Perioperative Nurse Training in Cardiothoracic Surgical Robotics

Throughout the 1980s, technology enabled a sharp increase in the number of video-assisted endoscopies performed in multiple specialties. As the use of lasers and focused energy devices increased, more demands were placed on perioperative nurses to become technically adept.

During the past 10 years, technology has grown exponentially, and the complexity of new devices and their applications has become a challenge for surgeons and perioperative nurses. Use of computer systems is common in ORs today, and advanced minimally invasive procedures have begun to rival conventional procedures. Without a thorough understanding of how equipment functions, distinguishing between a device failure and user error can be overwhelming. The ability of nurses to master new technologies depends on personal initiative because the volume and complexity of these technologies cannot be addressed adequately at monthly inservice programs. New methods for training individuals must be explored if staff members are to become proficient and remain competent.

A B S T R A C T

The exponential growth of OR technology during the past 10 years has placed increased demands on perioperative nurses. Proficiency is required not only in patient care but also in the understanding, operating, and troubleshooting of video systems, computers, and cutting edge medical devices. The formation of a surgical team dedicated to robotically assisted cardiac surgery requires careful selection, education, and hands-on practice. This article details the six-week training process undertaken at Sarasota Memorial Hospital, Sarasota, Fla, which enabled staff members to deliver excellent patient care with a high degree of confidence in themselves and the robotic technology. *AORN J* 74 (Dec 2001) 851-857.

ROBOTICS IN THE PERIOPERATIVE SETTING

Although surgeons have improved surgical techniques in recent years, the OR itself remains underautomated. New devices and equipment have invaded the OR, but this invasion has happened in the absence of an orderly framework. The transfer of work from man to machine—a process that has revolutionized many industries—has happened slowly in the perioperative setting; however, robotic devices are beginning to enter the surgical arena, creating computer-enhanced environments. To date, more than 350 hospitals in the United States and 500 hospitals worldwide have installed robotic technology in the OR.[1]

Robotic devices available in the OR include

- computer-controlled, image-directed surgical robots;
- voice-controlled OR workstations;
- robotic visualization devices; and
- robotic surgical instruments.[2]

Administrators at Sarasota Memorial Hospital, Sarasota, Fla, have acquired the latter two technologies because

> *During the last decade, as managed care and cost-containment pressures have become the pivot point in managing the health care environment, patients' expectation for state-of-the-art care has remained constant. Considering this, the success of an institution often is dependent on strategies developed to balance the need for advanced technology versus the need to reduce costs.*[3]

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In 1996, economic pressures at Sarasota Memorial forced cutbacks and required an out-of-the-box look at efficient use of resources. The goal was to consider using full-time equivalents (FTEs) more efficiently while maintaining or improving surgeon satisfaction. This motivated staff members to evaluate a robotic endoscope positioning device. The use of this device was implemented at Sarasota Memorial in 1997, and it presently is used to perform approximately 600 endoscopic procedures per year. Initially, there was skepticism about the value of this technology. The cost of employing an FTE to hold the endoscope averages $326 per 90 minutes, which is the average laparoscopic procedure length. When multiplied by 577 (ie, the actual number of procedures), the FTE cost equaled $188,102 for one year. Hospital administrators decided to lease three robotic endoscope positioning systems for $121,680 per year, resulting in a net savings of $66,422. Additionally, endoscope holder FTEs were assigned to other procedures, further improving the OR's FTE utilization. At Sarasota Memorial, the robot is as common to a general surgery laparoscopy as the insufflator or electrosurgical unit.

The success achieved with the use of robotics in general surgery encouraged administrators and cardiac surgeons to commit resources to a cardiothoracic robotic surgery project. They adopted a robotic surgical system that consists of a console, computer controllers, and three robotic arms controlled by the surgeon. One robotic arm positions an endoscope and camera assembly in response to the surgeon's simple voice commands. Working behind the ergonomic console, the surgeon uses the computer controllers to input movements that are scaled by the computer and translated onto the instruments.

CREATION OF A TRAINING PROGRAM

In June 1999, the US Food and Drug Administration selected Sarasota Memorial to participate in an expanded feasibility study. More than two years were spent developing cardiothoracic robotic surgical technology and surgeon skill by performing procedures in dry, cadaveric, and animate laboratories, both on- and off-site. Preparing the perioperative cardiothoracic surgical team also needed to be addressed.

The robotic surgical system training team consisted of three instructors who had a variety of clinical, managerial, and educational experience. The cardiothoracic surgery program at Sarasota Memorial uses six dedicated open-heart rooms, and approximately 1,600 procedures are performed at the hospital per year. More than 60% of open-heart procedures are performed between November and April. Increasing demands on staff members, including frequent overtime and increased call time, are extremely significant; therefore, selecting a group committed to learning, brainstorming, and practicing new robotic skills was paramount. Staff members understood that team training might conflict with call time or scheduled time off. Training sessions were scheduled when most team members were at work. If a session was missed, team members shared pertinent details and practiced hands-on skills during free time.

The training schedule was divided into easily assimilated portions. Didactic and clinical instruction was separated into a series of six progressive 90-minute sessions. The goal was to complete one session per week. Instructors made arrangements with the open-heart clinical coordinator to allow team members time to train. Some sessions exceeded the scheduled 90 minutes.

TRAINING SCHEDULE

Training consisted of the following sessions:

- familiarization with equipment,
- robotic equipment setup,
- room choreography in the OR,
- first dress rehearsal,
- second dress rehearsal, and
- final dress rehearsal.

Session one: Familiarization with equipment. The first 90-minute session was used to introduce the major components of the robotic system and to review video systems. The instructors discussed patient positioning, sterilizing robotic instrumentation, and draping robotic arms. They used a learner's laboratory so team members could perform a return demonstration of equipment setup, connections, and draping (Figure 1). The instructors discussed team members' questions, concerns, and ideas as they arose. Team members were encouraged to apply their clinical experience when integrating the technology into the cardiac surgery setting.

Session two: Robotic equipment setup. Session two included a review of session one, and instructors quizzed team members. The instructors presented additional information about the robot, including use during procedures involving the shoulder, elbow, and passive joints, as well as information about collar holders and instrument drivers. Team members then

Figure 1 • During a learner's laboratory, team members learn how to place robotic arms on the OR bed.

divided into two groups—group one included certified surgical technologists and RNs who serve as scrub people, and group two included RNs who serve as circulating nurses. The idea was to focus on the roles and skill sets people in each group would be responsible for and to give people in each group significant hands-on learning opportunities.

Session three: Room choreography in the OR. It was not until the third session that the concept of robotic cardiothoracic surgery became real. All of the equipment, including the robotic arms, computer console, and video system, was moved to a vacant OR. Placing this equipment in the OR enhanced team members' awareness of where each piece of equipment needed to be at different times during the perioperative experience (Figures 2 and 3).

Team members rehearsed, in sequence, placing the robotic arms on the bed, properly connecting each cable, plugging the cables into the console, setting the lower limits, and connecting the video system. One person took notes, timed the process to determine how much extra time would be needed to incorporate the use of robotics into the procedure, and recorded everything so team members could anticipate problems and collectively develop potential solutions.

Session four: First dress rehearsal. By the fourth session, team members incorporated all of the input from session three and included a volunteer to be the "patient." The "patient" lay on the OR bed as a patient would during an actual procedure. By using a conscious volunteer, team members quickly realized how important positioning is for a patient undergoing robotic surgery. As a result, they implemented different positioning tactics with significant input from the anesthesia care provider. The volunteer was treated like a true surgical patient (eg, arms tucked; blood pressure cuff, pulse oximeter, and electrocardiogram [ECG] leads placed). Input from perfusionists was incorporated during this initial dry run. Team members took great care not to disturb the general room set-up, specifically the location of the perfusion machine, as perfusionists were not trained concerning the robotic surgical system. Sterile draping of the patient proved to be vital, as team members found ways that contamination could occur between the robotic arms and team members who were scrubbed.

Session five: Second dress rehearsal. As with any skill, practice and repetition are the keys to confidence and competent performance. To promote team confidence, instructors suggested that the fifth training session be self-directed to crystallize the various steps in team members' minds. No additional steps were taken or lessons learned. The instructors only interjected if a step was missed or a team member requested assistance. Not surprisingly, team members felt extremely well prepared after this session and were looking forward to the first procedure.

Session six: Final dress rehearsal. The object of this last training session was to include all team members in a final rehearsal of equipment setup and procedure start-up. Team members who would be part of the actual surgical procedure were required to be present, and a volunteer "patient" was used once again. Anyone who had ideas or concerns was encouraged to discuss them. Team members rehearsed every step learned during the previous five sessions, including the full draping of the "patient." The surgeon shared information, including the locations of the ports, which showed nurses the significance of robotic arm placement (Figure 4). Team members' excitement escalated as they realized their hard work would soon pay off with the clinical application of this new technology.

RESULTS

The training program resulted in the entire cardiothoracic team having a single mindset and each team member understanding and executing his or her role successfully. Although preparation and training equipped team members to perform flawlessly, they did encounter a few unforeseen difficulties when performing actual procedures. A loose head extension on the OR bed would not support one robotic arm's

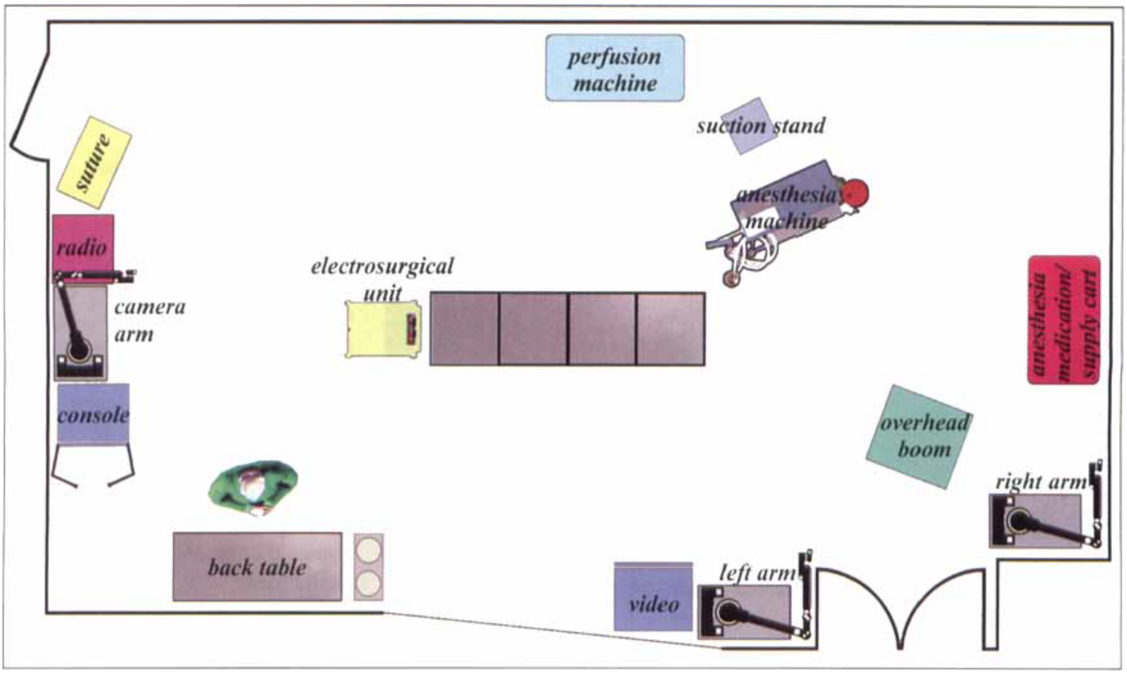

Figure 2 • Equipment setup before the patient enters the OR.

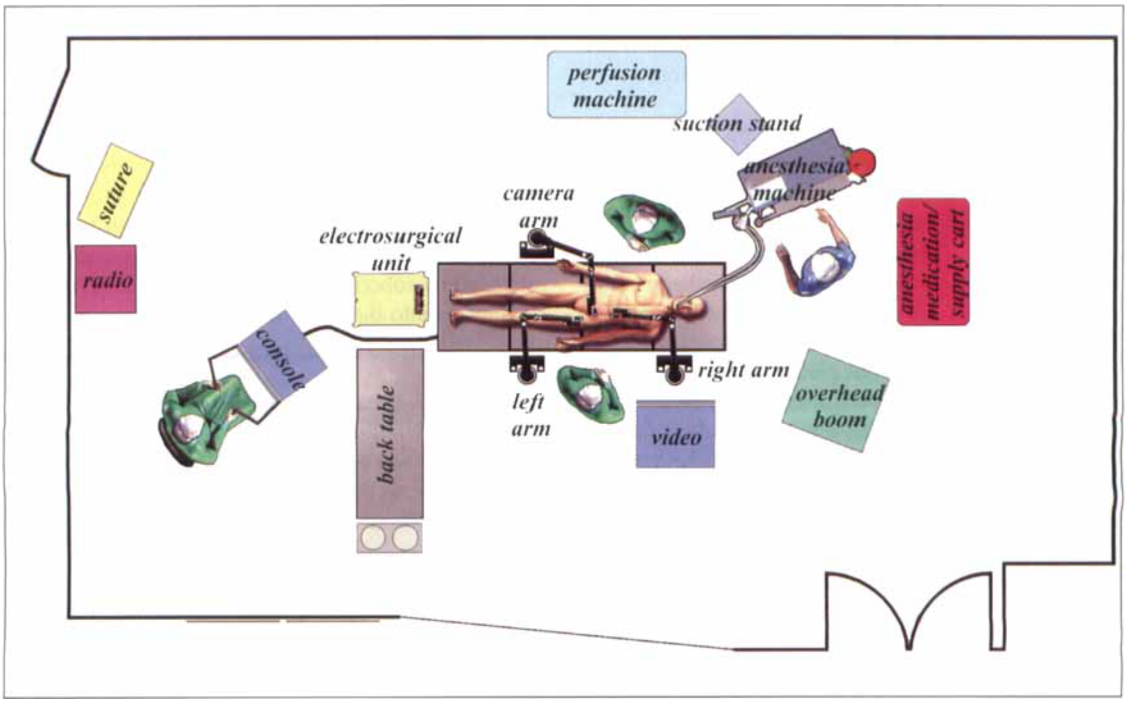

Figure 3 • Equipment setup and robotic arm placement during the robotic portion of the procedure.

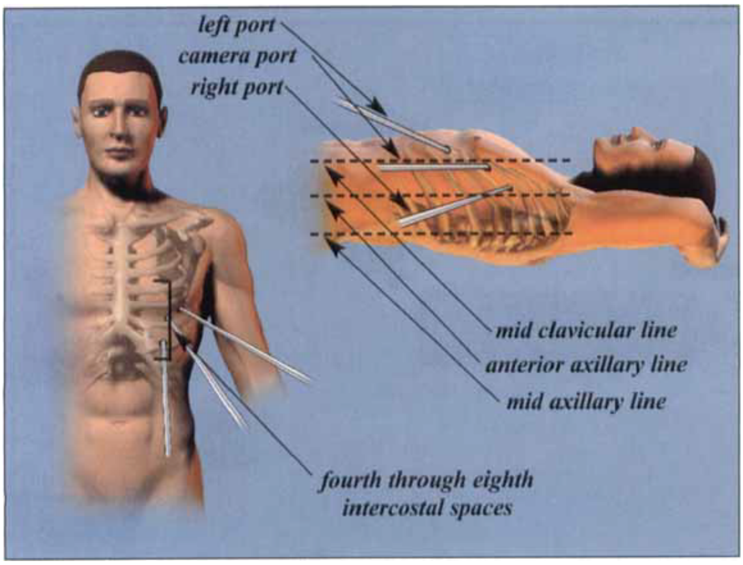

Figure 4 • Port locations for left internal mammary artery to left anterior descending anastomosis.

weight sufficiently. During robotic arm operation, the normal smooth movement of the device was negated by the head extension's lack of stability. Team members placed the ECG pads too far anterior, which interfered with the 5-mm port target sites. Additionally, thoracic trocar lengths were too short for the patient's anatomy.

The first patient left the OR at 1:55 PM. Turnover took 58 minutes, so the second patient entered the OR at 2:53 PM. Between the two procedures, team members met briefly to resolve issues that arose during the first procedure. They decided that reversing the head and foot of the bed might solve the loose head extension problem, or a foot extension might be added to the bed and the patient positioned approximately 11 inches toward the foot, thus placing the robotic arm on the main bed rail as opposed to the head extension rail. They also determined that the ECG pads should be placed more posterior below the patient's midaxillary line and the original thoracic trocar set should be replaced with a longer laparoscopic set.

Team members did not experience further problems during the second procedure, and the debriefing successfully solved the problems of the first procedure. By performing two procedures in one day, team members' confidence in the robotic technology and themselves greatly increased. At press time, Sarasota Memorial was the only institution to perform two robotic cardiac procedures in one day.

CONCLUSION

Robotically assisted, endoscopic coronary artery bypass graft (CABG) surgery is a long, exhaustive, and difficult procedure. Fifteen years ago, general surgeons described the laparoscopic cholecystectomy procedure in a similar way. The goal of performing a fully endoscopic CABG procedure has not yet been realized in the United States because cardiac instrumentation technology still must advance and overcome technical challenges and limitations.[4]

With the advancement of technology, a parallel development process must take place in training and preparing surgical team members. Any new OR technology may be approached and adopted in an incremental process—this is especially true in the case of medical robotics.[5] The expanded feasibility study permitted team members at Sarasota Memorial to perform nine robotically assisted procedures using the same surgical team for each procedure. Sarasota Memorial currently is screening patients for enrollment in a multicenter pivotal trial. Plans include condensing the training program to three one-hour sessions, which recently has been successful at other facilities. Proper training and preparation allow robotic instrumentation to be integrated seamlessly into the open-heart OR. ▲

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NOTES

1. Computer Motion, Inc, *Annual Report* (Goleta, Calif: Computer Motion, Inc, 1998); Computer Motion, Inc, company record of sales and existing customers.

2. *Ibid.*

3. K D Dunlap, L Wanzer, "Is the robotic arm a cost-effective surgical tool?" *AORN Journal* 68 (August 1998) 265.

4. H A Tabaie et al, "Endoscopic coronary artery bypass graft (ECABG) procedure with robotic assistance," *The Heart Surgery Forum* 2 no 4 (1999) 310-317; E R Stephenson, Jr, et al, "Robotically assisted microsurgery for endoscopic coronary artery bypass grafting," *Annals of Thoracic Surgery* 66 (September 1998) 1064-1067.

5. Popolow, "How robotics is transforming the OR," 35-39.

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Chocolate Simulates Brain Activity of Addictive Drugs

Canadian and US neuroscientists have identified areas of the brain that may underlie addiction and eating disorders, according to an Aug 28, 2001, news release from Northwestern University, Evanston, Ill. Scientists identified these areas by using positron emission tomography scans to measure brain activity in people eating chocolate.

Researchers asked participants to rate the pleasantness of eating chocolate and found that their ratings were associated with increased blood flow to particular areas of the brain, including the orbital frontal cortex and the midbrain. These areas also are activated by addictive drugs, such as cocaine. Different areas of the brain, however, are affected when participants perceive eating chocolate as aversive (eg, eating too much chocolate).

Fifteen participants were given between 16 and 74 squares (ie, 40 to 170 g) of chocolate. They were required to let these melt slowly in their mouths. Researchers measured participants' brain activity as they became full and as they ate despite no longer wanting to. Select brain regions were activated depending on whether participants were eating when they wanted to versus when they were full. One problem with studying addicts, however, is that researchers do not know what their brains were like before they became addicted, according to the release.

Measuring Brain Activity in People Eating Chocolate Offers New Clues About How the Body Becomes Addicted *(news release, Chicago: Northwestern University, Aug 28, 2001) http://www.northwestern.edu/univ-relations/media_relations/releases/august/chocobrain.html (accessed 20 Sept 2001).*