Interest in Vascular Surgery as a Specialty in a Climate of Competitive Fields

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Objective: Vascular surgery is unique in that it combines intricate skill sets, involves almost every anatomic territory, and crosses over with other subspecialties. Recent editorial publications have insinuated that the interest in our specialty is declining. We sought to examine the relative interest in vascular surgery compared with interventional cardiology (IC), cardiothoracic surgery (CT), and interventional radiology (IR).

Methods: Reviews of the National Residency Match Program and the American Board of Internal Medicine were performed for both fellowship and residency match data. Search terms were compared using Google trends. Job outlook was examined on the Cardiothoracic Surgery Network, Society for Vascular Surgery, Society of Interventional Radiology, and American College of Cardiology websites.

Results: Applications to fellowship positions offered for CT experienced a 44% (1.37/0.95) increase from 2014 to 2018, whereas vascular surgery experienced only an 8% (1.07/0.99) increase. In the past year, vascular surgery was the only field to experience a decline, 5% (1.12 to 1.07), whereas IC increased by 6% (1.01 to 1.09). In 2018, there were 2.0 U.S. medical students applying to each CT position compared with 1.0 applying to vascular surgery. Google trend data during the past 10 years show that interest has remained higher for search terms “interventional cardiology fellowship” (average 41/100) and “interventional radiology fellowship” (average 39/100) compared with “vascular surgery fellowship” (25/100) and “cardiothoracic surgery fellowship” (18/100). One of the most often related queries according to Google trends was salary. The average salary for a vascular surgeon in 2018 was $484,740 vs that of cardiothoracic surgery ($610,500 in 2016), IC ($612,910), and CT ($584,287). With regard to job outlook, there were most recently 108 jobs per 123 graduates currently posted for cardiothoracic surgeons, 112 of 225 for interventional radiologists, 249 of 309 for interventional cardiologists, and 91 of 166 for vascular surgeons.

Conclusions: The current interest in vascular surgery is on the decline, whereas a concurrent increase in interest is occurring for CT, IC, and IR subspecialties. The reason for this is unclear but needs to be examined to provide high-quality trainees in a climate of continuous increasing demand and extreme competition from other subspecialties.

Table II. Results of analysis of eight national specialty websites in terms of nine established criteria for an approximate National Efforts Score

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Motion Metrics Reliably Differentiate Competency: Fundamentals of Endovascular and Vascular Surgery

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Objective: The Fundamentals of Vascular and Endovascular Surgery is a curriculum that includes an endovascular model for skills testing differentiating between competent and noncompetent performers. The aim of our study was to further validate the model and to test its reliability in assessing the performance of endovascular trainees.

Methods: The model was tested in a virtual reality environment. Thirty-nine subjects were divided into three groups on the basis of their endovascular experience: novice (<50 endovascular cases), intermediate (50-500 endovascular cases), and expert (>500 endovascular cases). Performance was evaluated in four tasks, measuring the tool tip position and velocity on the virtual model. Average tool tip velocity and movement smoothness in the velocity frequency domain are validated parameters defining proficiency of movement. The data were filtered and interpolated to calculate the metrics. Trials containing critical tool manipulation errors were discarded.

Results: In total, 58 tasks completed by novices, 11 completed by intermediates, and 10 completed by experts were analyzed to determine performance. The difference in performance between the novice and expert groups was statistically significant for guidewire smoothness (P < .001). The expert group had a statistically significant higher average guidewire velocity compared with the novice group (P = .001). Fig.

Conclusions: The Fundamentals of Vascular and Endovascular Surgery model continues to differentiate novices from experts on the basis of their handling of guidewire tools, measured as smoothness and velocity.
**Postoperative Outcomes in Thoracic Outlet Decompression for Acute vs Chronic Venous Thoracic Outlet Syndrome**

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**Objective:** Venous thoracic outlet syndrome (VTOS) is a rare disorder that commonly occurs in young athletes and working adults. Published reports have demonstrated improved outcomes in patients presenting in the acute stage, defined as <2 weeks of symptoms. Our objectives were to compare symptomatic improvement in those undergoing thoracic outlet decompression surgery for acute presentations vs those who presented with chronic symptoms. In addition, we identified predictors of failure in symptom resolution after operative decompression.

**Methods:** This study consisted of a retrospective chart review of patients who underwent operative decompression for VTOS at the University of Pittsburgh Medical Center from 2013 to 2017. We examined baseline characteristics, comorbidities, presenting symptoms, interventions performed, and postoperative clinical outcomes. Patients were characterized as acute, subacute, or chronic presenters. Those with symptom onset <14 days of presentation were considered acute; those with symptoms from 14 days to <3 months were considered subacute, and those with symptoms lasting longer than 3 months before presentation were characterized as chronic. Our outcome of interest was return to baseline functional status as defined by returning to sports or work.

**Results:** A total of 51 patients underwent operative decompression for VTOS; 23 patients presented acutely, 7 patients presented subacutely, and 21 patients presented with chronic symptoms. Of these 50 patients, 5 had persistent symptoms despite undergoing operative decompression. Three were acute, one was subacute, and one was chronic. The Fisher exact test was 0.540, indicating that the proportion of patients returning to baseline functional status was similar among the three presentation groups. The effect of sex on return to functional status, although moderate in magnitude, trended toward significance (hazard ratio 0.630, P = 0.113). A multivariate Cox proportional hazards model was attempted, however, small sample size greatly limited the power of the study, and we were unable to identify any risk factors.

**Conclusions:** Those presenting with symptoms of VTOS for <14 days had similar outcomes in symptom resolution after operative decompression compared with those who presented with subacute (14 days-3 months) or chronic (>3 months) symptoms. A national database may be beneficial to study risk factors associated with symptom persistence after surgical decompression in this population of patients.


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**Machine Learning-Based Prediction of Abdominal Aortic Aneurysms for Individualized Patient Care**

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**Objective:** Machine learning (ML) can process complex nonlinear relationships between predictors. ML has had superior outcome predictions in a variety of settings including emergency department triage and pediatric traumatic brain injury. Our goal was to examine the utility of ML models for predicting risk of abdominal aortic aneurysm (AAA).

**Methods:** An ML model to predict the presence of AAA (>3 cm) was created from the database of a national nonprofit screening organization (AAAeruysm Outreach). Participants self-reported demographics and comorbidities. The model is a two-layered feed-forward shallow network. Sensitivity analysis for each input parameter was performed to identify which parameters had the most influence on the algorithm. The ML model then generated AAA probability based on patients' characteristics.

**Results:** A cohort of 10,329 patients with an AAA prevalence of 2.70% was analyzed. Consistent with logistic regression analysis, the ML model identified the following predictors of AAA: white ethnicity, male sex, age, smoking, hypertension, and diabetes.

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**Fig.** Tool tip movement smoothness (as measured by spectral arc length) for guidewire (A) and catheter (B) and average tool tip velocity (C) during task completion.

This model offers a useful instrument to test competency in endovascular surgeons.