Four-Year Experience with a Regional Program Providing Simulation-Based Endovascular Training for Vascular Surgery Fellows

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PURPOSE: High-fidelity procedure simulation has been found useful for training vascular surgery residents in endovascular procedures, but the costs of acquiring, maintaining, and operating simulators represent a barrier to routine use of endovascular simulation in vascular surgery programs. Providing simulation training opportunities through regional centers may make simulation more cost effective, but the costs and benefits of this approach have not been reported previously. We reviewed participation costs in a regional simulation program to provide a benchmark for comparison with other training options.

METHODS: Simulation-based training was offered annually from 2004 to 2007 to the 11 vascular surgery fellowships in Washington, Oregon, California, Arizona, and Utah. Participation was at the discretion of the program directors and fellows. Sessions were designed to offer individualized, hands-on training with 2-4 participants per 2-day session. SimSuite (Medical Simulation Corporation, Denver, Colorado) simulators were used.

RESULTS: During the 4-year period, participation by invited programs averaged 75%. Ten of 11 programs in the western United States region participated, with 34 fellows participating during the 4 years of the program. In addition, 2 program directors or faculty attended sessions to participate as learners, and 8 other individuals were allowed to participate (including 7 senior surgery residents and 1 vascular surgery fellow from out of the region). The average participant costs for travel, which include transportation, lodging, and meals, were $571. Simulation facility expenses, which included use of the simulator, computer-based training modules, and instructional support by an educational specialist, averaged $1055 per participant. Surgical faculty spent 12 hours per 2-day session instructing and in other direct educational activities. Costs for this time were not calculated separately.

CONCLUSIONS: Vascular surgery fellows' participation in simulation training at regional centers offers program directors a lower cost alternative for providing high-fidelity simulation training, compared with acquiring and operating an endovascular procedure simulator at their individual institutions. (J Surg 66: 330-335. © 2009 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: catheterization, stents, computer simulation, computer-assisted instruction, educational measurement, clinical competence, psychomotor performance

COMPETENCY: Medical Knowledge, Practice Based Learning and Improvement, Systems Based Practice

The article directly addresses the Accreditation Council for Graduate Medical Education (ACGME) core competencies of medical knowledge, practice-based learning and improvement, and systems-based practice.

In the core competency domains of patient care and medical knowledge, patient care simulations or procedural training devices (such as endovascular procedure simulators) can provide standardized experiences that can augment clinical and didactic instruction. Several virtual reality (VR) endovascular procedure simulators are now commercially available (Table 1), but guidelines for their use in vascular surgery graduate medical education (GME) programs have yet to be established.

Although vascular surgery GME programs currently have no requirements to provide simulation-based skills training, many vascular surgeons are familiar with endovascular simulation. Use of endovascular procedures simulators has become common at regional and national specialty meetings, as well as in many continuing medical education (CME) programs. When carotid artery stenting was introduced into clinical practice, many new users of approved carotid artery stents and distal embolic protection devices required training. Endovascular procedure simulation was a component of this training, offering a means for safe, effective, and available "hands-on" training that supplemented clinical experience.[1-3]

It is anticipated, however, that GME programs will be expected to include more structured procedural skills training outside the traditional clinical setting. The use of simulation

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TABLE 1. Commercially Available Endovascular Simulators

Endovascular AccuTouch Simulator	Immersion Medical, San Jose, California	http://www.immersion.com/medical
Angio Mentor	Simbionix USA Corp., Cleveland, Ohio	http://www.simbionix.com
SimSuite	Medical Simulation Corporation, Denver, Colorado	http://www.medsimulation.com
Procedius VIST, Vascular Intervention System Training	Mentice Medical, Göteburg, Sweden	http://www.mentice.com

technology has been cited as a way to meet safely the challenge of more efficiently providing clinically focused education within the mandatory constraints on resident work hours.[4,5] Simple devices teach hand-eye coordination, and more sophisticated VR trainers, such as the current generation of endovascular simulators, teach complex tasks, and sequencing. Residents can acquire and practice basic skills before applying them with patients. The learning environment of a skills laboratory also offers a less stressful and more controlled situation. Introducing new educational programs to provide this training, however, requires resources (equipment, space, personnel, etc.) and appropriate curricula. Establishing comprehensive capabilities at every GME site would be expensive and perhaps unjustifiable. One way to diminish overall costs, as well as the costs to individual programs, is to use simulation training centers as regional resources, allowing the GME programs at several institutions to share the use of a common facility.

Our group at the University of California, Davis has used an endovascular procedure simulator for training general surgery residents and vascular surgery fellows (Figure 1). A high-fidelity endovascular procedure simulator (SimSuite; Medical Simulation Corporation, Denver, Colorado) is one of the resources available in our institution's skills training laboratory, the "Center for Virtual Care." Since 2004, regional training programs have been offered for vascular surgery fellows. Trainees from programs throughout the western United States have participated. We reviewed the participation costs for this regional program to provide program directors a benchmark for comparison to other training options.

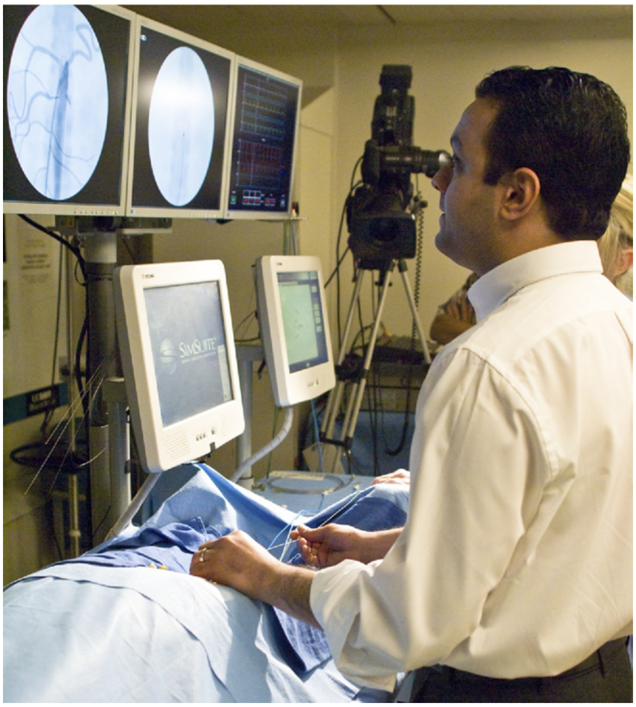

FIGURE 1. Endovascular procedure simulator, demonstrated here with videotape recording for ongoing validation studies.

METHODS

A program offering simulation-based training at our center in Sacramento, California was offered annually from 2004 to 2007 to the 11 vascular surgery fellowships in the 5 western states of Washington, Oregon, California, Arizona, and Utah. This set of programs was selected based on geography (programs within the area of membership of the Western Vascular Society) (Figure 2). By inviting participants from regional programs (less than 1,500 km radius), participants could travel by car or commercial air travel on the morning of the training program, arrive at our center in time to start training by noon, and return home the following evening, requiring only two days away from their home program. Participation was at the discretion of individual program directors and fellows.

The sessions were designed to offer individualized, hands-on training with 2-4 participants per 2-day session. SimSuite (Medical Simulation Corporation, Denver, Colorado) simulators were used. The small size of the groups was chosen to allow learners to have access to individualized training with the simulator, with the ability to complete 10 or more cases as primary operator or assistant. Each case started with a clinical case presentation of the simulated patient, which includes relevant laboratory and imaging data, as well as a short self-test, with immediate feedback on the self-test questions. Interactive problem solving was encouraged, with one-on-one mentoring provided through the simulated cases, which includes instruction on catheter handling, device selection, endovascular techniques, and alternative techniques. When not performing cases on the simulator, participants received didactic instruction, computer-based training, and tabletop procedure demonstrations. These demonstrations included catheter, sheath, and wire handling; angioplasty balloon inflation; and deployment of stents. The curriculum covered arteriography and intervention for treatment of aortoiliac, renal, femoral, and carotid artery disease. One-on-one faculty training was provided throughout the training sessions.