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# The Benefits of Simulation Training for Fellows and Residents

Long used in aviation, simulation technology is emerging as a key component of graduate medical education programs.

BY DAVID L. DAWSON, MD

As an endovascular surgeon in an academic practice, I am keenly interested in how to best train physicians to perform endovascular procedures. From my own professional involvement in aviation and aerospace medicine, I was aware of the value of simulation for complex technical training. More recent experience with new commercially available endovascular procedure simulators has demonstrated their value in the clinical training of fellows and residents.

After completing a fellowship in vascular surgery, I began service in the US Air Force (Figure 1). My military vascular surgery practice was fairly conventional at first, but I later became involved in planning and operational support for special teams that provided sophisticated medical care in remote settings. These teams were always seeking ways to improve training. The use of patient simulators for trauma and critical care training was introduced in the late 1990s, with positive results. Also, through my involvement in aerospace programs and participation as a flight crew member, I gained familiarity with aircraft simulators (Figure 2). Later, in a tour of duty with the National Aeronautics and Space Administration (NASA), I found myself in a culture that viewed simulation as an integral part of training. Simulation could be as simple as using a desktop teaching aid or as complex as a full-scale mission simulation, but it was incorporated every day.

**Figure 1. Dr. Dawson serving with the US Air Force.**

When, as an experienced vascular surgeon, I sought training in endovascular procedures, I completed a 3-month "mini-fellowship" with an experienced endovascular surgeon. Despite the mentoring in angiography, peripheral intervention, and endovascular aortic aneurysm repair, I recognized some shortcomings of the traditional training model. For instance, I would have liked to practice a broader range of procedures and more complex cases. I wanted more, but had limited time to get it. From my previous experience, I knew the value of training through simulation, and I was convinced that it could play an important role in training specialists to perform endovascular procedures.

## WHY SIMULATION?

Medical simulation systems (Figures 3 and 4) allow physicians to gain experience and confidence in a realistic, safe environment, while providing the opportunity to practice a number of technical and problem-solving skills in a short period of time. For example, one can perform selective catheterization of a renal artery again and again, each time with a different type of catheter. Simulation also

**Figure 2. A look inside a state-of-the-art flight simulator.**

provides more opportunity to encounter and manage complications, such as stroke or other intraprocedural problems that are not commonly seen in clinical practice. Furthermore, simulation introduces layers of physiologic complexity—such as high blood pressure—that trainees need to monitor and treat medically. Even for experienced interventionists, simulation can be a tool to help refine techniques, practice on challenging anatomy, or to learn new tricks for managing specific situations. For the junior residents and students, simulation offers a chance to observe firsthand what happens during a procedure, thereby improving their situational awareness, and perhaps sparking a career interest.

## TRAINING THE NEXT GENERATION OF INTERVENTIONISTS

In conjunction with the Medical Simulation Corporation (Denver, CO), the University of California Davis Medical Center (UCDMC) Division of Vascular Surgery created a simulation-based training program to provide vascular surgery fellows with hands-on training on a variety of endovascular procedures, including diagnostic arteriography, angioplasty, and stenting. SimSuite® (Medical Simulation Corporation) at UC Davis Center for Virtual Care is a state-of-the-art simulated facility made up of a preprocedure room where patient selection, diagnostics, and preparation are provided with computer-based interactive presentations; a procedure room that features an interactive, high-fidelity patient simulator; and a postprocedure room where patient issues and case outcomes are debriefed.

The goal of our pilot program in 2004 was to determine if SimSuite® was an efficient method to train fellows and residents who are starting endovascular training, but have little experience. Thirteen physicians who were either in or entering vascular surgery residencies and two program directors participated in the training program. Intensive 1.5-day sessions with two to four participants each offered a highly focused experience. Upon completion, participants were asked to fill out detailed questionnaires evaluating their simulation training. According to their assessments, endovascular simulation was found to be a useful adjunct to traditional teaching methods and clinical experience. On the basis of the pilot program's positive feedback, a training program for vascular surgery fellows in Western US programs was initiated in 2005.

In the endovascular operating room, a fellow or resident working on a case is very closely supervised. They benefit from the attending physician's coaching and feedback, but may not have opportunities for independent decision-making and problem-solving. Simulation encourages learning by doing. During a simulation, learners are encouraged to independently plan and carry out each step of a procedure. They may encounter problems with catheter positioning, guidewire placement, or difficulties in selecting balloon size—challenges they may not have faced in the OR. Errors in case simulations highlight certain problems that the trainee may not have appreciated, such as the need to think about procedures in an organized way and the need to plan ahead. Simulation may also reveal bad habits, such as the excessive use of fluoroscopy.

Although simulation takes place in a risk-free environment, it is not a stress-free environment. Something as simple as having the mentoring physician stand quietly behind the trainee, observing the simulated procedure, can introduce a level of stress that helps the trainee accept the reality of the exercise (this is a concept known in the "simulation world" as "suspension of disbelief").

**Figure 3. Reginald Low, MD, Chief of Cardiovascular Medicine at UCDMC, demonstrates the SimSuite® endovascular procedures simulator in the Center for Virtual Care. The simulator provides tactile, "haptic" feedback and displays real-time imaging and physiologic information.**

## BOSTON SCIENTIFIC TRAINING PROGRAM FEATURES SIMULATION TECHNOLOGY

Boston Scientific Corporation (Natick, MA) offers a carotid artery stenting (CAS) training program that utilizes the most advanced techniques and technologies, including simulation training. With multiple specialists such as interventional cardiologists, vascular surgeons, and interventional radiologists performing CAS, simulation training is valuable in providing a common platform.

The Boston Scientific CAS training program offers four levels of instruction to meet the educational needs of physicians with varying degrees of experience. The first level provides hands-on instruction in catheter-based procedures for licensed physicians with no previous endovascular training for peripheral vascular disease procedures.

For interventionists who are credentialed to perform peripheral vascular disease procedures but have yet to gain cerebral angiography or CAS experience, Boston Scientific offers the Online Carotid Education & Stenting Course, which provides the latest information on topics such as imaging and diagnosis, patient selection, and treatment of carotid artery disease. The free, CME-accredited course, supported through an unrestricted educational grant from Boston Scientific, includes a simulated CAS procedure and learning self-assessments throughout each of its seven modules. The program can be accessed at www.carotid.com, the company's Carotid Solutions program Web site.

The third level of training features the SimSuite® Carotid Education Course, a 2-day, CME-accredited program that focuses on carotid artery disease and stenting that is designed for interventionists credentialed to perform peripheral vascular disease procedures who have some cerebral angiography experience but have minimal or no CAS experience. This level of training also includes courses that provide hands-on training in diagnostic imaging techniques and interpretation that outlines a path for interventionists to become credentialed to perform CAS within their own facilities.

Credentialed interventionists who have the potential to act as trainers and proctors for CAS training programs may participate in the fourth level of training, Boston Scientific On-Label Device Training, which includes in-service programs, online modules, and optional simulation-based training on specific devices. This aspect of Boston Scientific's CAS training program illustrates how medical simulation provides a new opportunity in device training—the opportunity to master the use of a new device as it is introduced into the marketplace.

Learners engage seriously and act as they would in a clinical situation. Simulation gives residents and fellows an opportunity for an earlier transition into some of the critical-thinking paths that are necessary for safe and effective practice in the interventional suite or OR.

Simulation is quickly becoming a mainstream teaching tool in endovascular therapy. Carotid artery stenting (CAS) is the first medical procedure for which simulation training is an established prerequisite. When the FDA approved CAS, it specified that training programs had to accompany the marketing of the devices. All of the approved training programs have incorporated simulation because of its practicality and hands-on approach. Additionally, many CAS training programs are CME-accredited and may support hospital credentialing requirements.

**Figure 4. SimSuite® monitors display arteriographic renderings of vascular anatomy and can model catheters, guidewires, balloons, stents, and embolic protection devices as they are manipulated through the virtual vessels.**

Medical simulation has an exciting future. Years from now, there may be patient-specific simulations, in which surgeons will be able to train on simulated anatomy derived from an individual patient's CT, MR, or angiographic data. Even more realistic simulators and more complex cases will likely be developed.

Although medical simulation will never replace clinical experience, it is becoming accepted as an educational tool with the potential to make physician training safer and more efficient. ■

*David L. Dawson, MD, is Associate Professor, Division of Vascular Surgery, University of California Davis Medical Center in Sacramento, California. Dr. Dawson may be reached at sdawson@partners.org.* *SimSuite is a trademark of Medical Simulation Corporation.*