

## Selected Abstracts from the October Issue of the Journal of Vascular Surgery<sup>☆</sup>

### Vascular surgery training and certification: An international perspective

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**Objective.** Vascular surgery (VS) practice has expanded to incorporate interventional procedures, and this has stimulated changes in training. The purpose of this study was to review current VS training and certification in different countries.

**Methods.** A survey was completed by vascular surgeons involved with national certification in 34 countries. Results are expressed as the mean  $\pm$  SD, with comparisons by  $\chi^2$  and *t* tests.

**Results.** VS is currently an independent specialty in 15 surveyed countries, is a subspecialty of general surgery in 10 countries, and is not recognized as a specialty in 9 countries. There has been a clear time trend toward independent certification. In countries with independent VS certification, the length of VS training is  $3.7 \pm 0.9$  years plus  $2.3 \pm 0.7$  years of associated core general surgery (GS), for a total training length of  $5.9 \pm 1.0$  years. In countries with VS subspecialty certification, the length of VS training is  $2.4 \pm 0.5$  years after  $5.0 \pm 1.1$  years of GS, for a total training length of  $7.4 \pm 1.2$  years (each  $P < .01$  vs independent certification). The minimum required volume of major open VS operations during training is  $151 \pm 78$  in countries with independent VS certification vs  $113 \pm 53$  in countries with subspecialty certification. Endovascular requirements for training are established in 71% of countries with independent certification vs 37% of countries with subspecialty certification ( $P < .03$ ). Countries with independent VS certification produce  $5.4 \pm 2.8$  VS trainees per year per million population 65 years of age or older, vs  $3.0 \pm 1.8$  in countries with subspecialty certification ( $P < .02$ ).

**Conclusions.** Considerable variation exists in VS training in different countries. There is an international movement toward independent VS certification, with longer VS specific training but shorter overall residency duration. Countries with independent VS certification produce more trainees per year to serve their elderly population.

### Abdominal aortic aneurysm in women: Prevalence, risk factors, and implications for screening

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**Objective.** Accurate data regarding the prevalence and associated risk factors for aneurysmal disease is essential when determining the appropriateness of screening for abdominal aortic aneurysms (AAA). Although women are poorly represented in most large studies of AAA prevalence, the US Preventive Services Task Force recently recommended against primary screening for AAA in women. The purpose of this analysis was to define the prevalence and risk factors associated with the development of AAA in women.

**Methods.** A free duplex ultrasound screening was offered to men and women with cardiovascular risk factors or a family history of AAA. Patients were recruited through advertising at local screening centers and screenings were performed between 2004 and 2006. Demographic information and cardiovascular and aneurysmal disease risk factors were obtained for each patient through a questionnaire. A total of 17,540 subjects were screened for AAA, including 10,012 women (mean age 69.6 years) and 7528 men (mean age 70.0 years). Univariate and multivariable logistic regression analysis was performed on the subset of women that were screened to determine risk factors for and prevalence of AAA.

**Results.** Seventy-four aneurysms were detected in women (including four aneurysms  $>5$  cm diameter and 70 aneurysms 3 to 5 cm diameter) while 291 were detected in men, resulting in prevalence rates of 0.7% and 3.9%, respectively. Increasing age (odds ratio [OR]= 4.57, 95% confidence interval [CI] 1.98 to 10.54,  $P < .0001$ ), history of tobacco use (OR = 3.29, 95% CI 1.86 to 5.80,  $P < .0001$ ), and cardiovascular disease (OR= 3.57, 95% CI 2.19 to 5.84,  $P < .0001$ ) were independently associated with AAA in women on univariate and multivariable analysis. Women with multiple atherosclerotic risk factors

were more commonly found to have AAAs and had a prevalence rate of AAA as high as 6.4%.

**Conclusion.** Although the medical literature suggests a low prevalence rate of AAA in women in the general population, specific risk factors are associated with the development of AAA, and subgroups of women can be identified that are at a substantially increased risk of aneurysmal disease. In particular, elevated rates of AAA were found among women of advanced age ( $\geq 65$  years) with a history of smoking or heart disease. These data support the notion that women with such risk factors should be considered for AAA screening.

### Endovascular repair of para-anastomotic aortic aneurysms

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**Background.** Para-anastomotic aneurysms involving the aorta and iliac arteries can occur years after aortic surgery and are at risk for rupture and erosion into surrounding structures. We report on our continued experience with patients who have been treated for these lesions with endovascular management as an alternative to traditional open repair.

**Methods.** Patients who underwent endovascular repair of para-anastomotic aneurysms involving the distal aortic arch, descending thoracic aorta, abdominal aorta, or iliac arteries were prospectively followed up in a database. Patient comorbidities, initial aortic pathology, initial graft configuration, aneurysm characteristics, evidence of infection, type and configuration of endograft used, and follow-up were analyzed.

**Results.** From 1997 to 2006, 53 patients with 65 para-anastomotic aneurysms were treated with endovascular stent grafts. Patients who were originally treated for aortoiliac occlusive disease presented significantly later than those treated for aneurysmal disease (15.8 vs 8.9 years,  $P < .01$ ). The initial technical success rate was 98%. Endoleaks were identified in six patients (11%)  $\leq 1$  month of surgery, and three required reintervention, including open conversions. Endoleak complications were significantly associated with patients who had symptomatic para-anastomotic aneurysms ( $P = .01$ ). Perioperative mortality after endovascular repair was 3.8%. Overall mortality within a mean follow-up of 18 months was 49% and was significantly associated with older age at the time of endovascular treatment ( $P = .03$ ).

**Conclusion.** Endovascular repair of para-anastomotic aneurysms involving the aorta and iliac arteries is technically feasible and is associated with a low perioperative morbidity and mortality. Close follow-up is required to identify endoleaks. Long-term survival is limited in older patients. We recommend endovascular stent graft repair for para-anastomotic aneurysms in anatomically suitable patients.

### Clinical factors associated with long-term mortality following vascular surgery: Outcomes from The Coronary Artery Revascularization Prophylaxis (CARP) Trial

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**Background.** Preoperative cardiac risks and clinical indications for vascular surgery are both important determinants of outcome following a vascular operation. Using the nonrandomized cohort from the Coronary Artery Revascularization Prophylaxis (CARP) Trial, we analyzed the predictors of outcome based on the presenting vascular problem and prevalence of comorbid conditions and cardiac risks.

**Methods and Results.** Between March 1, 1999 and February 28, 2003, 4414 patients were ineligible for randomization in the CARP Trial and their survival was retrieved through the BIRLS system (the Department of Veterans Affairs Beneficiary Identification and Records Locator Subsystem). Surgical indications were either an abdominal aortic aneurysm ( $N = 1598$ ) or lower extremity ischemia for claudication ( $N = 1116$ ), rest pain ( $N = 670$ ), or tissue loss ( $N = 1030$ ). Patients were screened for major cardiac risks that included a history of angina, congestive heart failure, myocardial infarction, ventricular

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arrhythmias, pathological q-waves, and diabetes. The absence of multiple cardiac risks, as the sole reason for exclusion from randomization, occurred in 2314 (52.4%) screened patients and their probability of survival at 2.5-year post-surgery was 0.88. This was better than the survival of the remaining excluded patients ( $N = 2100$ ), which was 0.75 ( $P < .0001$ ) and the randomized cohort ( $N = 462$ ), which was 0.80 ( $P < .0001$ ). By Cox regression analysis, urgent surgery, congestive heart failure, ventricular arrhythmias and creatinine  $>3.5$  mg/dL were significantly associated with long-term postoperative mortality.

**Conclusions.** Patients without multiple cardiac risks or comorbid conditions have a good outcome following elective vascular surgery. Urgent surgery, creatinine  $>3.5$  mg/dL, congestive heart failure, and ventricular arrhythmias are identifiers of a poor long-term outcome and may justify aggressive strategies for risk-stratification in the postoperative period.

#### Prospective decision analysis for peripheral vascular disease predicts future quality of life

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**Objective.** Decision making for peripheral vascular disease can be quite complex as a result of pre-existing compromise of patient functional status, anatomic considerations, uncertainty of favorable outcome, medical comorbidities, and limitations in life expectancy. The ability of prospective decision-analysis models to predict individual quality of life in patients with lower extremity arterial occlusive disease was tested.

**Methods.** This was a prospective cohort study. The settings were university and Veterans Administration vascular surgery practices. All 214 patients referred with symptomatic lower extremity arterial disease of any severity over a 2-year period were screened, and 206 were enrolled. A Markov model was compared with standard clinical decision-making. Utility assessment and generalized (Short Form-36; SF-36) and disease-specific (Walking Impairment Questionnaire; WIQ) quality of life were derived before treatment. Estimates of treatment outcome probabilities and intended and actual treatment plans were provided by attending vascular surgeons. The main outcome measures were generalized (SF-36) and disease-specific (WIQ) variables at study entry and at 4 and 12 months.

**Results.** Primary intervention consisted of amputation for 9, bypass for 42, angioplasty for 8, and medical treatment for 147 patients. Considering all patients, no improvement in mean overall patient quality of life measured by the SF-36 Physical Component Score ( $27 \pm 8$  vs  $28 \pm 8$ ;  $P = .87$ ) or WIQ ( $39 \pm 22$  vs  $39 \pm 23$ ;  $P = .13$ ) was noted 12 months after counseling and treatment by the vascular surgeons. Individually considered SF-36 categories were improved only for Bodily Pain ( $40 \pm 23$  vs  $49 \pm 25$ ;  $P = .03$ ), with the most significant improvement observed among patients with the most severe pain ( $68 \pm 25$  vs  $37 \pm 23$ ;  $P = .02$ ) and among those undergoing bypass ( $60 \pm 29$  vs  $31 \pm 22$ ;  $P = .02$ ). It is noteworthy that when the treatment chosen was incongruent with the Markov model, patients were more likely to report a poorer quality of life at 1 year (Physical Component Score,  $25 \pm 8$  vs  $29 \pm 8$ ;  $P < .001$ ). The quality of life predicted at baseline by the Markov model correlated positively with the Physical Component Score ( $r = 0.23$ ), Bodily Pain ( $r = 0.33$ ), and Fatigue ( $r = 0.44$ ) and negatively with WIQ ( $r = -0.08$ ) observed 1 year later.

**Conclusions.** Prospective application of an individualized decision Markov model in patients with vascular disease was predictive of patient quality of life at 1 year. The patient's outcome was worse when the treatment received did not follow the model's recommendation. This decision analysis model may be useful to identify patients at risk for poor outcomes with standard clinical decision making.

#### Lesion severity and treatment complexity predict outcome following percutaneous infra-inguinal intervention for lower extremity ischemia

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**Objectives.** Percutaneous revascularization has become increasingly utilized for the treatment of lower extremity ischemia. Patients with limb-threat have been shown to be at increased risk of failure, although the reasons for this

remain unclear. This study analyzed factors predictive of percutaneous treatment failure, focusing specifically on lesion characteristics and treatment complexity.

**Methods.** We retrospectively reviewed percutaneous infra-inguinal interventions performed for peripheral occlusive disease between 2002 and 2005 using a prospectively maintained database. Lesion characteristics were assessed by angiography, and lesions were graded according to the TransAtlantic InterSociety Consensus (TASC) criteria. Patency was expressed by Kaplan-Meier method and compared by log-rank analysis. Multivariate Cox-regression analysis was used to assess significant factors on univariate analysis. Mean follow-up was 11.8 months.

**Results.** A total of 324 interventions for claudication (55.8%), rest pain (18.4%), or tissue loss (25.8%) were analyzed, including 284 primary interventions and 40 re-interventions in 258 patients (mean age  $72.1 \pm 10$  years, 51.0% male). TASC lesion grades included: A (4.9%), B (29.3%), C (37.7%), and D (28.1%). Isolated single-level interventions (femoral, popliteal, or tibial) were performed in 38.9%, while two-level interventions were performed in 46.2% and three-level interventions in 14.9%. Overall primary patency ( $\pm$  SD) at 6, 12, and 18 months was  $87 \pm 2\%$ ,  $66 \pm 2\%$  and  $59 \pm 4\%$ , respectively. Secondary patency at 6, 12, and 18 months was  $89 \pm 2\%$ ,  $76 \pm 3\%$ , and  $69 \pm 5\%$ . One-year limb salvage rate (limb-threat patients) was  $85 \pm 3\%$ . Limb-threatening ischemia as the indication for intervention was the strongest predictor of failure of both primary and secondary patency and was associated with four indicators of lesion severity and treatment complexity, including increasing TASC grade, multilevel intervention, tibial intervention, and reduced tibial outflow. One-year primary patency was inversely correlated with TASC severity (TASC A-C:  $67 \pm 6\%$ , D:  $61 \pm 4\%$ ;  $P < .05$ ), multilevel intervention ( $76 \pm 5\%$  and  $49 \pm 9\%$  for single vs multilevel,  $P = .002$ ), distal interventions ( $74 \pm 5\%$  and  $57 \pm 7\%$  for femoral vs tibial,  $P < .05$ ), and decreased tibial runoff ( $83 \pm 6\%$  and  $52 \pm 6\%$  for three- vs  $<$  three-vessels,  $P < .02$ ). No differences in secondary patency or limb-salvage rates existed for these lesion- and treatment-related variables. Multilevel intervention and tibial intervention remained significant independent predictors of primary patency on multivariate analysis.

**Conclusions.** Patients with limb-threatening ischemia are at increased risk of initial failure compared with claudicants, likely as a result of the increased prevalence of advanced lesion severity and treatment complexity, which predict decreased primary patency. However, this finding did not extend to secondary patency or limb-salvage in the overall patient population. Although additional studies with longer follow-up are needed, these findings argue that percutaneous intervention may still be considered as a primary treatment modality with the understanding that these patients may have higher re-intervention rates and may ultimately require salvage open surgical bypass for persistent failures of percutaneous therapy.

#### Factors associated with outcome after interventional treatment of symptomatic iliac vein compression syndrome

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**Background.** Iliac vein compression syndrome (IVCS) results from compression of the left iliac vein by the overlying right iliac artery against the pelvic brim. In many cases, patients are symptomatic. In symptomatic cases, management consists of angioplasty and stenting. Although therapy is often initially successful, factors associated with long-term outcome have been poorly defined. The purpose of this study was to identify factors associated with stent patency.

**Methods.** The medical records of all patients who underwent iliac vein percutaneous transluminal angioplasty and stenting from January 1996 to December 2006 for symptomatic IVCS were reviewed retrospectively. There were 50 women and 8 men, with a mean age of 42 years (median, 39 years; range, 17–71 years). Primary, assisted primary, and secondary patency rates were determined. Patient characteristics and clinical variables were evaluated by univariate and multivariate analysis to determine association with vein patency. **Results.** Symptoms consisted of lower extremity swelling (81%) and lower extremity pain (67%). Iliac vein obstruction was treated with pharmacologic thrombolysis (31% of patients) and mechanical thrombus fragmentation (17% of patients). The primary, assisted primary, and secondary patency rates of angioplasty/stenting were 74.1%, 79.7%, and 85.8% at 1 year and 38.1%,

62.8%, and 73.8% at 5 years, respectively. Using a Cox proportional risk model, male sex (hazard ratio, 6.5;  $P = .001$ ), recent trauma (hazard ratio, 5.3;  $P = .001$ ), and age younger than 40 years (hazard ratio, 3.8;  $P = .015$ ) were associated with decreased primary patency. In the absence of any risk factors, primary patency was 94.4% at 1 year and 63.0% at 5 years, decreasing to 28.6% and 0% for two or more risk factors.

**Conclusions.** Patency rates for iliac vein percutaneous transluminal angioplasty and stenting in patients with IVCS can potentially be predicted on the basis of a multivariate model. Assessing risk factors allows for patient stratification and appropriate clinical decision making. Prospective validation of these variables is necessary.

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#### **A randomized trial of the Tubulcus multilayer bandaging system in the treatment of extensive venous ulcers**

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**Background.** Venous ulcers are a major health problem because of their high prevalence and associated high cost of care. Compression therapy is the most widely used treatment for this condition. The vast majority of published articles on compression therapy present the results in the treatment of venous ulcers usually up to 15 to 20 cm<sup>2</sup>. However, there are no published data in English medical literature on the efficacy of compression therapy in the treatment of extensive venous ulcers (ulcers >20 cm<sup>2</sup> of more than 6 months' duration) with regard to healing rate, time to healing, and recurrence rate at 12 months after healing.

**Methods.** A total of 138 patients with extensive venous ulceration (ulceration surface, 20–210 cm<sup>2</sup>; duration, 7 months to 28 years) were randomized into 2 groups: (1) a treatment group (72 patients who were treated by using a multilayer bandaging system with the Tubulcus (a heelless open-toed elastic compression device knitted in tubular form) and elastic bandages and (2) a control group (66 patients treated with a multilayer bandaging system with elastic bandages only). The patients were treated on an ambulatory basis; the primary end point of the study was complete ulcer healing at 500 days. The secondary end point was to assess the ulcer recurrence rate during continuation of below-knee compression of different degrees of compression. In the treatment group, patients were instructed to continue to wear the Tubulcus (35 mm Hg), and patients in the control group were instructed to wear compression stockings with compression of 20 to 25 mm Hg. The exclusion criteria from the study were heart insufficiency with an ejection fraction <35, an ankle-brachial pressure index less than 0.8, and pregnancy.

**Results.** The cumulative healing rate was 93% in the treatment group and was 51% in the control group ( $P < .001$ ). The median healing time in the treatment group was 133 days (range, 28–464 days), and in the control group it was 211 days (range, 61–438 days). The recurrence rate at 12 months in the treatment group was 24% (16/67) and was 53% (18/34) in the control group ( $P < .05$ ). After additional compression treatment with the same treatment protocol, all 16 recurrent ulcers in the treatment group healed. In the control group, the healing rate of recurrent ulcers was 89% (16/18).

**Conclusions.** This study suggests that for extensive venous ulceration, multilayer compression therapy with the Tubulcus provides an extremely high healing rate. Compression of more than 30 mm Hg results in decreased ulcer recurrence. However, recurrence cannot be completely avoided.