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Predictors and outcome of endoleaks in the Veterans Affairs Open Versus Endovascular Repair (OVER) Trial of Abdominal Aortic Aneurysms

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Objective: The Veterans Affairs Open Versus Endovascular Repair (OVER) Trial of Abdominal Aortic Aneurysms study was a randomized controlled trial comparing open vs endovascular repair (EVAR) in standard-risk patients with infrarenal aortic aneurysms. The analysis reported here identifies characteristics, risk factors, and long-term outcome of endoleaks in patients treated with EVAR in the OVER cohort.

Methods: The OVER trial enrolled 881 patients, of whom 439 received successful EVAR. Logistic regression analysis was used to identify predictors for endoleaks and secondary interventions. Kaplan-Meier survival analysis, longitudinal plots, and generalized linear mixed models methods were used to describe time to endoleak detection, resolution, or death.

Results: During a mean follow-up of 6.2 $\pm$ 2.4 years, 135 patients (30.5%) developed 187 endoleaks. Four patients with EVAR went on to rupture; these four patients did not all have an endoleak. Mortality between patients who did and did not develop endoleaks was not significantly different. The 187 endoleaks included 12% type I, 76% type II, 3% type III, 3% type IV, and 6% indeterminate. Patient demographics and vascular risk factors were not associated with endoleak development. The presence of endoleaks resulted in an increase in aneurysm diameter over time ($P <$ .0001). Fifty-three percent of endoleaks resolved spontaneously, and 31.9% received secondary interventions. The initial aneurysm size independently predicted a need for secondary interventions ($P <$ .0003). Delayed type II endoleaks (detected $>$1 year after EVAR) were associated with aneurysm enlargement compared with the early counterpart. There was no difference in aneurysm size or length of survival between type II and other types of endoleak.

Conclusions: We present one of the most comprehensive and longest follow-up analyses of patients treated with aortic endografts. Endoleaks were common and negatively affected aneurysm diameter reduction. Delayed type II endoleaks were associated with late aneurysm diameter enlargement. Endoleaks and aneurysm diameter enlargement were not associated with excess mortality compared with those without these features.

Postoperative renal dysfunction independently predicts late mortality in patients undergoing aortic reconstruction

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Objective: Preoperative chronic kidney disease (CKD) has been shown to predict postoperative renal complications and mortality after open aortic surgery; the impact of postoperative renal complications less severe than permanent dialysis are unknown. We evaluated the impact of postoperative renal dysfunction severity on survival using a regional quality improvement registry.

Methods: Patients undergoing intact open aortic reconstruction in the Vascular Study Group of New England registry (2003-2012) were stratified by severity of postoperative renal complications; none, creatinine increase of greater than 0.5 mg/dL (incCr), or any hemodialysis (HD). Predictors of renal dysfunction and impact of renal complications on survival were analyzed using multivariable methods.

Results: We included 2695 patients, of which 65% (n = 1733) underwent open abdominal aortic aneurysm repair, and 35% (n = 962) open aortoiliac reconstruction. At baseline, 15% of patients had preoperative moderate CKD and 1.2% had severe CKD. Postoperative renal complications of incCr occurred in 8.5% of patients, and 1.5% required HD. Multivariable cumlogit regression identified severe baseline CKD (odds ratio [OR], 15; 95% confidence interval [CI], 6.4-34; $P <$ .001, moderate CKD (OR, 2.8; 95% CI, 1.9-3.3; $P <$ .001), suprarenal clamp use (OR, 2.2; 95% CI, 1.6-2.9; $P <$ .001), perioperative vasopressor requirements (OR, 2.2; 95% CI, 1.6-2.9; $P <$ .001), operating time (OR, 1.004 per minute; 95% CI, 1.003-1.006; $P <$ .001), and chronic obstructive pulmonary disease (OR, 1.5; 95% CI, 1.2-1.8; $P <$ .001) as independent predictors of worsening strata of postoperative renal dysfunction. Multivariable logistic regression analysis showed that patient age (OR, 1.06 per year; 95% CI, 1.01-1.1; $P =$ .01), baseline chronic obstructive pulmonary disease (OR, 1.6; 95% CI, 1.2-2.2; $P <$ .01), incCr (OR, 3.7; 95% CI, 1.8-7.4; $P =$ .009), and HD (OR, 4.8; 95% CI, 1.8-12.7); $P =$ .009) independently increased 30-day

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mortality. Risk-adjusted multivariable Cox regression showed that incCr (hazard ratio, 1.8; 95% CI, 1.3-2.6; $P < .001$) and HD (hazard ratio, 4.4; 95% CI, 2.8-6.9; $P < .001$) increased risk of late death independent of a variety of other clinical variables, including baseline CKD. The 5-year survival was lower (log-rank $P < .001$) in patients with incCr (66% $\pm$ 4%), and HD (38% $\pm$ 10%) compared with those with no renal complications (77% $\pm$ 1%).

Conclusions: Increasing severity of postoperative renal dysfunction independently predicts increased risk of late mortality after open aortic surgery. Perioperative measures to decrease renal complications may potentially prolong the survival of patients after open aortic surgery.

The in-hospital costs of treating high risk patients with fenestrated and branched endografts

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Objective: This study determined the 30-day morbidity and mortality and in-hospital costs of elective fenestrated (fEVAR) and branched (bEVAR) endovascular aneurysm repairs at a single academic institution and determined factors that influence them.

Methods: All elective fEVAR or bEVAR patients treated between November 2007 and March 2014 in a Canadian academic hospital were included. Procedural details, 30-day morbidity and mortality rates, and cost of hospitalization were analyzed. Nonparametric bootstrap analysis was used to compare means between groups and calculate confidence intervals (CIs).

Results: There were 84 consecutive fEVAR (n = 61) and bEVAR (n = 23) procedures. The 30-day mortality was 3.3% for fEVAR and 4.3% for bEVAR. Mean hospital stay was 7.2 $\pm$ 0.8 days for fEVAR and 12.6 $\pm$ 2.2 days for bEVAR. The mean cost of the index hospitalization was $57,000 for fEVAR and $91,000 for bEVAR. Device-related costs accounted for 55% of the total costs. The occurrence of intraoperative or postoperative events were used to further divide each of the fEVAR and bEVAR groups into "complicated hospitalization" (fEVAR, n = 10; bEVAR, n = 13) and "uncomplicated hospitalization" (fEVAR, n = 51; bEVAR, n = 10) groups. Device-related costs were not significantly different between the complicated and uncomplicated hospitalization groups (mean difference [95% CI] fEVAR: $3383 [−$3405 to $9809], $P = .3$; and bEVAR: $1930 [−$7892 to $11,288], $P = .68$). However, there were significant differences between the complicated and uncomplicated hospitalization groups in hospital length of stay (mean difference [95% CI] fEVAR: 8.1 [3.0-13.2] days, $P = .001$; and bEVAR: 10.8 [5.9-19.9] days, $P = .002$) and nondevice-related costs (mean difference [95% CI,] fEVAR: $25,843 [$11,689-$43,247], $P = .001$; and bEVAR; $20,326 [$9362-$36,615], $P = .002$).

Conclusions: bEVAR and fEVAR are expensive interventions. Intraoperative adverse events and postoperative systemic complications dramatically increase costs and length of stay. Measures to minimize complications will reduce hospitalization costs and improve patient outcomes.

Comparison of posterior and medial approaches for popliteal artery aneurysms

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Background: Long-term results of the posterior approach (PA) for the treatment of popliteal artery aneurysms are lacking in the literature. We reviewed our experience during a 13-year period in patients with popliteal artery aneurysms, comparing those treated through a PA with those operated on through a standard medial approach (MA).

Methods: Clinical data of all patients treated between February 1998 and October 2011 were retrospectively reviewed and outcomes analyzed. The Kaplan-Meier method was used to estimate survival, and χ^2, Wilcoxon, and log-rank tests were used for analysis.

Results: A total of 77 aneurysms were treated in 65 patients (64 men). Mean age was 68 years (range, 48-96 years). Thirty-six aneurysms were asymptomatic (47%). Mean sac diameter was 2.8 $\pm$ 1 cm. A PA was used in 43 PAAs (55%) and an MA in 34. The PA and MA patients differed significantly in age (median being older), smoking history (more frequent in PA), and renal insufficiency and cerebrovascular disease (higher for MA). In 42 cases the aneurysm was symptomatic (54.5%) for chronic limb ischemia, with intermittent claudication in 18 patients, acute ischemia in 17, blue toe syndrome in 3, compression on adjacent structures in 3, and rupture with severe acute pain in 1. All PA repairs consisted of aneurysmectomy with an interposition graft with end-to-end anastomoses; among MA repairs, 22 interposition grafts and 12 bypasses were performed. A polytetrafluoroethylene graft was used in 54 cases. Five patients had an early thrombosis (two PA and three MA). No perioperative deaths occurred. Two patients sustained a permanent (PA) and a temporary (MA) peroneal nerve lesion. There were no early amputations. The median in-hospital stay was longer for MA (10 days) than for PA (7 days; $P = .02$). Median follow-up was 58.8 months (range, 5 days-166 months). Nine patients died during follow-up of unrelated causes. The 5-year primary and secondary patency rates were 59.6% $\pm$ 8.6% and 96.5% $\pm$ 3.4%, respectively, for PA, and 65.1% $\pm$ 11.1% and 79.4% $\pm$ 9.7%, respectively, for MA ($P = .53$ for primary patency rate and $P = .22$ for secondary patency rate). Limb salvage was 100% at 5 years and 93.3% $\pm$ 6.4% at 10 years for PA and 91.1% $\pm$ 6.3% at both time points for MA ($P = .28$).

Conclusions: PA and MA both achieved satisfactory results in primary and secondary patency rates, as well as limb salvage, during long-term follow-up. The differences between the two groups were small and not statistically

significant. PA was burdened by similar postoperative nerve and wound complications compared with MA. The in-hospital stay after PA was significantly lower.

Urgent carotid intervention is safe after thrombolysis for minor to moderate acute ischemic stroke

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Objective: Carotid intervention shortly after an acute neurologic ischemic event is being performed more frequently in stroke centers to reduce the risk of recurrent stroke. Thrombolysis with recombinant tissue plasminogen activator (tPA) is offered to select patients with ischemic stroke symptoms who present within 4.5 hours. However, there is a paucity of data as to whether tPA followed by urgent carotid endarterectomy (CEA) or carotid artery stenting (CAS) has an increased risk of complications, particularly intracerebral hemorrhage (ICH). We sought to determine the periprocedural complications of urgently performed CEA or CAS following tPA.

Methods: From January 2009 to January 2015, 762 patients underwent carotid interventions (CEA, n = 440; CAS, n = 322) at a tertiary referral center and 165 patients (21.6%) underwent an urgent CEA or CAS during the index hospitalization for an acute transient ischemic attack or stroke. We compared the effect of intravenous tPA on 30-day complications, including ICH. The χ^2 and Fisher exact tests were used to determine significance between groups.

Results: During the 6-year period, 165 patients underwent urgent carotid interventions (CEA, n = 135; CAS, n = 30) for acute neurologic symptoms. Of these, 19% (31 patients [CEA, n = 25; CAS, n = 6]) had tPA for an acute stroke; the remaining (134 patients [CEA, n = 110; CAS, n = 24]) fell outside of the tPA time window. Most strokes were minor or moderate with a mean National Institutes of Health Stroke Scale (NIHSS) score of 6.6 (range, 0-19). The mean time to intervention for both groups was 2.4 days (0-15 days). The 30-day stroke, death, and myocardial infarction rates were 9.7% (3 of 31) for the tPA group compared with 4.5% (6 of 134) for the no-tPA group ($P = .37$). Including bleeding complications in these 30-day outcomes, there was no difference between the tPA (3 of 31) and the no-tPA cohorts (8 of 134; $P = .43$). In the tPA group, there were one ICH, one neck hematoma/death, and an additional death; in the no-tPA group, there were one ICH, two neck hematomas, one stroke, two myocardial infarctions, one ICH/death, and one additional death. No significant increased rates of bleeding were noted within the tPA group (2 of 31) compared with the no-tPA group (4 of 134; $P = .32$). Moreover, in the tPA cohort, more than half of the patients (17 of 31) underwent revascularization within 72 hours (CEA = 13; CAS = 4) with outcomes similar to those who underwent revascularization after 72 hours.

Conclusions: Thrombolysis followed by urgent CEA or CAS is not associated with an increased risk of complications in select patients who present with acute neurologic symptoms. Selection of patients is important; there was no ICH and only one death in each group for patients with minor to moderate ischemic stroke (NIHSS score <10).

A randomized controlled trial of interrupted versus continuous suturing techniques for radiocephalic fistulas

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Objective: Continuous suturing techniques have conventionally been used for the end-to-side anastomoses of radiocephalic fistulas (RCFs); however, primary patency rates are poor. Only 50% to 60% of RCFs ever achieve functional patency. We hypothesized that a hybrid interrupted-continuous suturing technique (as used in many microsurgical procedures) may improve outcomes in fistulas constructed from small vessels.

Methods: A randomized controlled trial comparing hybrid interrupted continuous (n = 42) with continuous (n = 36) suturing techniques for RCF was undertaken. Patients were excluded if vessels were <1.8 mm in diameter or if previous ipsilateral fistula had been attempted. A priori power calculation indicated that a sample size of 78 patients was required to detect an improvement in patency from 50% to 80% ($\alpha = .05$, $\beta = .8$). The primary end point was primary patency at 6 weeks (assessed by a blinded observer for the presence of thrill and bruit). Secondary end points were immediate patency, functional patency (assessed clinically and by ultrasound) at 6 weeks, and presence of anastomotic stenosis.

Results: Groups were comparable for basic patient demographics, operating surgeon, and vessel diameter as measured on preoperative ultrasound (mean age, 58.9 $\pm$ 13 years; 68% male). Primary patency at 6 weeks was higher in the hybrid interrupted-continuous suturing technique group (71% vs 47%; $P = .01$). Immediate patency was also higher in the hybrid interrupted-continuous suturing technique group (93% vs 67%; $P < .001$). There was no significant difference in functional patency at 6 weeks (52% vs 36%; $P = .18$). Three patients developed an anastomotic stenosis. All were in the hybrid interrupted-continuous suturing technique group. One patient from the interrupted suturing technique cohort required re-exploration for bleeding.

Conclusions: A hybrid interrupted-continuous suturing technique yielded higher immediate and 6-week primary patency rates for RCF. The hybrid interrupted-continuous suturing technique may improve anastomotic compliance and reduce the narrowing and puckering that can occur on suture tightening in small-caliber vessels. Based on these findings, consideration should be given to performing hybrid interrupted-continuous anastomoses for RCFs.