Digital Surgery: How Doctors Use a Robot Named Da Vinci to Learn

By DEBRA GOLDSCHMIDT

Technology, with the help of two New York surgeons, is paving the way for better surgeons and better operations in the future.

Minimally invasive, or laparoscopic, surgery has been around for 30 years allowing doctors to make small incisions instead of larger cuts, which is less traumatic for patients so they are able to recover more quickly and have smaller scars.

Surgeons use a tiny camera and small instruments to perform these operations. They insert them into small incisions in the body to access the area they are operating on. This kind of surgery is challenging for surgeons because they have a limited view of the surgical area and limited movement of the surgical instruments. New York surgeon Dr. Robert Ashton, Jr., at St. Luke's Roosevelt Hospital, likens it to, "having casts on your arms - you can only open and close your hands, you can't move your wrists," he said.

Thanks to a robot named da Vinci, laparoscopic surgeons now have the freedom to move their wrists, so to speak. "The extensive range of motion allows precision that is not available in standard minimally invasive procedures," according to Intuitive Surgical, makers of the robot. The added movement has resulted in improvements in the way these procedures are performed. In some cases, patients who are too sick to undergo open surgery are now candidates for robot-assisted surgery. Surgeons have also invented operations that couldn't be done without da Vinci.

Traditional heart surgery, for example, requires surgeons to crack the patient's chest – done by making a long incision (eight to ten inches long), cutting the bone, and then splitting the ribs. When performed with da Vinci's assistance the procedure requires just three puncture wounds, each about an inch in diameter. Surgeons then use three pencil-sized instruments, one containing a miniature camera, to operate on the heart. The surgeon sits several feet away from the patient at a console where he controls each instrument by inserting his thumb and index finger of each hand into slots on the end of two joystick-like handles. The surgeon places his face against a goggle-like vision hole in the console for a three-dimensional view of the area being operated on, which surgeons say provides a better view than the standard two-dimensional view available during other laparoscopic surgery. Other surgical staff watches the images on a TV monitor that is in the operating room.

The surgeons' hand movements are sent through a computer, which allows for precise and scaled motions, to the instruments inside the patient. The instruments have "seven degrees of freedom and mimic the dexterity of the human hand and wrist," according to da Vinci's makers. Surgeons say this allows them to have better control over the surgical instruments.

But there are some disadvantages to robot-assisted surgery. One is cost - hospitals spend millions on the robot and the result is an operation that costs approximately $200,000 more than traditional surgery. However, patients are discharged from the hospital sooner so money is saved on nursing care and pain medications. Therefore, hospitals say that in the end the cost is about even. Additionally, hospitals that offer robotic surgery are able to attract more patients, which also helps recoup costs.

Another disadvantage is that robot-assisted surgery can take nearly twice as much time as a conventional operation, according to Dr. Michael Argenziano at New York Presbyterian Hospital, doubling the time patients spend under anesthesia.

In addition to several heart procedures, da Vinci also assists in general surgery such as gastric bypass surgery, and urological procedures such as prostate removal. Toyna Chin, marketing and communications manager for Intuitive Surgical, said the company is expanding da Vinci into other types of surgery. Outside the U.S. da Vinci assists in gynecological and vascular surgeries, according to Chin who explained that those procedures are not yet approved by the U.S. Food and Drug Administration and therefore cannot be performed in the U.S.

The number of hospitals with a da Vinci Surgical System is growing, as is the demand for surgeons who can operate the robot. St. Luke's Roosevelt Hospital, in New York, is one of over 210 hospitals worldwide that own da Vinci, most of those hospitals are in the U.S., according to Chin. There, heart surgeon and Director of robotics, Dr. Joseph DeRose, Jr. and his team are setting a surgical precedent in the way they are training a new generation of surgeons.

On July 1st five new surgical residents will begin training at St. Luke's Roosevelt Hospital under the guidance of DeRose and Dr. Robert Ashton. Their first assignment will be to complete a series of drills at different workstations. Their performance will provide a baseline of how each completes various tasks. Throughout their training they will have to reach a specified performance level before they operate, first on pigs, then on people.

The residents will also complete a questionnaire with information about their hobbies such as computer use, video games, sports, and musical instruments and they will be asked how much time they spent practicing or playing. This is all information DeRose and Ashton hope will provide clues as to why some people are better at the drills than others. The doctors are trying to develop, what they call, "an objective training package," for teaching and evaluating students. This may sound basic but it doesn't exist, said DeRose.

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They are starting the first formal simulator-training program to gather information about how people learn tasks, especially those that require hand-eye coordination. They will be observing surgical trainees but say their findings will provide critical information about how people learn tasks in general.

LapSim is one of the workstations the residents will use. It is a computer simulator with a monitor and a stand that has two surgical instruments like those the trainees will use for surgery. It was developed to give surgeons realistic practice before touching patients. Doctors learn navigation and coordination of the instruments, and skills such as grasping objects, cutting, applying clips to a bleeding artery, and suturing in a realistic anatomical environment, according to Thomas Nowak, director of marketing for Immersion, makers of the simulator hardware and distributors of the LapSim software.

Doctors liken the training to flight simulators pilots use before taking over the controls in a cockpit. The objective is to train for

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real life scenarios through the use of three dimensional technology and interactive video that "provide a realistic virtual working environment." The program prompts users with red and green signals telling them which hand to use and it flashes red if the user pokes the body, which would cause tissue damage in a patient. That damage is calculated into a final score that the user gets at the end of the drill. If a major mistake occurs, such as cutting an artery, a message alerts the user to the problem then stops the drill and calculates a score, which includes blood loss. The training sessions can be tailored for a specific curriculum or adapted to offer the right level of challenge to each student. Each student's performance is stored in a database so instructors to track their progress.

Residents will also complete drills on the Stryker Endoscopy, which Ashton calls "inanimate training." The trainee stands at a box and looks at two-dimensional images on a TV monitor and moves a camera and two surgical instruments to complete tasks such as picking up a ball or moving objects around. This is similar to the way Ashton and DeRose trained to get used to the instruments.

No one knows if spending time on one type of simulator verses the other is more beneficial. DeRose and Ashton hope to find out.

The residents will also be using da Vinci for drills such as placing beads into a jar through a slot and passing a strand of hair back and forth between the instruments. "With this [the robot in the training lab] we can take the same device from the lab to the operating room, it's the ultimate in training because it's the same thing," Ashton said.

Robots are the wave of the future in surgery, according to many surgeons. DeRose and Ashton are developing training specifically for robotic surgery. They see da Vinci as more than a surgical tool. "We aren't using technology to train for technology, we are using technology to learn how to train people," DeRose said.

They have a computer hooked up to the robot in their lab that records every movement made with the instruments. Then computer scientists translate the numbers into scores based on factors such as which movements were nicer. "By measuring the outcomes, we can figure out what skills make the residents better," Ashton said.

DeRose hopes to arm his new residents with the basic skills for laparoscopic surgery before they go into the operating room so when they get there they will be able to "focus on all of the idiosyncrasies of the surgery and get better at it." Some say the result will be better surgeons.

Ashton said the difference he's seen in surgery during the last five years comparable to the difference between night and day, which he attributes to technology. He admits that when he first heard of a robot for surgery he thought the idea was crazy. Both Ashton and DeRose predict that 10 years from now, surgery will be completely different then it is today. If all goes according to plan, the training they are developing will apply to surgical training in the future, regardless of the technology.

In the end, better technology and better surgeons can only benefit patients.