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# Selected Abstracts from the September Issue of the Journal of Vascular Surgery☆

## Editors: Anton N. Sidawy and Bruce A. Perler

### Suprarenal graft fixation in endovascular abdominal aortic aneurysm repair is associated with a decrease in renal function

Athanasios Saratzis, Pantelis Sarafidis, Nikolaos Melas, James P. Hunter, Nikolaos Saratzis, Dimitrios Kiskinis, George D. Kitas

***Introduction:*** Suprarenal endograft fixation is routinely used in the endovascular repair of abdominal aortic aneurysms (EVAR) to enhance proximal endograft attachment but can be associated with an adverse outcome in renal function. This prospective study assessed the effect of suprarenal fixation on serum creatinine concentration and estimated glomerular filtration rate (eGFR), calculated by the Modified Diet in Renal Disease equation, 12 months after elective EVAR.
***Methods:*** Patients undergoing elective EVAR were divided into suprarenal vs infrarenal fixation groups matched for age, sex, smoking, and aneurysm diameter. Serum creatinine and eGFR were measured at baseline, 6, and 12 months.
***Results:*** Included were 92 patients (2 women), with a mean age of 71 ± 7 years, with 46 in each group. No device-related complications were noted. Serum creatinine did not differ significantly between groups at 6 ($P = .24$) or 12 ($P = .08$) months but significantly increased in the suprarenal group at 12 months (1.08 ± 0.36 to 1.16 ± 0.36 mg/dL; $P < .001$) vs baseline. The eGFR (mL/min/1.73 $m^2$) did not differ significantly at baseline between the suprarenal (85 ± 27) and infrarenal (80 ± 28; $P = .33$) groups or at 6 months (88 ± 29 vs 77 ± 24, respectively; $P = .07$). At 12 months, the suprarenal group had a lower eGFR (73 ± 23) than the infrarenal group (84 ± 26; $P = .027$). The eGFR at 12 months showed a significant decrease in the suprarenal (80 ± 28 to 73 ± 23; $P < .001$) but not in the infrarenal group (85 ± 27 to 84 ± 26; $P = .48$). The drop in eGFR differed significantly at 12 months in the infrarenal vs the suprarenal (0.82 vs −6.94; $P < .001$) group. No patient progressed to end-stage renal disease or disclosed a drop in eGFR > 30%.
***Conclusions***: In contrast to previous studies, this study suggests that suprarenal endograft fixation in elective EVAR is associated with a drop in eGFR at 12 months.

### Superior outcomes for rural patients after abdominal aortic aneurysm repair supports a systematic regional approach to abdominal aortic aneurysm care

Matthew W. Mell, Christie Bartels, Amy Kind, Glen Leverson, Maureen Smith

***Objective:*** The impact of geographic isolation on abdominal aortic aneurysm (AAA) care in the United States is unknown. It has been postulated but not proven that rural patients have less access to endovascular aneurysm repair (EVAR), vascular surgeons, and high-volume treatment centers than their urban counterparts, resulting in inferior AAA care. The purpose of this study was to compare the national experience for treatment of intact AAA for patients living in rural areas or towns with those living in urban areas.
***Methods:*** Patients who underwent intact AAA repair in 2005 to 2006 were identified from a standard 5% random sample of all Medicare beneficiaries. Data on patient demographics, comorbidities, type of repair, and specialty of operating surgeon were collected. Hospitals were stratified into quintiles by yearly AAA volume. Primary outcomes included 30-day mortality and rehospitalization.
***Results:*** A total of 2616 patients had repair for intact AAA (40% open, 60% EVAR). Patients from rural and urban areas were equally likely to receive EVAR (rural 60% vs urban 61%; $P = .99$) and be treated by a vascular surgeon (rural 48% vs urban 50%; $P = .82$). Most rural patients (86%) received care in urban centers. Primary outcomes occurred in 11.6% of rural patients (1.3% 30-day mortality; 10.3% rehospitalization) vs 16.0% of urban patients (3% 30-day mortality, 13% rehospitalization; $P = .04$). In multivariate analyses, rural residence was independently associated with treatment at high-volume centers (odds ratio, 1.64; 95% confidence interval, 1.34-2.01; $P < .0001$) and decreased death or rehospitalization (odds ratio, 0.69; 95% confidence interval, 0.49-0.97; $P = .03$).
***Conclusions:*** Despite geographic isolation, patients in rural areas needing treatment for intact AAAs have equivalent access to EVAR and vascular surgeons, increased referral to high-volume hospitals, and improved outcomes after repair. This suggests that urban patients may be disadvantaged even with nearby access to high-quality centers. This study supports the need for criteria that define centers of excellence to extend the benefit of regionalization to all patients.

### Associated injuries, management, and outcomes of blunt abdominal aortic injury

Charles de Mestral, Andrew D. Dueck, David Gomez, Barbara Haas, Avery B. Nathens

***Objective:*** Blunt abdominal aortic injury (BAAI) is very rare, and current literature is limited to case series of single-center experience. Through an analysis of the National Trauma Data Bank, the largest aggregation of United States trauma registry data, our aim was to characterize the associated injury pattern, contemporary management, and in-hospital outcomes of patients with BAAI.
***Methods:*** We used a nested case-control design. The overall cohort consisted of adult patients (age ≥16 years) severely injured (Injury Severity Score ≥16) after blunt trauma who were treated at a level 1 or 2 trauma center in years 2007 to 2009. Cases were patients with BAAI and were frequency-matched by age group and mechanism to randomly selected controls at a one-to-five ratio. Multivariable matched analysis (conditional logistic regression) was used to derive adjusted measures of association between BAAI and adjacent arterial, intra-abdominal, and bony injuries.

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***Results:*** We identified 436 patients with BAAI from 180 centers. The mean Injury Severity Score was 35 ± 14, and most patients were injured in motor vehicle crashes (84%). Multivariable analysis showed injury to the thoracic aorta, renal and iliac artery, small bowel, colon, liver, pancreas, and kidney, as well as lumbar spine fractures were independently associated with BAAI. A total of 394 patients (90%) were managed nonoperatively, and 42 (10%) underwent repair. Of these 42 patients, 29 (69%) underwent endovascular repair, with 11 patients undergoing open aortic repair and two extra-anatomic bypasses. Median time from admission to repair was 1 day (interquartile range, 1-2 days). Overall mortality was 29%. A total of 271 (69%) of patients managed nonoperatively survived to hospital discharge.
***Conclusions:*** The index of suspicion for BAAI should be raised in severely injured patients by the presence of injuries to the lumbar spine, bowel, retroperitoneal organs, and adjacent major arteries. Although endovascular repair is the most common intervention, most patients are managed nonoperatively and survive to hospital discharge.

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### Regional use of combined carotid endarterectomy/coronary artery bypass graft and the effect of patient risk

Douglas W. Jones, David H. Stone, Mark F. Conrad, Yvon R. Baribeau, Benjamin M. Westbrook, Donald S. Likosky, Jack L. Cronenwett, Philip P. Goodney

***Introduction:*** Although carotid artery stenosis and coronary artery disease often coexist, many debate which patients are best served by combined concurrent revascularization (carotid endarterectomy [CEA]/coronary artery bypass graft [CABG]). We studied the use of CEA/CABG in New England and compared indications and outcomes, including stratification by risk, symptoms, and performing center.
***Methods:*** Using data from the Vascular Study Group of New England from 2003 to 2009, we studied all patients who underwent combined CEA/CABG across six centers in New England. Our main outcome measure was in-hospital stroke or death. We compared outcomes between all patients undergoing combined CEA/CABG to a baseline CEA risk group comprised of patients undergoing isolated CEA at non-CEA/CABG centers. Further, we compared in-hospital stroke and death rates between high and low neurologic risk patients, defining high neurologic risk patients as those who had at least one of the following clinical or anatomic features: (1) symptomatic carotid disease, (2) bilateral carotid stenosis >70%, (3) ipsilateral stenosis >70% and contralateral occlusion, or (4) ipsilateral or bilateral occlusion.
***Results:*** Overall, compared to patients undergoing isolated CEA at non-CEA/CABG centers (n = 1563), patients undergoing CEA/CABG (n = 109) were more likely to have diabetes (44% vs 29%; $P = .001$), creatinine >1.8 mg/dL (11% vs 5%; $P = .007$), and congestive heart failure (23% vs 10%; $P < .001$). Patients undergoing CEA/CABG were also more likely to take preoperative beta-blockers (94% vs 75%; $P < .001$) and less likely to take preoperative clopidogrel (7% vs 25%; $P < .001$). Patients undergoing CEA/CABG had higher rates of contralateral carotid occlusion (13% vs 5%; $P = .001$) and were more likely to undergo an urgent/emergent procedure (30% vs 15%; $P < .001$). The risk of complications was higher in CEA/CABG compared to isolated CEA, including increased risk of stroke (5.5% vs 1.2%; $P < .001$), death (5.5% vs 0.3%; $P < .001$), and return to the operating room for any reason (7.6% vs 1.2%; $P < .001$). Of 109 patients undergoing CEA/CABG, 61 (56%) were low neurologic risk and 48 (44%) were high neurologic risk but showed no demonstrable difference in stroke (4.9% vs 6.3%; $P = .76$), death, (4.9 vs 6.3%; $P = .76$), or return to the operating room (10.2% vs 4.3%; $P = .25$).
***Conclusions:*** Although practice patterns in the use of CEA/CABG vary across our region, the risk of complications with CEA/CABG remains significantly higher than in isolated CEA. Future work to improve patient selection in CEA/CABG is needed to improve perioperative results with combined coronary and carotid revascularization.

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### Symptomatic venous thromboembolism after femoral vein harvest

Ravi V. Dhanisetty, Timothy K. Liem, Gregory J. Landry, Brett C. Sheppard, Erica L. Mitchell, Gregory L. Moneta

***Objective:*** The femoral vein is increasingly utilized as a conduit in major arterial and venous reconstruction. However, perioperative complications, especially venous thromboembolism (VTE) associated with femoral vein harvest (FVH), are not well described. The purpose of this study was to determine the incidence and risk factors for the development of symptomatic VTE in patients who undergo FVH.
***Methods:*** We conducted a retrospective cohort study of all patients who underwent FVH over a 5-year period at a single institution. Patient clinical characteristics, indications for surgery, postoperative venous duplex scans, and computerized tomography scans of the chest were gathered and reviewed from an electronic medical record query. Statistical analysis was performed to determine which factors correlate with development of perioperative complications after FVH.
***Results:*** There were 57 patients (53% male; mean age, 62 years) who underwent 58 FVHs. Of the procedures, 53% were performed for arterial reconstruction and 47% for vascular reconstruction after cancer resection (85% portomesenteric reconstruction). Perioperative VTEs were diagnosed in 17 of 58 (29%) FVH procedures. Sixteen ipsilateral deep vein thromboses (DVT) occurred distal to the FVH site and five (9%) occurred proximal to the FVH site. The incidence of VTE was significantly greater in patients with malignancy (52% vs 10%; $P = .001$), and 88% of all VTEs in this series were diagnosed in patients with cancer. All DVTs proximal to the FVH site and all DVTs in the contralateral extremity occurred in patients with malignancy. Pulmonary embolism occurred in two patients. No patients developed compartment syndrome or limb loss. Eight patients (14%) required FVH site wound debridement.
***Conclusions:*** VTE after FVH occurs more frequently in patients with malignancy. Aggressive and prolonged thromboprophylaxis and routine venous ultrasound surveillance are warranted after FVH in patients with malignancy.

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### Negative pressure wound therapy on exposed prosthetic vascular grafts in the groin

Paul Berger, Dennis de Bie, Frans L. Moll, Gert-Jan de Borst

***Objective:*** This study assessed the outcome of vacuum-assisted closure (VAC) as primary therapy for exposed prosthetic vascular grafts in the groin (Szilagyi III).
***Methods:*** The study included all consecutive patients with Szilagyi III groin infections and exposed prosthetic graft material from 2009 to 2011. After initial wound debridement, VAC was applied using a two-layer combination, consisting of polyvinyl alcohol and polyurethane sponges. Continuous negative pressure was set on a maximum of 50 mm Hg. All patients received complementary antibiotic therapy. The primary endpoint was defined as complete wound closure. Secondary endpoints comprised bleeding complications, amputation, and death.
***Results:*** The study evaluated 15 patients with 17 Szilagyi III groin infections. Mean total length of VAC therapy was 43 days (range, 14-76 days). Mean time until complete healing was 51 days (range, 24-82 days). Mean length of VAC therapy in the hospital was 21 days (range, 5-61 days). Eleven patients received continued VAC treatment at home for a mean length of 22 days (range, 5-69 days). Complete healing was achieved in 14 groins (82%). Three failures due to persisting infection, persisting necrosis, and a pseudomonas infection were noted. No bleeding complications, amputations, or late reinfections occurred. Median follow-up was 380 days (range, 56-939 days). Despite therapy failure, all 17 grafts were preserved.
***Conclusions:*** VAC therapy on an exposed prosthetic vascular graft in the groin is safe and feasible when applying a combination of polyvinyl alcohol and polyurethane foam dressing and 50 mm Hg of continuous negative pressure, resulting in midterm graft preservation.

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### Anatomic distribution and mortality of arterial injury in the wars in Afghanistan and Iraq with comparison to a civilian benchmark

Nickolay P. Markov, Joseph J. DuBose, Daniel Scott, Brandon W. Propper, W. Darrin Clouse, Billy Thompson, Lorne H. Blackbourne, Todd E. Rasmussen

***Objective:*** The purpose of this study was to examine the anatomic distribution and associated mortality of combat-related vascular injuries comparing them to a contemporary civilian standard.

***Design:*** The Joint Trauma Theater Registry (JTTR) was queried to identify patients with major compressible arterial injury (CAI) and noncompressible arterial injury (NCAI) sites, and their outcomes, among casualties in Iraq and Afghanistan from 2003 to 2006. The National Trauma Data Bank (NTDB) was then queried over the same time frame to identify civilian trauma patients with similar arterial injuries. Propensity score-based matching was used to create matched patient cohorts from both populations for analysis.
***Results:*** Registry queries identified 380 patients from the JTTR and 7020 patients from the NTDB who met inclusion criteria. Propensity score matching for age, elevated Injury Severity Score (ISS; >15), and hypotension on arrival (systolic blood pressure [SBP] <90), resulted in 167 matched patients from each registry. The predominating mechanism of injury among matched JTTR patients was explosive events (73.1%), whereas penetrating injury was more common in the NTDB group (61.7%). In the matched cohorts, the incidence of NCAI did not differ (22.2% JTTR vs 26.6% NTDB; $P = .372$), but the NTDB patients had a higher incidence of CAI (73.7% vs 59.3%; $P = .005$). The JTTR cohort was also found to have a higher incidence of associated venous injury (57.5% vs 23.4%; $P < .001$). Overall, the matched JTTR cohort had a lower mortality than NTDB counterparts (4.2% vs 12.6%; $P = .006$), a finding that was also noted among patients with NCAI (10.8% vs 36.4%; $P = .008$). There was no difference in mortality between matched JTTR and NTDB patients with CAI overall (2.0% vs 4.1%; $P = .465$), or among those presenting with Glasgow Coma Scale (GCS) <8 (28.6% vs 40.0%; $P = 1.00$) or shock (SBP <90; 10.5% vs 7.7%; $P = 1.00$). The JTTR mortality rate among patients with CAI was, however, lower among patients with ISS >15 compared with civilian matched counterparts (10.7% vs 42.4%; $P = .006$).
***Conclusions:*** Mortality of injured service personnel who reach a medical treatment facility after major arterial injury compares favorably to a matched civilian standard. Acceptable mortality rates within the military cohort are related to key aspects of an organized Joint Trauma System, including prehospital tactical combat casualty care, rapid medical evacuation to forward surgical capability, and implementation of clinical practice guidelines. Aspects of this comprehensive combat casualty care strategy may translate and be of value to management of arterial injury in the civilian sector.

## Micro-lightguide spectrophotometry for tissue perfusion in ischemic limbs

Lise Pyndt Jørgensen, Torben V. Schroeder

***Objective:*** To validate micro-lightguide spectrophotometry (O2C) in patients with lower limb ischemia and to compare results with those obtained from toe blood pressure.
***Methods:*** We prospectively examined 59 patients, 24 of whom complained of claudication, 31 had critical ischemia, and four were asymptomatic. Diabetes was present in 19 (32%) patients. Saturation ($SO_2$) and flow measured with O2C were determined with the limb in the horizontal position followed by a 55 cm elevation. Toe pressures were determined in the horizontal position only. In addition, 13 patients were examined before and, on average, 3 days after revascularization.
***Results:*** Median $SO_2$ was 62% (25%-75% percentile: 37%-75%) with the limb in the horizontal position and 16% (3%-41%) with the limb elevated. Comparing the individual toe pressures with $SO_2$ values measured in the horizontal position and elevated position revealed a significant correlation ($r_s = 0.40$; $P < .01$ and $r_s = 0.56$; $P < .01$, respectively). A low $SO_2$ (ie, <40% in the horizontal position and <20% in the elevated position) was highly predictive of a toe pressure of 40 mm Hg or less. In the horizontal position, the positive predictive value was 100%, whereas the negative predictive value was 47%. The similar figures in the elevated position were a positive predictive value of 97% and a negative predictive value of 68%. Postoperatively, $SO_2$ increased significantly from 27% (P25%-75%: 11-75) to 79% (68%-87%) in the horizontal position ($P = .008$) and from 14% (P25%-75%: 2%-39%) to 55% (30%-73%) in the elevated position ($P = .011$), respectively. Looking at the individual 13 cases in which revascularization was performed, three patients had a partial reconstruction (ie, superficial femoral artery occlusion distal to a central reconstruction or reconstruction to a popliteal blind segment). These patients had significantly lower postoperative $SO_2$ as well as toe pressure compared with the 10 patients with unobstructed flow to the foot.
***Conclusions:*** O2C was easy to use, fast, and painless. The most useful finding was the high predictive value of a low saturation and the rise in O2C values after successful revascularization.