.7)	0.06	69 (5.5)	12 (5.1)	0.8
Extremity Embolization	11 (4.7)	5 (4)	0.8	5 (2.6)	12 (4.6)	0.3	30 (2.4)	6 (2.6)	0.9
Leg Compartment Syndrome	2 (0.9)	0 (0)	0.3	1 (0.5)	3 (1.2)	0.5	16 (1.3)	2 (0.9)	0.6
Intestinal Ischemia	12 (5.1)	3 (2.4)	0.2	16 (8.4)	6 (2.3)	0.003	31 (2.5)	7 (3)	0.6
Renal Ischemia	10 (4.2)	6 (4.8)	0.8	12 (6.3)	11 (4.2)	0.3	41 93.3)	13 (5.6)	0.08
New Dialysis	15 (6.4)	2 (1.6)	0.06	13 (6.8)	7 (2.7)	0.04	41 (3.3)	5 (2.1)	0.5
Spinal Cord Ischemia	25 (10.6)	14 (11.1)	0.9	10 (5.3)	8 (3.1)	0.2	15 (1.2)	4 (1.7)	0.5

Continuous variables displayed as mean ± standard deviation
Categorical variables displayed as number of patients (%)
MACE, major adverse cardiovascular event (composite of perioperative death, in-hospital myocardial infarction, and in-hospital stroke); ICU, intensive care unit; LOS, length of stay; MI, myocardial infarction; CHF, congestive heart failure; CV, cerebrovascular; CVA, cerebrovascular accident; TIA, transient ischemic attack; PNA, pneumonia

Figure 1 | 1-year Survival sn/ch-EVAR versus PMEG by aneurysm repair extent



16. Trends in Preoperative Imaging Prior to Elective Carotid Endarterectomy

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Objective/Introduction:
Duplex ultrasound (DUS) has been a favored imaging modality for carotid bifurcation disease due to its low cost and non-invasive nature. Computed tomography angiography (CTA) has replaced conventional angiography (CA) due to its safety but also requires radiation exposure and contrast. We hypothesized that CTA preoperative imaging prior to elective carotid endarterectomy (CEA) has increased and replaced DUS. We examine the trends in CEA preoperative imaging and its relationship to symptom status.

Methods:
The southern California regional study group of the VQI (SoCal VOICe) includes 17 centers across Southern California. We reviewed all elective CEA procedures performed over the past nine years from 15 centers that provided CEA data. Three cohorts (2011-2013), (2014-2016), and (2017-2020) were compared over time. The preoperative imaging modalities used for each case were analyzed and the use of single or multiple preoperative studies were determined. The four imaging modalities examined were DUS, CTA, magnetic resonance angiography (MRA), and CA. Trends in imaging over time and the influence of symptom status on imaging were analyzed. Center-level variation in imaging was also examined.
Results: From January 2011 to May 2020, 2519 elective CEAs were entered. Of the 2336 eligible cases (183 excluded due to incomplete data), 62% were for asymptomatic and 38% for symptomatic disease. Preoperative imaging studies ordered included 56% DUS, 28% CTA, 6% MRA, and 10% CA. Single imaging studies were used in 56.3% of cases, two studies in 40.4%, and >2 studies in 3.3%. Over the nine-year study period, single studies were more common for asymptomatic patients, whereas the use of two or more studies was more common for symptomatic patients. The overall trend among the three different time periods shows that for both asymptomatic and symptomatic patients, the use of single DUS studies has decreased over time ($p<0.001$), whereas the use of single CTA studies has increased over time ($p<0.001$). The use of CTA varied widely by study center ranging from 12-52.9% for symptomatic and 10.5-75% for asymptomatic patients. 2020 was the first year that CTA overtook duplex as the most frequently ordered study for symptomatic patients.

Conclusions:
Over the past nine years, the majority of patients undergoing elective CEA in the SoCal VOICe had only a single preoperative imaging study. Overall, DUS was most frequently the sole study in both symptomatic and asymptomatic patients. However, as a single study, CTA is becoming more frequently used than duplex. Further investigation into the variation in practice may help standardize imaging prior to CEA and control healthcare costs.

17. Effects of Timing on In-hospital and One-year Outcomes after TransCarotid Artery Revascularization

PMID: 33038481
Citation: Cui CL, Dakour-Aridi H, Eldrup-Jorgensen J, Schermerhorn ML, Siracuse JJ, Malas MB. Effects of Timing on In-hospital and One-year Outcomes after TransCarotid Artery Revascularization. J Vasc Surg. 2020 Oct 7:S0741-5214(20)32136-4. doi: 10.1016/j.jvs.2020.08.148. Epub ahead of print. PMID: 33038481.

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Objective:
Current recommendations are to perform carotid endarterectomy (CEA) within two weeks of symptoms due to superior long-term stroke prevention, although urgent CEA within 48-hours has been associated with increased perioperative stroke. With the development and rapid adoption of TransCarotid Artery Revascularization (TCAR), we aim to study the impact of timing on outcomes after TCAR.

Methods:
Symptomatic patients undergoing TCAR in the Vascular Quality Initiative between September 2016 and November 2019 were stratified by time to procedure: urgent (TCAR within 48-hours), early (TCAR between 3-14 days after symptoms), and late (TCAR greater than 14 days after symptoms). Primary outcome was in-hospital rates of stroke/death and evaluated using logistic regression. Secondary outcome was one-year rate of recurrent ipsilateral stroke and mortality, analyzed using Kaplan Meier Survival Analysis.

Results:
A total of 2608 symptomatic patients undergoing TCAR were included: 144 urgent (5.52%), 928 early (35.58%), and 1536 (58.90%) late. Patients undergoing urgent intervention had increased risk of in-hospital stroke/death that was driven primarily by increased risk of stroke. No differences were seen in in-hospital death. On adjusted analysis, urgent intervention had a 3-fold increased odds of stroke [OR:2.8, 95%CI:1.3-6.2, p=0.01] and a 3-fold increased odds of stroke/death [OR:2.9, 95%CI:1.3-6.4, p=0.01] when compared to late intervention. Patients undergoing early intervention had comparable risks of stroke [OR:1.3, 95%CI:0.7-2.3, p=0.40]

and stroke/death [OR:1.2, 9%CI:0.7-2.1, p=0.48] when compared to late intervention. On subset analysis, the type of presenting symptoms was an effect modifier. Both patients presenting with stroke and patients presenting with transient ischemic attacks (TIA) or amaurosis fugax (AF) had increased risk of stroke/death when undergoing urgent compared to late TCAR: [OR:2.7, 95%CI:1.1-6.6, p=0.04] and [OR:4.1, 95%CI:1.1-15.0, p=0.03] respectively. However only patients presenting with TIA or AF had experienced increased risk of stroke when undergoing urgent compared to late TCAR: [OR:5.0, 95%CI:1.4-17.5, p<0.01]. At one-year follow-up, no differences were seen in recurrent ipsilateral stroke (urgent:0.7%, early:0.2%, late:0.1%, p=0.13) or post-discharge mortality (urgent:0.7%, early:1.6%, late:1.8%, p=0.71).

Conclusion:
TCAR has a reduced incidence of stroke when performed 48-hours after onset of symptoms. Urgent TCAR within 48 hours of onset of stroke is associated with a three-fold increased risk of in-hospital stroke/death with no added benefit up to one year after the intervention. Further studies are needed on long-term outcomes of TCAR stratified by timing of the procedure.

18. Black Patients have Higher Mortality as Compared to Non-Black Patients at OneYear End Point after Infrainguinal Bypass for Critical Limb Ischemia: A Study from VQI Database

Authors:
Ahsan Zil-E-Ali, Faisal Aziz

Introduction:
Racial minorities have overall poor surgical outcomes with higher mortality rates. Our study aims to find short and long-term outcomes within the subpopulation of CLI patients stratified by race.

Methods:
VQI database was used to study the patient diagnosed with Critical Limb Ischemia further stratified into Black and Non-Black Population. The Non-Black population included Native Americans, Asians, Native Hawaiian or Pacific Islander and White patients. Multivariate Logistic Regression and Cox Proportional-Hazard Model was used to learn the outcomes.

Results:
Of 35,392 patients identified as CLI, 6,404 were black patients and 28,983 were Non-black patients. Black patients underwent the procedure at relatively at a younger age than the Non-Black Patients. Black patients had higher % of hypertensive (93.73% vs 88.99%; $p<0.001$) and diabetes mellitus (60.38% vs 54.77%; $p<0.001$) as compared to non-Black patients. At thirty-day and one-year end point, black patients had higher rates of mortality when compared to Non-Black patients (30 Days: 12.24% vs 10.89%; $p=0.002$, $\Delta 1.35\%$) (1-year: 34.59% vs 32.20%; $p<0.001$, $\Delta 2.39\%$). A model showed that Black patients had insignificant difference in mortality outcome as compared to Non-Black patients. However, with at one-year end point computed by cox proportional-hazard showed that Black patients had higher likelihood of death (HR: 1.06, CI 1.00-1.11; $p=0.036$). Non-Black patients had lower risks of one-year mortality (HR:0.95, CI 0.90 - 0.99; $p=0.036$).

Conclusion:
Black and Non-Black Patients do not have different mortality outcomes in the first thirty days of the infrainguinal bypass for CLTI but at the one-year endpoint, black patients had higher risks of mortality.

19. Higher Risk For Neurological Events After Carotid Endarterectomy in Symptomatic Patients From Asian Descent: A Review of the Vascular Quality Initiative

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Abstract

Objective:
To review racial/ethnic differences in terms of outcomes in symptomatic patients treated with carotid endarterectomy (CEA) in the Vascular Quality Initiative (VQI).

Methods:
All symptomatic patients, who underwent CEA and disclosed racial background within VQI were included in this review. Primary end point was in hospital neurologic events (transient ischemic attacks and strokes), myocardial infarction and death. Secondary end point included logistic regression analysis to assess for possible causes of racial disparities in terms of post-operative outcomes.

Results:
There were 54,322 symptomatic CEAs performed from January 2003 to May 2019. From those, 50,682 (93.3%) identified themselves as white, 2,902 (5.3%) identified themselves as black/African-American and 738 (1.4%) identified themselves as Asians. There were 33,481 (61.6%) male patients. Post-operative neurologic events occurred with higher frequency in the Asian group at a rate of 3.8% vs. 2.9% in black/African-Americans vs. 2.3% in whites (p=0.002). The post-operative rates for myocardial infarction (p=0.112) and death (p=0.067) were not significant among groups. On multivariable logistic regression analysis, the procedural length (OR=42.7 [95% CI=4.14-0.10]; p<0.001) was a predictor of neurologic event after CEA.

Conclusion:
Using VQI, post-operative neurologic events were noted to be higher in symptomatic patients of Asian descent after CEA. Myocardial infarction and deaths were no different among groups. On multivariable logistic regression analysis, operation length was a predictor of post-operative

neurologic event. Although there are statistically significant differences in terms of post-operative neurologic events among groups compared; these data should be interpreted with caution due to the few number of Asian patients included in VQI. Other national databases should be queried to assess whether this observation can be validated.

20. The Impact of Baseline Renal Function and Contrast Medium Volume/Estimated Glomerular Filtration Rate Ratio on Reduced Renal Function Following Endovascular Abdominal Aortic Aneurysm Repair

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Declaration of Conflict of interests:
The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

ABSTRACT

Objective:
The aim of this study was to determine the impact of baseline serum creatinine, estimated glomerular filtration rate (eGFR), and contrast medium volume (CMV) on the incidence of reduced renal function (RRF). We aimed to determine a simple and effective CMV/eGFR ratio to predict RRF after endovascular abdominal aortic aneurysms repair (EVAR).

Methods:
A retrospective review of patients who underwent EVAR in in the Society for Vascular Surgery/Vascular Quality Initiative (SVS/VQI) from January 2015 to August 2020 were analyzed. Reduced renal function was defined as an increase in creatinine following the procedure of > 0.8 mg/dl (70.7 umol/L) or 50% increase from baseline. Receiver operator characteristic curve analyses were conducted to measure the predictability of serum creatinine, eGFR, contrast medium volume, fluid and CMV/eGFR ratio on RRF. Two data sets (training and test) were developed for model building and validation.

Results:
SVS/VQI data for endovascular aortic repair contained 38,701 records from Jan 2015 - Aug 2020. There were 30539 patient records divided into a training data set (n=18283, 60%) and test data set (n=12256, 40%). The reduced renal function (RRF) rate for the training set was 3.2% (n=593). Characteristics of patients with RRF included more females (32.0 versus 18.9%, $p<0.001$), older in age (75.6 $\pm$ 8.4 versus 73.3 $\pm$ 8.7 years), more congestive heart failure (21.1 versus 12.3%, $p<0.001$) and more chronic obstructive pulmonary disease (COPD) (42.2 versus 34.2%, $p<0.001$) among other differences. A receiver operator characteristics curve analysis revealed that eGRF, creatinine, contrast, intravenous fluid and contrast medium volume (CMV)/eGFR ratio all were significantly ($p<0.05$) correlated with RRF. It was noted that the CMV/eGFR ratio had the largest area under the curve (0.60), while creatinine had the lowest (0.51). Negative predictive values were found to be 97.3 (CMV/eGFR), 97.0 (creatinine), 97.2 (eGFR), 97.3 (contrast) and 97.1 (intravenous fluid). Following multivariate analysis to predict RRF using the training data set, the CMV/eGFR remained as an independent predictor (Odds Ratio, OR: 1.3 with 95% CI: 1.0, 1.5, $p<0.015$). An analysis for RRF in the test data set found that CMV/eGFR ratio was an independent predictor of RRF (OR: 1.5, CI: 1.2 to 1.8, $p<0.001$) as well as several other variables.

Conclusion:
RRF after EVAR is a dreaded and potentially devastating complication. In our analysis, baseline serum creatinine, eGFR, contrast medium volume and the ratio (CMV/eGFR) were all significantly associated with RRF. The optimal cut-off value for the CMV/eGFR ratio <=2, provides a simple, easy to use equation to guide maximum contrast use for the endovascular interventionist.

Keywords: Reduced renal function, endovascular abdominal aortic aneurysm repair, contrast volume, estimated glomerular filtration rate, Ratio, renal, failure

21. Temporal Trendsin the Use of Carotid Endarterectomy, Transfemoral Carotid Artery Stenting, and TranscarotidArtery Revascularization in the Vascular Quality Initiative

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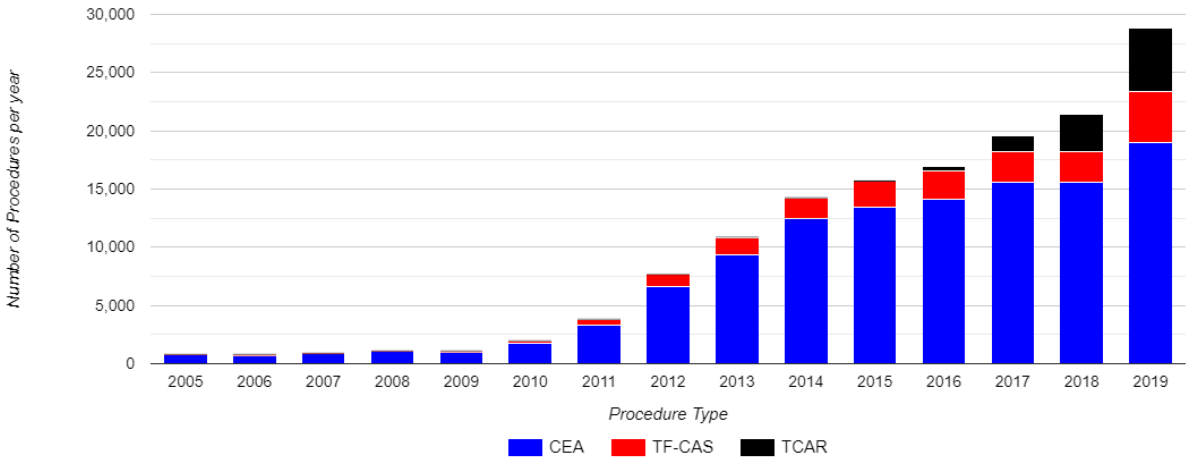
Objective:
Carotid endarterectomy(CEA) is the traditional gold standard for treatment of carotid artery stenosis, but transfemoral carotid artery stenting(TFCAS) and transcarotid artery revascularization(TCAR) are considered acceptable alternatives in select patients.We aimed to explore temporal trends associated with the use of CEA, TFCAS, and TCARfor the treatment of carotid artery stenosis in a real-world population.

Methods:
All patients with >50% carotid artery stenosis who underwentelectiveCEA, TFCAS, or TCAR inthe Vascular Quality Initiative (2005-2019) were included. We described trends in the annual proportion of carotid revascularization procedures performed with each technique using Cuzick's test, and described odds of undergoing TFCAS and TCAR vs. CEA by calendar year using logistic regression overall and stratified by symptom status and degree of stenosis (moderate=50-69%, high-grade = 70-99%).

Results:
Overall, 145,218 carotid revascularization procedures were performed in 135,459 patients, including 78.6% CEA,13.9% TFCAS, and 7.5% TCAR. Overall, the number of carotid revascularization procedures increased with time (P<0.001); the proportion of CEA procedures decreased over time from 95.3% of carotid interventions in 2005 to 65.8% in 2019(P=0.001), whereas the proportion of TFCAS increased from 4.7% to 15.3% (P=0.02) and TCAR increased from 0% to 28.7%(P<0.001) (Figure1). Relative to CEA, the use of TFCAS increased by 4% per year (95%CI 1.03-1.04) and the use of TCAR increased by 207% per year(95%CI 2.03-2.11).When patients were stratified by symptom status, the use of TCAR increased for both symptomatic (OR 2.16, 95%CI 2.10-2.23) and asymptomatic patients (OR 2.12,95%CI 2.06-2.17), whereas the use of TFCAS only increased for symptomatic patients (OR 1.07,95%CI 1.06-1.08). When stratified by degree of stenosis, use of TCAR increased significantly per year for both moderate (OR 2.38, 95%CI 2.29-2.48) and high-grade (OR 1.75, 95%CI 1.70-1.79) stenosis, whereas the use of TFCAS increased for moderate stenosis (OR 1.28,95%CI 1.25-1.30)but decreased for high-grade stenosis (OR 0.76,95%CI 0.75-0.76).

Conclusions:
The number of carotid revascularization procedures has increased significantly in the last 10 years, and is primarily driven by increases in the use of TFCAS and TCAR. There is a critical need for long-term outcomes of these technologies given the ubiquity of their application across a wide range of disease severity.

Figure 1. Proportion of CEA, TFCAS, and TCAR procedures performed per year in the Vascular Quality Initiative (2005-2019)



22. Gender Differences in Perioperative Outcomes for EVAR versus OSRfor Abdominal Aortic Aneurysms: A Vascular Quality Initiative Study

Authors:
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Objective:
Abdominal aortic aneurysm (AAA) impacts men four times more commonly than women. However, women who develop AAAs have worse outcomes compared to men. Women with AAAs are older, have quicker growing AAAs, have a4x higher risk of rupture and tend to rupture at small diameters compared to men. In addition, women undergoing AAA repair are less likely to undergo endovascular aortic repair (EVAR) compared to an open surgical repair (OSR) and when EVAR is performed, studies have shown inferior survival outcomes over OSR compared to men. This study aimed to compare perioperative outcomes between men and women undergoing EVAR versus OSR for AAA using a large, national vascular database.

Methods:
All patients with an AAA who underwent OSR or EVAR in the Vascular Quality Initiative from January 2003 to August 2020 were included. We compared perioperative (30-day) outcomes(stroke, cardiac complications, respiratory complications, intestinal ischemia, dialysis, re-intervention, mortality) for men versus women who underwent for EVAR vs OSR using ANOVA and multivariable logistic regression models.

Results:
Over this study period, 68,337 AAA procedures were performed of which 80.8% were EVAR (N=55,199) and 19.2% OSR (N=13,138). 55,965 were elective AAAs (83.6% EVAR, 16.4% OSR), 6,419 were symptomatic AAAs (75.9% EVAR,24.1% OSR), and 5,706 (58.3% EVAR, 41.7% OSR) were ruptured AAAs. 81% of all EVAR procedures were performed on males and 74% of all OSR procedures were performed on males. Women had significantly worse 30-day outcomes post EVAR compared to men; postoperative stroke ($p<0.0001$), total cardiac complications ($p<.0001$), total respiratory complications ($p<.0001$), postoperative vasopressors required ($p<.0001$), intestinal ischemia ($p<.0001$), postoperative dialysis($p<0.01$), re-operation required($p<.0001$), death ($p<.0001$), and composite outcomes ($p<.0001$), occurred more frequently in women when compared to men undergoing EVAR.
For OSR, the odds Ratio was statistically higher for death in women compared to men(OR=1.36, 95%CI 1.15-1.61, $p<.0001$) but rates of post-operatively dialysis were statistically lower in women (OR=0.88, 95%CI 0.78-0.99, $p<.0001$) compared to men undergoing OSR.

Conclusions:
EVAR has a significantly higher risk of perioperative outcomes in women compared to men. For those undergoing OSR, women appear to have a higher risk of death, but lower risk of post-operative dialysis but otherwise had comparable outcomes to men.

23. Endovascular and Open Repair of Abdominal Aortic Aneurysms is Associated with Worse Perioperative Outcomes in Patients Older than 65 years: A Vascular Quality Initiative Study

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Objective:
Prior literature has shown that abdominal aortic aneurysm (AAA) occur in up to 13% of men and 6% of women over the age of 65 with these percentages rising as people age. Recent data has indicated that older patients do better with open surgical repair (OSR)while younger patients tend to do better with endovascular aneurysm repair (EVAR), a somewhat counterintuitive conclusion. The aim of this study was to compare perioperative outcomes for both EVAR and OSR between patients older and young than 65 years of age.

Methods:
All patients with an AAA who underwent OSR or EVAR in the Vascular Quality Initiative from January 2003 to August 2020 were included. We compared perioperative (30-day) outcomes between patients older than 65 and younger than 65 for EVAR vs. OSR using ANOVA and multivariable logistic regression models.

Results:
Over this study period, 68,337 AAA procedures were performed of which 80.8% were EVAR (N=55,199) and 19.2% OSR (N=13,138). 55,965 were elective AAAs (83.6% EVAR, 16.4% OSR), 6,419 were symptomatic AAAs (75.9% EVAR,24.1% OSR), and 5,706 (58.3% EVAR, 41.7% OSR) were ruptured AAAs. 85% of EVAR patients were over the age of 65 and 75% of OSR patients were over the age of 65.

Total cardiac complications (p<.0001), death (p<.0001) and composite outcomes (p<.0001) were significantly higher for those >65 than those <65 for those undergoing EVAR. For OSR, congestive heart failure (p<0.05), post-operative dialysis (p<0.05) and death (p<.001) were significantly higher for those >65 compared to those <65 years of age. Intensive care unit (ICU) length of stay and overall length of stay were not different between groups for EVAR. However, when comparing ICU stay for those <65 years old for OSR (4.3±6.6 days) to those >65 years old for OSR (5.3±7.7 days) and total length of stay for those <65 years old for OSR (9.8±13.6 days) to those >65 years old for OSR (10.8±14.2 days), both were statistically significant (p<.0001 and p<0.05 respectively).

Regardless of type of repair, odds ratios were significantly higher for those >65 than <65 for total cardiac complications (OR=1.86; 95% CI 1.62-2.14, p<.0001), total respiratory complications (OR=1.28; 95% CI 1.10-1.48, p<.0001), vasopressors required post-operatively

(OR=1.51; 95% CI 1.36-1.69, p<.0001), intestinal ischemia (OR=1.53; 95% CI 1.22-1.92, p<.0001), post-operative dialysis (OR=1.48; 95% CI 1.30-1.68, p<.0001), re-operation (OR=1.26; 95% CI 1.07-1.47, p<.0001) and death (OR=2.90; 95% CI 2.28-3.68, p<.0001).

Conclusions:
Regardless of whether the AAA is repaired through an OSR or an EVAR, patients ≥65 years of age have a significantly higher risk of perioperative complications comparedto those <65 years of age.

24. The Relationship Of The Degree of Carotid Lesion Calcification to Adverse Events After Carotid Artery Stenting

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Introduction:
The impact of carotid artery lesion calcification on adverse events following carotid artery stenting is not well studied. There are few reports that associate heavily calcified lesions with high risk of perioperative stroke following transfemoral carotid artery stenting (TFCAS). With the advent of transcarotid artery revascularization (TCAR), we thought to compare the outcomes of these two procedures stratified by the degree of lesion calcification.

Methods: Our cohort was derived from the Vascular Quality Initiative (VQI) database for carotid artery stenting. Patients with missing information on the degree of carotid artery calcification were excluded. Patients were stratified into two groups: >50% circumferential calcium (severe), and $\leq$ 50% calcification. Student t-test and chi-square test were used to compare patients' baseline characteristics and crude outcomes, as appropriate. Clinically relevant and statistically significantly variables on univariable analysis were added to a logistic regression model clustered by center identifier. The final models were tested for goodness of fit using the Hosmer-Lemeshow test.

Results: A total of 11,342 patients were included (TFCAS: 4,416; TCAR: 6,926). Patients with more severe calcification were older, had more comorbidities (CAD, COPD, and CHF) and more contralateral occlusion. There were more patients with prior ipsilateral CEA in the less severe calcification group. In patients who underwent TCAR, there were no significant differences between those who had >50% vs. $\leq$50% carotid calcification in the odds of in-hospital stroke (OR: 1.2, 95%CI:0.8-1.8, P=0.41), death (OR: 0.87, 95%CI:0.36-2.1,P=0.75), stroke or death (OR: 1.2, 95%CI:0.8-1.7, P=0.45), MI (OR: 1.1, 95%CI: 0.6-2.0, P=0.78), or stroke, death or MI (OR: 1.2, 95%CI: 0.81.6, P=0.31). However, in patients with heavy calcification who underwent TFCAS, there was 50-60% increase in the odds of stroke (OR: 1.6, 95%CI:1.04-2.5,P=0.03), stroke or TIA (OR: 1.6, 95%CI:1.1-2.3,P=0.013) and stroke or death (OR: 1.5, 95%CI:1.02-2.08,P=0.039). There was no significant difference in the odds of in-hospital death and stroke, death, or MI. In patients with severe calcification and compared to TFCAS, TCAR was associated with 40-70% reduction in the odds of stroke or TIA(OR: 0.6, 95%CI:0.38-0.91,P=0.018), death (OR: 0.3, 95%CI:0.13-0.72,P=0.006), stroke or death (OR: 0.5, 95%CI:0.32-0.8,P=0.004), stroke, death or MI (OR: 0.58, 95%CI:0.39-0.87,P=0.008). There were no significant differences between TCAR and TFCAS in the odds of in-hospital stroke and MI (Table 1).

Conclusions: The degree of carotid artery calcification has a negative impact on the outcomes of patients undergoing TFCAS. However, it doesn't appear to impact the outcomes of patients undergoing TCAR. In patients with heavily calcified lesions, TCAR seems to have favorable outcomes compared to TFCAS. These results confirm the superiority of the flow reversal compared to distal embolic protection devices. Further research is needed to assess long-term outcomes and confirm the safety of TCAR in heavily calcified lesions.

Table 1. In-hospital outcomes of patients undergoing TCAR vs TFCAS stratified by the degree of lesion calcification.

outcomes	**TCAR (N=6,926) (>50% vs. ≤50%)**		**TFCAS (N=4,416) (>50% vs. ≤50%)**		**TCAR vs TFCAS Patients with >50% calcification**	
	OR (95% CI)	**P value**	**OR (95% CI)**	**P value**	**OR (95% CI)**	**P value**
Stroke/death	1.2 (0.8-1.7)	0.452	1.5 (1.02-2.08)	0.039	0.5 (0.32-0.8)	0.004
Stroke	1.2 (0.8-1.8)	0.406	1.6 (1.04-2.5)	0.032	0.69 (0.4-1.1)	0.140
Death	0.87 (0.36-2.1)	0.752	1.05 (0.6-1.9)	0.871	0.3 (0.13-0.72)	0.006
Stroke/TIA	1.12 (0.8-1.6)	0.531	1.6 (1.1-2.3)	0.013	0.6 (0.38-0.91)	0.018
Stroke/death/MI	1.2 (0.81.6)	0.372	1.4 (0.99-2.06)	0.060	0.58 (0.39-0.87)	0.008
MI	1.1 (0.6-2.0)	0.781	1.04 (0.5-2.3)	0.924	0.79 (0.37-1.7)	0.536

25. Observations regarding the effect of COVID-19 on amputations performed in a tertiary referral health system

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Objective:
Vascular practices across the country engaged in care prioritization in response to the COVID-19 pandemic. In anticipation of a strain on healthcare resources, our tertiary referral center implemented guidelines to tier procedures by type and urgency with a shift toward telehealth encounters. The aim of this analysis is to reveal the impact of this alteration in practice pattern on the amputation experience for a similar time interval before and during the initial pandemic.

Methods:
Our institutional Vascular Quality Initiative (VQI) database was used to evaluate and compare amputations and contemporaneous vascular procedures performed in the 6 months following the pandemic-related healthcare changes (April – September 2020) to a 6-month period immediately prior to this interval (July-December 2019). All lower extremity amputations, bypass procedures, and peripheral vascular interventions (PVI) performed by a single vascular surgery practice across five hospitals of a major healthcare system were included.

Results:
There was an increase in the total number of amputations performed during the initial pandemic interval (n=64) compared to the pre-COVID interval (n=42) with an increase in both major (32 vs 25) and minor (32 vs 17) amputations. There was a statistically significant increase in mean amputations per month during the pandemic interval for total amputations (mean 7.0 vs. 10.7, p=0.028) and minor amputations (2.8 vs. 5.3, p=0.016) with the numerical increase in major amputation not reaching mean statistical significance. The total number of revascularization procedures (bypass and endovascular) performed during the initial pandemic (n=169) was decreased compared to pre-COVID levels (n=208). Decreases in the performance of bypass (mean per month: 14 vs. 11.2 p = 0.24) and endovascular procedures (mean per month: 20.7 vs. 17.0, p = 0.37) were noted although did not reach mean statistical significance. However, the ratio of amputation to bypass increased from 0.5 to 1.0 (p = 0.01) as did amputation to endovascular procedures from 0.3 to 0.6 (p = 0.01).

Conclusions:
A rise in the total number of amputations, predominantly minor, and a corresponding decrease in revascularization procedures was observed during the initial COVID-19 pandemic. Further investigation is warranted to identify the underlying etiology of this impact; decreased revascularization performed, delayed care, infection, or the result of case prioritization. Future emphasis on the delivery of care to prevent amputation and optimize outcomes during a pandemic is indicated.

26. Frailty and Outcomes Following Percutaneous Vascular Interventions in Lower-Extremity Peripheral Artery Disease: Insights from the Vascular Quality Initiative

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Background:
Frailty is associated with adverse outcomes among patients undergoing cardiovascular interventions. It is unknown whether frailty is associated with mortality and unplanned amputation in patients with lower-extremity peripheral artery disease (PAD) undergoing percutaneous vascular interventions (PVI).
Methods: Patients undergoing PVIs between 2010 and 2019 were identified from the Society of Cardiovascular Surgery Vascular Quality Initiative North-Eastern database. Frailty was assessed by the 5-item modified frailty index (mFI-5), a composite score of the following characteristics: hypertension, diabetes, heart failure, chronic obstructive pulmonary disease, and bedridden functional status. A score of 2 or more denoted frailty. Logistic regression models examined the associations between frailty and in-hospital mortality and unplanned amputation.
Results: Out of 7,369 PAD patients undergoing PVI, 32% had mFI-5 of 0 or 1, and 68% had mFI-5 of ≥2. A higher score on the mFI-5 was associated with higher odds of mortality (adjusted OR=1.56, CI 95% 1.16;2.10, P <0.01) (Figure) but not unplanned amputation (OR=0.88, CI 95% 0.63;1.26, P 0.51).

Conclusion:
Higher frailty scores for patients undergoing PVI translated into a higher in-hospital mortality risk. Frailty could be considered in the perioperative decision-making for PAD patients undergoing PVI.

Figure: Association of frailty as assessed by the 5-item modified frailty index with adjusted odds of in-hospital mortality (Panel A) and major amputation (Panel B).