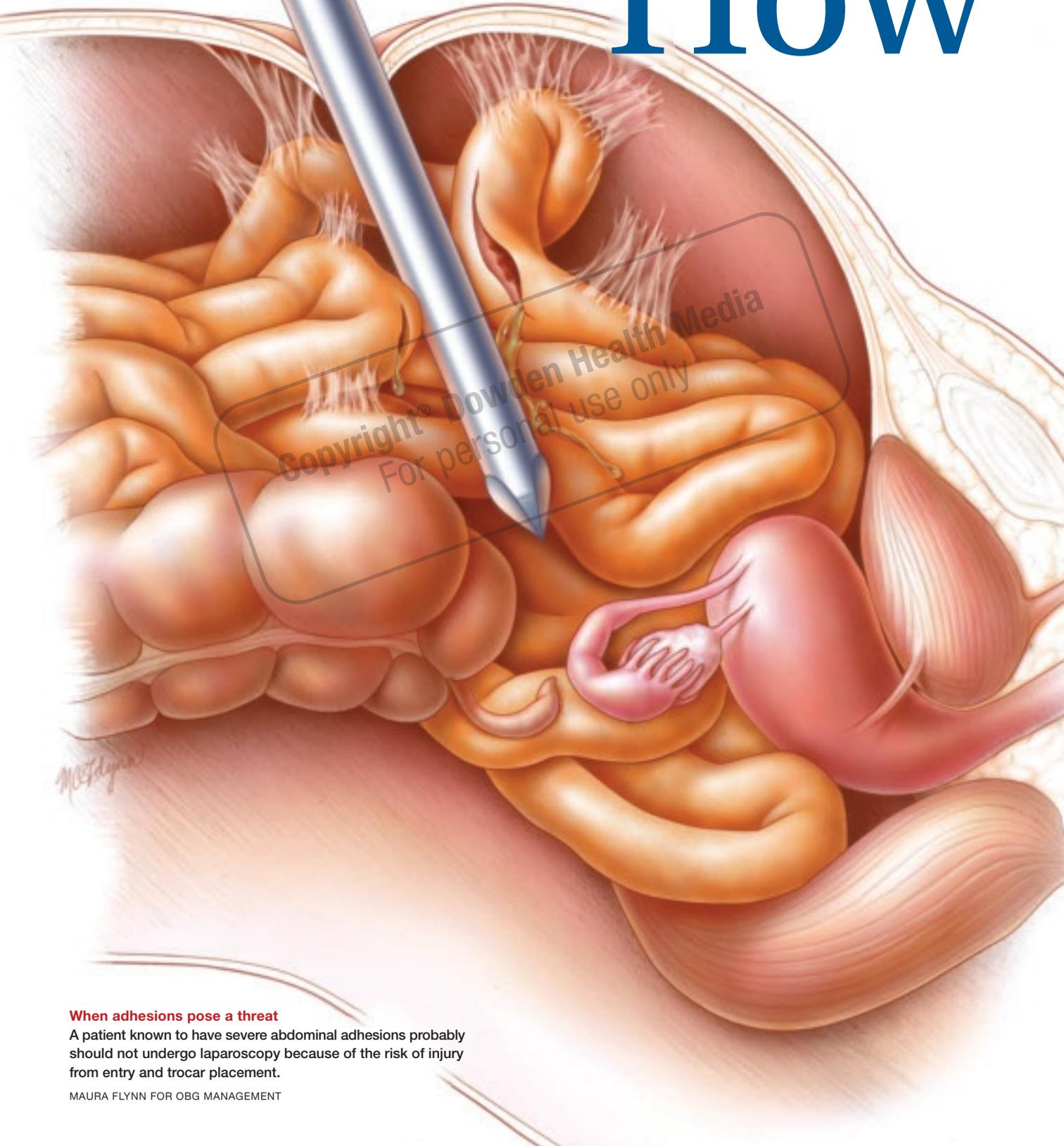




How



When adhesions pose a threat

A patient known to have severe abdominal adhesions probably should not undergo laparoscopy because of the risk of injury from entry and trocar placement.

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to avoid injury to bowel during laparoscopy

👉 Be reluctant to perform laparoscopy in a patient known to have significant adhesions. Also, be aware of risk of injury at trocar entry and mindful of how you use energy devices.

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The author reports no financial relationships relevant to this article.

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CASE

Postoperative abdominal pain. Is it gastroenteritis?

R.B., 35 years old, undergoes laparoscopic adhesiolysis for abdominal pain. Previously, she underwent exploratory laparotomy for a ruptured tubal pregnancy and, in separate operations, right oophorectomy via laparotomy for a ruptured corpus luteum cyst and diagnostic laparoscopy.

During the current surgery, extensive adhesions are observed, including interloop intestinal adhesions. The adhesions are lysed using monopolar scissors and a needle electrode, and R.B. is discharged home the same day.

Later that day and the next day, R.B. complains of abdominal pain that does not respond to prescribed analgesics, as well as nausea and vomiting. A nurse practitioner takes her call and prescribes a stronger analgesic, an antiemetic, and an antibiotic.

The following day, the patient's husband telephones the treating gynecologist to report that his wife is still experiencing severe pain and nausea. He is told to bring her to the office, where she is described as having mild lower abdominal tenderness and mild rebound. An abdominal radiograph shows air-fluid levels and distended bowel. The gynecologist determines that the patient is experiencing gastroenteritis.

On postop day 3, R.B. continues to suffer from severe abdominal pain, nausea, and vomiting, and is unable to get out of bed. Her husband takes her to the emergency room

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10 ways to lower the risk of intestinal injury

- ▶ **Avoid laparoscopy** when severe adhesions are anticipated—such as when the patient has a history of multiple laparotomies, or when significant adhesions have been documented.
- ▶ **Be aware that laparoscopy carries additional risks** beyond those of the primary surgical procedure, owing to factors peculiar to endoscopic technique and instrumentation.
- ▶ **Consider open laparoscopy** or insert the primary trocar at an alternative location, such as the left upper quadrant, when the patient has a history of laparotomy.
- ▶ **Avoid blunt dissection** for anything other than mild (filmy) adhesions. Sharp dissection associated with hydrodissection is the safest method of adhesiolysis. Clear visualization of the operative site is the sine qua non for precise dissection.
- ▶ **Avoid monopolar electro-surgical devices** for laparoscopic surgery whenever possible. Also remember that bipolar and ultrasonic devices can cause thermal injury by heat conduction as well as by direct application. Laser energy will continue beyond the target unless provision is made to absorb the residual energy.
- ▶ **At the conclusion** of any laparoscopic procedure, especially after adhesiolysis or bowel dissection, inspect the intestines and include the details in the operative report.
- ▶ **After any laparoscopic procedure**, if the patient does not improve steadily, the first presumptive diagnosis to be excluded is injury secondary to the procedure or technique.
- ▶ **The major symptom** of intestinal perforation is abdominal pain, which does not ease without increasing quantities of analgesics.
- ▶ **Investigate any bowel injury** thoroughly to determine viability at the site of injury. Whenever possible, repair all injuries intraoperatively.
- ▶ **After intestinal perforation**, the risk of sepsis is high. Look for early signs such as tachycardia, subnormal body temperature, depressed WBC count, and the appearance of immature white cell elements.

at another hospital, where she is found to have diffuse peritonitis, absent bowel sounds, and:

- temperature, 101.8°F
- heart rate, 130/min
- respiratory rate, 24/min
- blood pressure, 90/60 mm Hg
- white blood cell (WBC) count, $21.5 \times 10^3/\mu\text{L}$
- x-ray showing free air.

A general surgeon performs an exploratory

laparotomy and finds foul-smelling abdominal fluid, 200 to 300 mL of pus, and a 1-cm perforation of the sigmoid colon. He performs sigmoid colon resection and a left-colon colostomy. A second laparotomy is necessary to drain a subphrenic abscess.

Four months later, the colostomy is taken down and bowel continuity is established.

Subsequently, the patient experiences episodes of gaseous and fecal incontinence, which are thought to be secondary to nerve damage. A ventral hernia is also diagnosed.

Could this outcome have been avoided?

No physician would wish a major complication of surgery upon any patient. Yet, sometimes, preventive efforts fall short of the goal or the physician is slow to suspect injury when the patient experiences postoperative abdominal pain and other symptoms. Intestinal injury may not be common during laparoscopy, but it is certainly not rare. And the longer diagnosis is delayed, the greater the risk of sepsis, even death.

Recognizing the limitations of laparoscopic surgery is a first step toward reducing the complication rate.^{1,2} The ability to determine when laparotomy would better serve the patient's interests is also critical, and prompt diagnosis and repair of any complication that does occur will ensure and speed the patient's recovery.

The most serious complications associated with diagnostic and operative laparoscopy are major vessel and intestinal injuries. Both types of injury significantly raise the risk of mortality, which ranges from 2% to 23%.^{3,4} The overall risk of injury to the gastrointestinal tract averages 1.6 to 2.0 for every 1,000 cases. The risk of major vessel injury averages 0.5 for every 1,000 cases.⁵⁻⁹

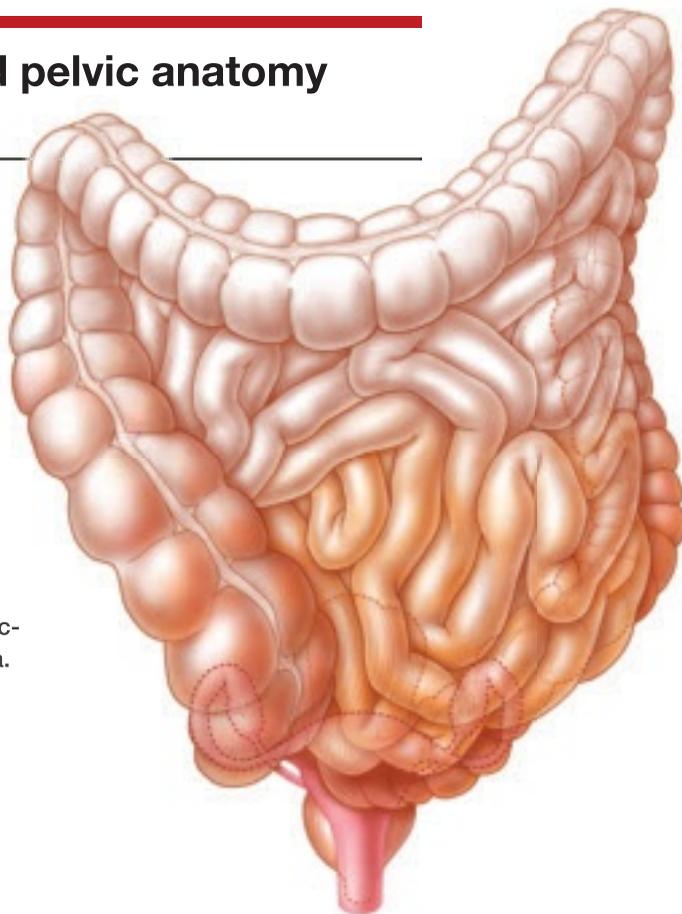
In an earlier article for OBG MANAGEMENT, I reviewed vascular injury during laparoscopy.¹⁰ In Part 1 of this article, I focus on ways to avoid intestinal injury. In Part 2, which follows on page 55, I outline strategies to identify it in a timely manner when it does occur.

Familiarity with intestinal and pelvic anatomy can prevent surgical injury

A thorough familiarity with pelvic anatomy is important to avoid injury at trocar entry, but it is even more critical in regard to operative injury. The small intestine spreads diffusely throughout the abdomen beneath the anterior abdominal wall. It lies beneath the umbilicus and anterior midline, whereas the large bowel is located at the periphery. The sigmoid colon swings left to right before joining the rectum anterior to the presacral space. The sigmoid junction with the descending colon lies well to the left of the midline, and the cecum lies at the pelvic brim to the right of midline.

Depending on the degree of redundancy of the mesentery of the cecum or sigmoid colon, these structures may droop into the pelvis and cover the adnexa. Therefore, adhesions are likely to develop between the large or small intestine, or both, and the adnexa following dissection in the vicinity of or immediately over the tubes and ovaries. Knowing the normal anatomic relationships is vital for restorative surgery.

When severe adhesions involve the large intestine, it is critical to know the anatomy of the retroperitoneum and be skilled enough to gain safe entry and to dissect that space to safely separate the adnexa when they are densely adhered to the pelvic sidewall in the area of the obturator fossa.



In some women, the intestines droop into the pelvis and cover the adnexa, making adhesions between these structures highly likely following dissection in the vicinity of the tubes and ovaries.

MAURA FLYNN FOR OBG MANAGEMENT

As laparoscopy evolves, the injury rate rises

Over the past 40 years, laparoscopy has evolved from an uncommonly utilized diagnostic tool to a minimally invasive alternative to laparotomy for even the most difficult and complex operations, reaching a high point with robotic laparoscopy. As this technology has developed, serious complications—to some degree, unique to laparoscopy—have increased. In the future, as less skilled surgeons perform a greater percentage of laparoscopic surgeries, a still greater number of complications will arise.

The frequency of intestinal perforation is not great relative to the total number of lapa-

roscopic procedures performed. The **TABLE** (page 50) lists several series totaling more than 380,000 laparoscopic operations. The risk of reported bowel perforation ranged from 0.6 to 6 for every 1,000 procedures, with a mean risk of 2.4 for every 1,000. However, these data are inconclusive because the total number of laparoscopic operations performed in the United States is not accurately known. Nor is the precise number of complications associated with these procedures known—specifically, the number of intestinal perforations—as no law requires them to be reported.

Research surveys are unreliable in many cases. In addition, the relative expertise of the surgeon is impossible to quantify. For exam-

**TABLE** Studies of complications reveal: Gastrointestinal injury is no rare event during laparoscopic surgery

Study (year; country)	Cases	Complications	Deaths	GI injury
Brown et al (1978; UK) ¹⁶	50,247	345	4	117 (2.3/1,000)
Soderstrom (1993; US) ¹⁷	No data	No data	3	66
Bateman et al (1996; US) ¹⁸	1,162	No data	No data	3 (2.6/1,000)*
Champault et al (1996; France) ¹⁵	103,852	337	6	63 (0.6/1,000) [†]
Saidi et al (1996; US) ¹⁹	452	47	0	0
Jansen et al (1997; Netherlands) ⁵	25,764	145	2	29 (1.13/1,000)
Harkki-Siren et al (1997; Finland) ⁸	70,607	96	0	44 (0.6/1,000)
Harkki-Siren et al (1997; Finland) ⁷	1,165	119	0	5 (4/1,000) [‡]
Chapron et al (1998; France) ⁶	29,996	96	1	48 (1.6/1,000)
Chapron et al (1999; France) ⁹	No data	No data	No data	62 (0.6–1.6/1,000)
Gordts et al (2001; France) ²⁰	3,667	No data	No data	24 (6/1,000)
Bhoyrul et al (2001; US) ¹³	No data	629	32	128 [§]
Wang et al (2001; Taiwan) ²¹	6,451	42	0	10 (1.6/1,000)
Sharp et al (2002; US) ¹⁴	185	84	2	24**
Brosens et al (2003; Belgium) ²²	85,727	No data	No data	195 (2.3/1,000)

* 80 open laparoscopy procedures; 30 closed laparoscopy procedures

[†] Limited to trocar injuries[‡] Laparoscopic hysterectomy[§] All trocar injuries obtained through Food and Drug Administration reports

** Limited to optical access trocars

FAST TRACK

Surgical skill is the greatest unknown variable in any outcome study of any surgical procedure

ple, although a surgeon may have many years of operative experience, it is unclear whether this always translates into skill or comfort with laparoscopic procedures. And, when a resident scrubs in with a faculty surgeon, any data collected fail to reflect which part of the surgery was performed by the resident and which by the fully trained gynecologist.

These unknown variables are important in terms of risk, surgical complications, and outcomes. Surgical skill is the greatest un-

known factor in any outcome study of any surgical procedure.

Classifying intestinal injuries

As in the case of major vessel injury, intestinal injury sustained during laparoscopy can be classified as either:

- Injury secondary to the approach. This category refers to entry complications associated with creation of the pneumoperitoneum and insertion of primary and secondary trocars.
- Injury secondary to the procedure or operation. This type of injury occurs as a result of manipulation with various devices during laparoscopy. The devices may include probes, forceps, scissors, or energy devices such as laser, electro-surgical, and ultrasonic instruments.

DID YOU SEE IT?

Avoiding vascular injury at laparoscopy

› Michael S. Baggish, MD
OCTOBER 2004

You can find it in our archive at www.obgmanagement.com

CONTINUED ON PAGE 52

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“Medical Verdicts on the Web”

escorts you into the courtroom for a look at compelling malpractice cases involving bowel injury at laparoscopy—an eye-opening follow-up to Dr. Michael S. Baggish’s two-part article in this issue on how to avoid this potentially devastating trauma.



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How trocar injury happens

Several studies have demonstrated that abdominal adhesions place any patient into a high-risk category for trocar injury to the intestines. Patients who have undergone multiple laparotomies, like the patient in the case that opened this article, are more likely to have severe adhesions and fall into the highest risk category for bowel perforation.¹¹ It is impossible to predict with any degree of accuracy whether the intestine is adherent to the entry site.

Pneumoperitoneum can be protective

Creation of a pneumoperitoneum creates a cushion of gas between the intestines and the anterior abdominal wall (provided the intestines are not adherent to the abdominal wall). Manufacturers of disposable trocars with a retractable shield recommend creating an adequate pneumoperitoneum so that the “safety shield” deploys quickly and properly, unlike direct insertion, in which no gas is infused and space is insufficient for complete shield activation.

Open laparoscopy techniques, which allow the surgeon to enter the peritoneal cavity by direct vision without a sharp trocar, may diminish but not eliminate the risk of bowel injury.

What the data show

Of the 130 intestinal injuries recently reported by Baggish, 62 of 81 (77%) small bowel injuries were related to trocar insertion, as were 20 of 49 (41%) large intestinal injuries.¹² In other words, 82 of 130 intestinal injuries (63%) were the direct result of trocar entry.

Bhojyul and associates reported 629 trocar injuries, of which 182 were visceral.¹³ Of the 32 deaths, six were secondary to unrecognized bowel injury. Of 176 nonfatal visceral injuries, 128 (73%) involved the intestines, and 22 were unrecognized.

Optical-access and open laparoscopic systems were designed to prevent such injuries. Sharp and colleagues reported 24 intestinal injuries out of a total of 79 complications (30%) associated with optical-access trocars after reviewing data obtained from the Medical



Device Reports (MDR) and Maude databases maintained by the Food and Drug Administration.¹⁴ In the Baggish series, 4.6% of injuries were associated with open laparoscopy.¹²

Champault and colleagues reviewed complications in a survey of 103,852 operations.¹⁵ Although they recommended use of open laparoscopy as opposed to blind insertion, they presented no data on the safety of open techniques.

How intraoperative injury happens

Operative injury of the large or small bowel often occurs during sharp or blunt dissection, performed during laparoscopy using accessory mechanical or energy devices. The latter type of device is utilized increasingly because laparoscopic knot tying and suturing are rather awkward and slow, and laparoscopic suturing to control bleeding is difficult. The size of the needle required for laparoscopic suture placement must be small enough to navigate a trocar sleeve.

Avoid blunt dissection when adhesions are present

The separation of dense adhesions between the intestines and neighboring bowel, other viscera, or abdominal wall is risky when blunt dissection is used. The tensile strength of the fibrotic connective tissue may well exceed that of the thin intestinal wall. Tearing the adhesion free may bring with it a portion of the bowel wall. Such injuries are frequently missed or described as serosal injuries and left unexplored and unrepaired.

Hydrodissection is a safer alternative. It involves the infiltration of sterile water or saline under low pressure between the parietal peritoneum and underlying retroperitoneal structures, providing a safe and natural plane for dissection. In addition, when the CO₂ laser is used, the liquid acts as a heat sink to absorb any penetrating laser energy.

Energy devices create thermal effects

Energy devices used to cut tissue during operative laparoscopy coagulate blood vessels

in a variety of ways, but the common pathway is thermal. Many hypotheses have evolved to explain how vessels are sealed, but none has demonstrated nonthermal activity except for cryocoagulation.

The devices most commonly used for cutting and hemostasis at laparoscopy are:

- **electrosurgical** (both monopolar and bipolar). Bipolar electrosurgical devices have advantages over monopolar devices when it comes to high-frequency leaks, direct coupling, and capacitive coupling.
- **laser** (CO₂, holmium:YAG, Nd:YAG, KTP-532, argon). As I mentioned, CO₂ laser devices are effectively backstopped by water, especially in strategic areas such as over and around intestines, major vessels, and the ureters.
- **ultrasonic** (Harmonic Scalpel, ultrasonic aspirator [CUSA]).

Laser and ultrasonic devices do not require a flow of electrons to create coagulation, but do produce heat that will spread peripherally by thermal conduction from the zone of impact (target).

The extent of energy-inflicted injury cannot be predicted

Inadvertent injury with energy devices can occur directly through contact with the bowel, indirectly by heat conduction through tissue, through capacitive coupling (monopolar electrical only), and by forward scatter (laser only).

Upon direct contact with the intestine, energy devices cut into the tissue in a manner similar to mechanical scissors or a knife but produce a larger wound. The reason? The transfer of heat to areas adjacent to the primary wound produces additional necrosis.

CONTINUED

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Upon direct contact with the intestine, energy devices produce a larger wound than mechanical scissors or a knife, owing to heat transfer

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Major vascular injury during laparoscopy: Pearls to cope

› Magdy Milad, MD
APRIL 2008

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Heat conduction, capacitive coupling, high-frequency leaks, and front scatter coagulate the intestinal wall with subsequent tissue devitalization and necrosis, the extent of which depends on the power density at contact and the duration of energy applied.

It is impossible to predict the depth or area of devitalization in energy-inflicted injury by visualization of the event.

In the Baggish review of 130 intestinal injuries, the number of injuries sustained during the operative procedure was 19 involving the small intestine and 29 involving

the large bowel.¹² Of this subset, 44% (21 cases) were secondary to the use of energy devices, with monopolar electrosurgical instruments alone accounting for 9 (43%) of the injuries.

Even best-laid plans can go awry

Despite our best intentions and precautions, accidents do sometimes happen, and bowel injury is no exception. In Part 2 of this article, which follows on page 55, I detail steps you can take to detect injuries in as timely a manner as possible.

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It is impossible to predict the depth of devitalization in energy-inflicted injury by visualization of the event

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