National Simulation-Based Training of Fellows

The Vascular Surgery Example

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KEYWORDS

• Simulation • Fellowship training • Vascular surgery • Boot camp • Assessment

KEY POINTS

- Vascular surgery trainers face many challenges in assuring graduates possess appropriate technical skills for open and endovascular procedures, including reduced work hours, rapidly evolving technology, and the need to teach complex but infrequently performed open surgical procedures.
- Using methods similar to general surgery technical skills assessments in laparoscopic and endoscopic surgery, vascular surgery educators developed a set of fundamental technical skills stations for purposes of training and assessment.
- Elements contributing to an effective simulation-based training course in vascular surgery include faculty-to-trainee ratios; large fresh cadaver component; emphasis on less commonly encountered procedures; and focused training, feedback, and assessment of trainees.

Surgical educators have experienced mounting pressure to train competent surgeons within the scope of decreasing work hours, increasing patient safety concerns, and mounting public scrutiny. Vascular surgery is no exception and, in fact, faces the additional challenges of a rapidly changing field in which new and evolving technologies have drastically affected the practice. The scope of disease once relegated entirely to open surgical management is shifting increasingly and exponentially toward endovascular interventions. The result is a field in which open operations are less often encountered by trainees and those circumstances requiring an open procedure now involve highly complex and challenging cases. Meanwhile, new endovascular technologies are coming to market constantly, requiring users to learn new skills (in training and beyond). The obvious answer to some educators is the use of simulation. Simulation-based technologies are useful for endovascular procedures in much the

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same way as they are for laparoscopy because the 3-dimensional to 2-dimensional conversion of both approaches leads to ease of developing high-fidelity images of anatomy. Open surgery, on the other hand, presents more challenges in the creation of high-fidelity, responsive simulations. Nonetheless, vascular surgery has obvious applications for simulation-based technology. The implementation of simulation-based training for surgical trainees has evolved rapidly in the past 20 years. Trainees, as well as vascular educators, increasingly support integration of simulation into the training paradigm. In a recent survey of current vascular surgery trainees, 86% of respondents reported a belief in the educational value of simulation-based training. Fifty-six percent of vascular surgery programs currently offer simulation-based training, most commonly in the form of peripheral endovascular simulators (70%), anastomotic models (58%), or endovascular aortic aneurysm repair models (53%). More than a third of current vascular fellows and senior residents (37%) have attended outside simulation-based courses.[1]

ENDOVASCULAR SIMULATION

When it was first introduced, endovascular simulation was a largely industry-driven means of introducing interventionalists to new endovascular devices and techniques using virtual reality (VR) simulators. Carotid artery stenting was identified as a high-risk procedure with potentially devastating consequences for patients. VR simulators could help mediate good outcomes. To meet this need, VR simulation was developed to allow users to be trained on a safe platform. Similarly, to be approved for use of a device by industry, simulation-based practice was required for thoracic and abdominal endovascular repair. Several validation studies were published to demonstrate the utility of this approach. These studies confirmed that performance improved with standardized simulation-based practice.[2,3] Based in part on these findings, a 2005 consensus statement from the Society for Vascular Surgery, the American College of Cardiology, and the Society for Vascular Medicine and Biology encouraged the use of simulation-based training. The statement read, "In an effort to assist physicians with differing backgrounds and skills to reach a common benchmark of proficiency, metric-based simulation should be incorporated into training. This will provide skills acquisition in an objective manner, based on real-world situational experience."[4]

VR simulation for endovascular interventions was rapidly developed for the breadth of vascular interventions from aortic to mesenteric and lower extremity. Numerous studies evaluating validity and utility of endovascular simulation were carried out and, across the board, results supported the utility of endovascular simulation-based training. Participants improved their performance on the simulated procedures for aortic, renal, lower extremity, and carotid interventions as measured by global rating scales, procedural checklists, and procedural metrics (ie, task completion time, fluoroscopy time, contrast use).[5–7] In select studies, these improvements translated to skills demonstrated on a live animal model.[8,9] These encouraging findings have led the vascular surgery programs with adequate funding to make the large investment (>$200,000) in VR simulators. However, many programs simply cannot afford that expense, making standard implementation of VR simulation into the curriculum impractical.

SIMULATION-BASED TRAINING FOR OPEN VASCULAR PROCEDURES AND TASKS

The earliest forms of vascular simulation-based training for surgical trainees came in the form of bench-top anastomotic models. Requiring only a stable platform, woven graft material, sutures, and basic instruments, structured, low-risk practice could be