Surgeons get respect for the high-risk care they provide under often stressful conditions, but they haven’t always had access to innovations in medical technology to make their jobs easier. That’s changing, as medical companies and hospitals are adopting new technologies that take advantage of modern medicine to perform procedures with greater ease and possibly greater safety.

Many of the advancements in surgical technology we have seen so far revolve around the use of surgical tools to perform a procedure quicker and cleaner. These include Bovie knives, staplers, sealing devices and more. The robot is one of those tools that has allowed us to convert minimally invasive procedures to easier cases and convert open cases to minimally invasive cases. None of us doubt the improved ability we have with the robot and look forward to improvements in these surgical tools. However, it is not just the surgical tools that can help us, but our eyes can help as well.

In real life, we have our own eyes, limited and varied in their ability, to help us in surgery. With robotic or laparoscopic surgery, we have cameras that today can see infrared, fluorescent and thermal images not visible to the naked eye.

Imagine a world where an injection of a specific dye can show us lymph nodes, a ureter, nerves or a tumor. Imagine a world where a dye can show us if a graft or piece of bowel has good blood supply and therefore a better chance to heal and not breakdown or leak.

Enhanced visualization on the robotic platform, along with fluorescence technology, has improved performance and safety.

In this edition of the Robotic Surgery Advantage, you will read how our surgeons are using fluorescent dyes to identify sentinel nodes in gynecologic oncology and to see the biliary tree in hepatobiliary surgery. We will also see a novel use of fluorescence in showing the blood supply to bowel anastomotic ends. With this use of technology we hope to improve ease of surgery, as well as patient safety.
The ability to target sentinel lymph nodes is an important advance in the treatment of cervical and endometrial cancer. At Baptist Health South Florida’s Center for Robotic Surgery, surgeons identify sentinel nodes using state-of-the-art fluorescence imaging that is integrated into the robotic system.

Gynecologic oncology surgeon John Diaz, M.D., led some of the research that established the benefits of sentinel node mapping for patients with early-stage cervical and endometrial cancer. Now recognized as a valuable option by the National Comprehensive Cancer Network, this approach has two main advantages:

- Decreased complications. For sentinel node biopsy, the surgeon removes one or two lymph nodes on each side, which have been identified as the first lymph nodes to which cancer is likely to have spread. “By moving away from complete lymphadenectomy, we have reduced the associated morbidity,” said Dr. Diaz. The risk is decreased for lymphedema and nerve, great vessel and ureteral damage.
- Improved detection rates. Because only two to four lymph nodes need to be examined, it is feasible to perform ultrastaging—an enhanced pathologic assessment that can detect micrometastases. “The added cost of ultrastaging is greatly offset by a higher detection rate for metastatic lymph nodes,” Dr. Diaz said.

IDENTIFYING SENTINEL NODES

To locate sentinel lymph nodes during robotic surgery for cervical or endometrial cancer, the surgeon injects indocyanine green (ICG) dye into the primary organ. The surgeon then toggles between ordinary white light and near-infrared imaging to observe the dye as it travels into the lymph nodes.

In the surgeon’s near-infrared view, lymph nodes containing the dye appear neon green, while surrounding tissues appear gray, heightening the contrast. “In experienced hands, using this method to identify sentinel nodes adds only about five minutes to the total surgical time,” Dr. Diaz said.

LOOKING TOWARD THE FUTURE

Fluorescence imaging may play an even larger role in gynecologic cancer surgery in the future, and Dr. Diaz is on the leading edge of research into potential applications. He serves on the safety monitoring board for an international clinical trial that is studying a related fluorescence imaging system.

Among other things, the trial is investigating whether there is a correlation between the heat maps produced during near-infrared fluorescence imaging and malignant tissue. “If that proves to be the case,” Dr. Diaz said, “it could have potential applications for defining tumor margins as well as identifying which lymph nodes are actually metastatic.”
PREVENTING ANASTOMOTIC LEAKS
AFTER BOWEL RESECTION

A
nastomotic leakage is a potentially devastating complication of bowel resection, with a reported mortality rate of about 15–20 percent. One factor that may contribute to leaking is inadequate blood supply, which may severely compromise healing of the anastomosis.

“To remove a section of bowel, the surgeon must cut and staple across numerous blood vessels coming into the bowel from the underside,” said Ricardo Estape, M.D., a gynecologic oncologist and medical director at Baptist Health South Florida’s Center for Robotic Surgery. “Because these vessels are obscured by fat, it can be difficult for the surgeon to ascertain whether blood flow to the end of the bowel is affected.”

To overcome this obstacle, Dr. Estape uses fluorescence imaging technology that is integrated into the robotic platform. “An anesthesiologist injects dye into a vein intraoperatively,” said Dr. Estape. “Within a few seconds, blood vessels light up bright green, allowing the surgeon to see how blood flow to the end of the bowel looks.”

AVOIDING A DREADED COMPLICATION

The Center for Robotic Surgery is one of the few medical centers using fluorescence imaging for this purpose during robotic bowel surgery. For the last two years, Dr. Estape has been utilizing this approach in ovarian and endometrial cancer patients who have metastatic tumors of the bowel.

“This is just another example of how we are taking advantage of advanced technology to improve patient safety,” said Dr. Estape. Of the first 25 bowel resections he performed using robotic surgery with fluorescence imaging, no patients have developed anastomotic leaks. Dr. Estape is currently following patients and collecting data to assess long-term outcomes for statistical analysis.

The prospects appear promising. Small studies from Europe have already shown that robotic surgery with fluorescence imaging may reduce the risk of anastomotic leakage. Dr. Estape believes that the approach could be applied to several types of bowel surgery.

“Using conventional techniques, about 3–5 percent of bowel resection patients experience an anastomotic leak,” said Dr. Estape. Those who survive often require two to three weeks of hospitalization to receive treatment for infection and sepsis. Another surgery is required, and many patients end up living with a permanent stoma. Dr. Estape noted, “Anything that reduces the risk of developing this severe complication is going to have a huge impact on the quality of patient care.”

Fluorescence technology and enhanced visualization with the robot helps prevent surgical complications.
Reducing the Risk of Bile Duct Injury During Gallbladder Surgery

Bile duct injuries during cholecystectomy can lead to severe and sometimes life-threatening complications. Such injuries are often the result of anatomic anomalies, which may be obscured by fat and inflammation in the area. “The biliary system has some of the most varied anatomy in the entire body,” said general surgeon Jorge Rabaza, M.D., chief of surgery at South Miami Hospital.

To help prevent bile duct injuries, surgeons may use fluorescence imaging to visually assess the major ducts connecting to the gallbladder. Traditionally, that meant performing intraoperative cholangiography (IOC). However, at Baptist Health South Florida’s Center for Robotic Surgery, surgeons now use a newer fluorescence imaging technology, which is integrated into the robotic platform. This imaging method has important advantages:

- **Real-time assessment.** A surgeon using the robotic system can see the illuminated biliary tree while actually performing the surgery. In contrast, imaging and surgery are performed sequentially, not simultaneously, when using conventional IOC.
- **Decreased surgical time.** In conventional IOC, a catheter is inserted through the abdominal wall into the cystic duct, and a contrast agent is introduced. Then a radiologic technologist positions a fluoroscopy machine over the patient to take the image. By comparison, the fluorescence imaging procedure used during robotic surgery is more streamlined.

**ILLUMINATING THE BILIARY TREE**

In this newer procedure, indocyanine green (ICG) dye is injected into the patient’s bloodstream prior to surgery. The dye soon concentrates in the liver and is then excreted through the biliary tree.

Once surgery is underway, the surgeon can switch from ordinary white light to near-infrared imaging. In the near-infrared view, the biliary tree glows green as the dye passes through, while other tissues appear gray. “No fluoroscopy machine is required, so there is no exposure to radiation,” said Dr. Rabaza.

Concurrent visualization of the biliary tree helps the surgeon avoid mistakenly cutting or damaging the bile duct during gallbladder surgery. And that, in turn, may spare patients from additional surgery and long-term complications, including liver failure. “Added to superior visualization in the white-light view and excellent maneuverability, fluorescence imaging is one more advantage of robotic cholecystectomy,” said Dr. Rabaza.