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Selected Abstracts from the Journal of Vascular Surgery

The effect of surgeon and hospital volume on mortality after open and endovascular repair of abdominal aortic aneurysms

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Background: Higher hospital and surgeon volumes are independently associated with improved mortality after open repair of abdominal aortic aneurysms (AAAs) in the era before endovascular AAA repair (EVAR). The effects of both surgeon and hospital volume on mortality after EVAR and open repair in the current era are less well defined.

Methods: We studied Medicare beneficiaries who underwent elective AAA repair from 2001 to 2008. Volume was measured by procedure type during the 1-year period preceding each procedure and was further categorized into quintiles of volume for surgeon and hospital. Multilevel logistic regression models were used to evaluate the effect of surgeon volume, accounting for hospital volume, on mortality after adjusting for patient demographic and comorbid conditions as well as the analogous effect of hospital volume adjusting for surgeon volume. The multilevel models included random effects for surgeon and hospital to account for the clustering of multiple patients within the same surgeon and within the same hospital.

Results: We studied 122,495 patients who underwent AAA repair (open: 45,451; EVAR: 77,044). After EVAR, perioperative mortality did not differ by surgeon volume (quintile 1 [0-6 EVARs]: 1.8%; quintile 5 [28-151 EVARs]: 1.6%; $P = .29$), but decreased with greater hospital volume (quintile 1 [0-9 EVARs]: 1.9%; quintile 5 [49-198 EVARs]: 1.4%; $P < .01$). After open repair, perioperative mortality decreased with both higher surgeon volume (quintile 1 [0-3 open repairs]: 6.4%; quintile 5 [14-62 open repairs]: 3.8%; $P < .01$) and hospital volume (quintile 1 [0-5 open repairs]: 6.3%; quintile 5 [14-62 open repairs]: 3.8%; $P < .01$). After adjustment for other predictors, surgeon volume was not associated with perioperative mortality after EVAR (odds ratio [OR], 0.9; 95% confidence interval [CI], 0.7-1.1); however, hospital volume was associated with higher perioperative mortality (quintile 1: OR, 1.5; 95% CI, 1.2-1.9; quintile 2: OR, 1.3; 95% CI, 1.02-1.6; and quintile 3: OR, 1.2; 95% CI, 1.01-1.5, compared with 5). After open repair, higher surgeon volume was also associated with lower mortality (quintile 1: OR, 1.5; 95% CI, 1.3-1.8; quintile 2: OR, 1.3; 95% CI, 1.1-1.6; and quintile 3: OR, 1.2; 95% CI, 1.1-1.4, compared with 5). Risk of mortality also was higher for patients treated at lower-volume hospitals (quintile 1: OR, 1.3; 95% CI, 1.1-1.5; quintile 2: OR, 1.3; 95% CI, 1.1-1.5; and quintile 3: OR, 1.2; 95% CI, 1.1-1.4, compared with 5).

Conclusions: After EVAR, hospital volume is minimally associated with perioperative mortality, with no such association for surgeon volume. After open AAA repair, surgeon and hospital volume are both strongly associated with mortality. These findings suggest that open surgery should be concentrated in hospitals and surgeons with high volume.

Volume of subclinical embolic infarct correlates to long-term cognitive changes after carotid revascularization

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Objective: Carotid intervention is safe and effective in stroke prevention in appropriately selected patients. Despite minimal neurologic complications, procedure-related subclinical microemboli are common and their cognitive effects are largely unknown. In this prospective longitudinal study, we sought to determine long-term cognitive effects of embolic infarcts.

Methods: The study recruited 119 patients including 46% symptomatic patients who underwent carotid revascularization. Neuropsychological testing was administered preoperatively and at 1 month, 6 months, and 12 months postoperatively. Rey Auditory Verbal Learning Test (RAVLT) was the primary cognitive measure with parallel forms to avoid practice effect. All patients also received 3T brain magnetic resonance imaging with a diffusion-weighted imaging (DWI) sequence preoperatively and within 48 hours postoperatively to identify procedure-related new embolic lesions. Each DWI lesion was manually traced and input into a neuroimaging program to define volume. Embolic infarct volumes were correlated with cognitive measures. Regression models were used to identify relationships between infarct volumes and cognitive measures.

Results: A total of 587 DWI lesions were identified on 3T magnetic resonance imaging in 81.7% of carotid artery stenting (CAS) and 36.4% of carotid endarterectomy patients with a total volume of 29,327 mm^3. Among them,

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54 DWI lesions were found in carotid endarterectomy patients and 533 in the CAS patients. Four patients had transient postoperative neurologic symptoms and one had a stroke. CAS was an independent predictor of embolic infarction (odds ratio, 6.6 [2.1-20.4]; $P < .01$) and infarct volume ($P = .004$). Diabetes and contralateral carotid severe stenosis or occlusion had a trend of positive association with infarct volume, whereas systolic blood pressure $\geq$140 mm Hg had a negative association ($P = .1$, .09, and .1, respectively). There was a trend of improved RAVLT scores overall after carotid revascularization. Significantly higher infarct volumes were observed among those with RAVLT decline. Within the CAS cohort, infarct volume was negatively correlated with short- and long-term RAVLT changes ($P < .05$).

Conclusions: Cognitive assessment of procedure-related subclinical microemboli is challenging. Volumes of embolic infarct correlate with long-term cognitive changes, suggesting that microembolization should be considered a surrogate measure for carotid disease management.

Predictive ability of the Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIfI) classification system after first-time lower extremity revascularizations

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Objective: The Society for Vascular Surgery (SVS) Wound, Ischemia and foot Infection (WIfI) classification system was proposed to predict 1-year amputation risk and potential benefit from revascularization. Our goal was to evaluate the predictive ability of this scale in a real-world selection of patients undergoing a first-time lower extremity revascularization for chronic limb-threatening ischemia (CLTI).

Methods: From 2005 to 2014, 1336 limbs underwent a first-time lower extremity revascularization for CLTI, of which 992 had sufficient data to classify all three WIfI components (wound, ischemia, and foot infection). Limbs were stratified into the SVS WIfI clinical stages (from 1 to 4) for 1-year amputation risk estimation, a novel WIfI composite score from 0 to 9 (that weighs all WIfI variables equally), and a novel WIfI mean score from 0 to 3 (that can incorporate limbs missing any of the three WIfI components). Outcomes included major amputation; revascularization, major amputation, or stenosis (>3.5× step-up by duplex; RAS) events; and death. Predictors were identified using Cox regression models and Kaplan-Meier survival estimates.

Results: Of the 1336 first-time procedures performed, 992 limbs were classified in all three WIfI components (524 endovascular and 468 bypass; 26% rest pain and 74% tissue loss). Cox regression demonstrated that a one-unit increase in the WIfI clinical stage increases the risk of major amputation (hazard ratio [HR], 2.4; 95% confidence interval [CI], 1.7-3.2) and RAS events in all limbs (HR, 1.2; 95% CI, 1.1-1.3). Separate models of the entire cohort, a bypass-only cohort, and an endovascular-only cohort showed that a one-unit increase in the WIfI mean score is associated with an increase in the risk of major amputation (all three cohorts: HR, 5.3 [95% CI, 3.6-6.8], 4.1 [2.4-6.9], and 6.6 [3.8-11.6], respectively) and RAS events (all three cohorts: HR, 1.7 [95% CI, 1.4-2.0], 1.9 [1.4-2.6], and 1.4 [1.1-1.9], respectively). The novel WIfI composite and WIfI mean scores were the only consistent predictors of death among the three cohorts, with the WIfI mean score proving most strongly predictive in the entire cohort (HR, 1.4; 95% CI, 1.1-1.7), the bypass-only cohort (HR, 1.5; 95% CI, 1.1-1.9), and the endovascular-only cohort (HR, 1.4; 95% CI, 1.0-1.8). Although the individual WIfI wound component was able to predict mortality among all patients (HR, 1.1; 95% CI, 1.0-1.2) and bypass-only patients (HR, 1.2; 95% CI, 1.1-1.3), neither the additional individual WIfI components nor the WIfI clinical stage were able to significantly predict mortality among any cohort.

Conclusions: This study supports the ability of the SVS WIfI classification system to predict major amputation; however, the novel WIfI mean and WIfI composite scores predict amputation, RAS events, and mortality more consistently than any other current WIfI scoring system. The WIfI mean score allows inclusion of all limbs, and both novel scoring systems are easier to conceptualize, give equal weight to each WIfI component, and may provide clinicians more effective comparisons in outcomes between patients.

High dose-rate brachytherapy for the treatment of lower extremity in-stent restenosis

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Objective: Historically, edge stenosis and late thrombosis limited the effectiveness of adjunctive endovascular brachytherapy (EVBT) for in-stent restenosis (ISR) after percutaneous transluminal angioplasty (PTA) and stenting. We evaluated an updated protocol of PTA and EVBT for ISR among patients with lower extremity occlusive disease.

Methods: This is a retrospective, single-center review of patients treated with PTA and EVBT for ISR in the iliac and femoropopliteal segments between 2004 and 2012. A dose of 20 Gy was given at a depth of 0.5 mm beyond the radius of the largest PTA balloon using iridium 192, with at least 2-cm-long margins of radiation coverage proximal and distal to the injured area. Stents were assessed for patency by duplex ultrasound imaging at 1, 3, 6, 9, 12, and 18 months and then yearly. The primary end point was freedom from $\geq$50% restenosis in the treated segment at 6 months, 1 year, and 2 years. Patency data were estimated using the Kaplan-Meier method. Secondary end points were early and late thrombotic occlusion.

Results: Among 42 consecutive cases in 35 patients of EVBT for ISR in common or external iliac (9 [20.8%]) and superficial femoral or popliteal (33 [76.7%]) arteries, or both, 21