GENERAL SURGERY NEWS

In the News

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Toward No-Scar Surgery Again—This Time With Energy

Panel to Discuss Energy Devices and Potential for Incision-Free Surgery

By Monica J. Smith

Energy-driven technology is a cornerstone of surgery. Although surgeons use the devices at their disposal skillfully, for the most part, many do not know exactly how they work. A better understanding of the technology, experts say, could help surgeons make the most of these essential tools, as well as set them up for future forms of energy-based surgery.

“If you consider monopolar electrosurgery, we’ve been using electrocautery for basically a century now—patents on the Bovie date to 1910,” said Raymond Lanzafame, MD, a general surgeon in Rochester, N.Y., and scientific chair and member of the board of directors for the Society of Laparoendoscopic Surgeons.

“What we’ve discovered over time is that one, the technology is useful; two, it does carry complications; and three, that a lot of people using these applications have little understanding of how and why they work, when to use them, and for what sorts of applications,” he said.

According to a study conducted by the Society of American Gastrointestinal and Endoscopic Surgeons in 2012, surgeon knowledge of how energy-based technology works is fairly low (*Surg Endosc* 2012;26:2735-2739). “Both academic and community surgeons scored about 25% on questions pertaining to the outputs of these devices and a median pretest score of 55%. So there’s been an increase in the realization that we need to educate people about the technologies,” Dr. Lanzafame said.

Most complications occur because of qualities inherent to the technology, he said. “For example, the sealing devices get very hot and stay hot; even after they’re turned off, they can burn something in close proximity. With monopolar devices, you might get arcing or capacitance coupling,” Dr. Lanzafame said.

“Surgeons who understand the possible complications are better prepared to identify a problem faster and deal with it.”

In addition to a basic understanding of how particular energy-based devices work, it is important to know their best applications. Some types of energies outshine others for certain components of procedures: dissection, coagulation, vessel sealing, operating near-critical structures and so forth.

“That’s why it’s really important for surgeons to understand the energy device they are using, and to know what type is best suited for the particular case; that knowledge is truly empowering,” said Mona Orady, MD, director of robotic surgery at Saint Francis Memorial Hospital, in San Francisco.

“Knowing the specifics of the energy as well as the correct settings is especially important when you’re doing a complex case and may be using the energy a little differently than you would in a routine procedure.”

An electrocautery pencil instrument.

To this end, the SLS and other societies make it a priority to educate surgeons on the use of energy in surgery, which will be a priority focus of this year's Minimally Invasive Surgery Week, in September. After all, surgeons are unlikely to learn anything in-depth about their devices from device company representatives unless they know what questions to ask.

"Reps go out and promote their device as superior for one reason or another, but they don't explain how the energy is different in terms of application, or exactly how the energy works," Dr. Orady said.

She makes it a point to ask how the energy is applied differently in one instrument versus another, how it affects the tissue, and whether or not impedance detection is built in with an automatic adjustment in energy application. These types of questions help her understand how best to use the device, as well as the lateral spread of thermal energy that may occur.

Dr. Orady encourages other surgeons to ask device company representatives the difficult questions—whether at a meeting, online or in their office. “What is the type of energy? The frequency? The output? Does it adjust to tissue reaction? That’s how you educate yourself. Really find out the difference, the advantages of a particular device, so that you can also be aware of the potential risks and learn to avoid them.”

Dr. Orady also advises staying abreast of the literature and taking advantage of resources such as the SLS’s educational materials. “Doctors’ time is limited, but they must allow a certain amount of their time to investigate what can move them forward,” she said. “Things are progressing very rapidly, and surgeons who don’t keep up-to-date won’t know what their options are and what alternatives they have that will allow them to avoid complications that were more common in the past.”

For example, as a gynecologist, one of the main conditions she treats is fibroids. Available devices now use cryotherapy, heat or microwave energy to ablate fibroids rather than surgically remove them, and these devices will likely be used for different applications in the future.

“Most of these things are in experimental phases now, but if we surgeons don’t empower ourselves by understanding what’s out there, we won’t be able to keep up with what’s coming in the future at a rapid rate,” Dr. Orady said.

Richard Satava, MD, professor emeritus of surgery at the University of Washington, in Seattle, predicts the next generation of surgery will ultimately use energy to perform procedures in the most minimally invasive way imaginable: without incisions.

“When you look back in history, you see changes occur when multiple new technologies converge. We are in the information age, moving forward with computers and robots, but we have another group of people (nonsurgeons), working on imaging and sensing technologies at the cellular and molecular level with genetics, transcription factors, signaling molecules and so forth,” he said.

“The flow of electrons is the determinant between living and not-living things. Because of that fact, and the new technologies we have, we are going to be able to see and manipulate—diagnose and treat—individual cells at the molecular level using directed energy.”

As an example of using directed energy, Dr. Satava described using high-intensity focused ultrasound (HIFU) to stop hemorrhage.

“It goes through the body and focuses energy at specific points in the image where you want to focus. With HIFU, you can do the diagnosis and treatment at the same time; you see where the bleeding is, you direct the energy to the spot where you’re looking, and you seal the blood vessel without any surgery.”

Doppler ultrasound will make the diagnosis, and HIFU stops the bleeding instantaneously. That is why the new, noninvasive surgery is called directed energy for diagnosis and therapy, he added.

Researchers are now developing ways to determine the wavelengths of light needed to manipulate specific molecules, and early evidence suggests that energy can be controlled—focused to turn on or turn off specific molecules, Dr. Satava said. “Theoretically, most of the diseases we know about will be amenable to this type of noninvasive treatment.”

At this point, there is no indication that such a noninvasive approach will be applicable to trauma and other types of surgery hinged around tissue repair and reconstruction, so surgeons will continue to be necessary, he said. “But many of the diseases we need a surgeon for now will be cured with directed energy in the future, so surgeons need to start thinking now about this new technology and ensure their role in focusing and controlling energy for noninvasive surgery.”

Each Energy Source Provides Unique Benefits

Minimally invasive surgery uses a wide variety of energy sources and devices to cut, coagulate, vaporize and seal tissues. Electrosurgery and surgical diathermy involve the use of a high-frequency A.C. electric current, either as a cutting modality or to cauterize small blood vessels to stop bleeding. This technique induces localized tissue burning and damage, the zone of which is controlled by the frequency and power of the device.

A special session on surgical energy will be held in September at MIS Week 2017, in San Francisco.

Type of Energy	Function	Benefit	Notes
Monopolar	The electric current passes from one electrode near the tissue to be treated to another fixed electrode elsewhere in the body. Tissue resistance increases as it desiccates. Narrow tissue sites can be heated to the point of desiccation as electricity flows back to return to the electrode (Ohm's law). The higher the voltage, the farther a spark can jump to other tissue sites. Wattage is a measure of power, and this determines the amount of heat produced to create a surgical effect.	Rapidly heats tissue to explode cells to steam. No real tissue contact. Risk is reduced by lowering frequency generators.	Most laparoscopic instruments are a long electrode.
Bipolar	Both electrodes are mounted on the same penlike device, and the electric current passes only through the tissue being treated. Water is driven out and tissue desiccates, stopping the flow of current. Heating of tissues and the instrument along with tissue compression causes tissue coagulation and welding. The various instruments have different thermal profiles. The instruments remain hot after the device has been turned off. Inadvertent contact with adjacent or other tissues can result in iatrogenic injury.	Prevents the flow of current through other body tissues and focuses only on the tissue in contact. In combination devices, in vitro burst pressures for sealed vessels are significantly higher than can be achieved with either energy source alone. Some device designs also allow connection to a monopolar electrosurgical generator.	Current passes through tissues compressed between two electrodes.
Ultrasound	High-intensity focused ultrasound can ablate tumors or other tissue noninvasively with minimal to no collateral damage. Relatively high-power ultrasound can break up stony deposits or tissue.	Speeds up the healing process by increased blood flow in the treated area. Decreases pain from the reduction of swelling and edema.	Using specific frequencies of ultrasound, light, microwaves, etc. to operate is known, and companies are developing new technology around MRI and high-intensity focused ultrasound.
Molecular energy	Frequencies of energy (light, ultrasound, microwave, etc.) can penetrate through tissues (such as x-rays, but without harmful radiation). By precisely choosing the frequency and power of energy (directed energy), it is possible to use the energy to make a diagnosis (e.g., spectroscopy) or perform a therapy (e.g., ablation), and this can be done instantaneously at the cellular or molecular level using a single instrument. This is referred to as "directed energy for diagnosis and therapy."	Molecular energy works for the reduction of solid tumors and other gynecologic and neurologic problems.	Where physics and biology meet—and relevant to the future of medicine. Find out more during MIS Week 2017. Visit SLS.org for information on the meeting.

Source: The Society of Laparoendoscopic Surgeons