

Patient Safety Tip of the Week

December 5, 2023

Thermal Injuries During Surgery

We’ve done several columns on iatrogenic thermal injuries (see list below). But one type is particularly bothersome – thermal injury that goes initially unrecognized during surgery. Such cases typically present after a delay of several days. A couple cases are illustrative.

40-year-old woman with chronic pelvic pain, history of chronic pelvic inflammatory disease, and recent severe menorrhagia underwent laparoscopic hysterectomy and bilateral salpingo-oophorectomy. No significant complications were recognized during the procedure. An indigo dye test was performed before ending the procedure and it was negative (and on return to the floor dye was appropriately noted in the Foley catheter). There was some liquid vaginal discharge post-op but was felt that the drainage was simply from irrigation fluid that had not fully drained, and she was discharged from the hospital. Three days after discharge a phone call from the gynecologist to the patient noted there was continuing vaginal fluid leakage. The urologist performed cystoscopy and a retrograde pyelogram. The right ureter was patent but there was leakage of dye from the left ureter. An attempt to put a stent into the left ureter was unsuccessful so the patient underwent surgical reimplantation of the left ureter 7 days after the original surgery. There was no leakage immediately after that surgery but several days later leakage recurred. Clear yellow discharge from the vagina persisted and CT scan revealed leakage of contrast from the right ureter. She ultimately had placement of a percutaneous nephrostomy tube into the right ureter and placement of a stent from above to below.

A 36-year-old female patient with a history of chronic pelvic pain had a laparoscopic-assisted vaginal hysterectomy with bilateral tubal ligation and endometrial ablation. However, she had persistent pelvic pain that was unresponsive to analgesics and several courses of GnRH agonist therapy. She eventually had a laparoscopic procedure for fulguration of any possible foci of endometriosis and lysis of adhesions. Some minor bleeding was noted on the left side. Monopolar cautery was used. Estimated blood loss was minimal. Approximately one week later she suddenly developed suprapubic and left abdominal pain associated with nausea and diaphoresis. Transurethral ultrasound showed

fluid in the pelvis and abdomen and a right ovarian cyst. CT scan with IV and oral contrast showed generalized ascitic fluid and the bladder appeared intact. There was no hydronephrosis. It was suspected that she likely had an injury to her ureter, perhaps a thermal injury related to the prior surgery. But cystoscopy showed no ureteral injury. Instead, it showed a likely thermal bladder injury on the posterior wall of the bladder about 2" from the trigone. A Foley catheter was inserted and she was sent home on Bactrim. However, she returned several days later with sudden onset of suprapubic pain and CT scan showed the Foley catheter transecting her bladder with ascites and free air in the retroperitoneum. She went to the OR where the Foley catheter was removed and necrotic tissue at the perforation site was removed. The bladder defect was closed surgically and a new Foley catheter inserted. She was discharged with a plan to repeat a cystogram prior to Foley removal in about a week.

The incidence of ureteral injury during hysterectomy was estimated to be 0.2%-6% depending on the type of operation performed, noting that most ureteral injuries are under-reported and only 30% are recognized during the surgery ([Brotherton 2008](#)). Oh and colleagues ([Oh 2000](#)) reviewed the charts of 12 women who had delayed recognition of ureteral injuries. Patients presented with fever, hematuria, flank pain, or peritonitis between 3 and 33 days postoperatively. The mechanism of ureteral injuries was related to electrocoagulation in seven of these.

Of course, it's not just ureters and bladders that are prone to thermal injury. Any hollow viscus can be affected. Thermal injuries to bowel are especially dangerous because of the havoc raised by fecal contents spilling into the peritoneal cavity. Just as adhesions increase the likelihood of mechanical injury to bowel during surgery, adhesions also are associated with increased likelihood of thermal injury to bowel. Cassaro ([Cassaro 2015](#)) discussed delayed manifestations of laparoscopic bowel surgery and noted that electrosurgery is used extensively in laparoscopic surgery and can cause thermal injuries that are harder to detect than mechanical injuries. It's important to recognize that thermal injuries may occur with use of monopolar cautery even to tissues not in direct contact with the cautery tool. Cassaro notes that electrosurgical devices can cause thermal tissue damage through a number of mechanisms, including:

- unintended direct application of the electrosurgical current to the tissues
- transmission through another conductive instrument, or coupling
- discharge through faulty insulation
- capacitive coupling, a phenomenon that occurs when the surrounding charge that is associated with the use of all the monopolar active electrodes is not allowed to flow back through the body tissues to the passive electrode and builds up in a metal part of the instrument that may then transfer this energy into the tissue and damage it
- antenna coupling, which occurs when the active electrode acts as an active transmitting antenna and emits energy, which is captured without direct contact by an inactive wire in close proximity that functions as an electrically inactive receiving antenna

He notes that, of these, all but the inadvertent direct application of thermal energy involve coupling and energy discharge that are likely to occur outside the operator's limited field of view afforded by the laparoscope. Alkatout et al. ([Alkatout 2012](#)) noted that most electrothermal injuries to the bowel (approximately 75%) are unrecognized at the time of occurrence.

Moorthy ([Moorthy 2015](#)) emphasizes that laparoscopic instruments should be regularly checked to ensure that there is no damage to the insulation and that surgeons using energy devices for the first time should be trained in their use. All these are in addition to the issues associated with training and credentialing in laparoscopic surgery.

See also our July 28, 2020 Patient Safety Tip of the Week "[Electrosurgical Safety](#)" for a good discussion of how thermal injuries may be related to electrosurgical instruments.

The **delay in development of symptoms** following thermal injury to viscera is typical. The initial thermal injury does not fully penetrate the wall of the viscus (a "partial thickness" injury) but subsequently tissue necrosis occurs, leading to perforation of the hollow viscus and leakage of contents into a body cavity.

We've seen a trend toward more **robotic procedures**, not only in gynecological surgery but in urological and general abdominal surgery as well. Looking at thermal injuries during surgery, Hodges found that injuries were to viscera in 44.4% of robotic cases, compared to 1.7% in open surgical cases and 8.1% in laparoscopic cases ([Hodges 2023](#)). The overall incidence of thermal injury to viscera is unknown but these statistics are bothersome and indicate the need for careful vigilance following robotic procedures.

To summarize, thermal injury to viscera are important for two reasons:

1. They are often unrecognized during the surgery
2. They typically present after a delay of several days

While careful technique and careful attention to tools used during surgery are important, it's most important that appearance of new symptoms several days following surgery should merit prompt consideration of the possibility of thermal visceral injury.

Our prior columns on iatrogenic burns:

- March 2009 "[Risk of Burns during MRI Scans from Transdermal Drug Patches](#)"
- June 1, 2010 "[Iatrogenic Burns](#)"
- October 5, 2010 "[More Iatrogenic Burns](#)"
- December 23, 2014 "[Iatrogenic Burns in the News Again](#)"
- March 2015 "[Another Source of Iatrogenic Burns](#)"
- September 5, 2017 "[Another Iatrogenic Burn](#)"
- June 5, 2018 "[Pennsylvania Patient Safety Authority on Iatrogenic Burns](#)"
- July 28, 2020 "[Electrosurgical Safety](#)"
- January 2021 "[New MRI Risk: Face Masks](#)"

- May 3, 2022 “[Iatrogenic Burns Again](#)”
- December 6, 2022 “[Rare Risk – Defibrillator Fires](#)”
- April 25, 2023 “[Joint Commission: Beware Light Source Burns](#)”

References:

Brotherton J, Chang F. Delayed Thermal Injury to the Ureter during Total Laparoscopic Hysterectomy Using Ultrasonic Energy Source: A Case Report. Journal of Minimally Invasive Gynecology 2008; 15(6) Supplement: 103S-104S November 2008
[https://www.jmig.org/article/S1553-4650\(08\)00777-2/fulltext](https://www.jmig.org/article/S1553-4650(08)00777-2/fulltext)

Oh BR, Kwon DD, Park KS, et al. Late Presentation of Ureteral Injury After Laparoscopic Surgery. Obstetrics & Gynecology 2000; 95(3): 337-339
https://journals.lww.com/greenjournal/abstract/2000/03000/late_presentation_of_ureteral_injury_after.4.aspx

Cassaro S. Delayed Manifestations of Laparoscopic Bowel Injury. The American Surgeon 2015; 81(5): 478-482
<https://journals.sagepub.com/doi/10.1177/000313481508100529>

Alkatout, I., Schollmeyer, T., Hawaldar, N. A., Sharma, N., & Mettler, L. (2012). Principles and safety measures of electrosurgery in laparoscopy. JSLS : Journal of the Society of Laparoendoscopic Surgeons 2012; 16(1): 130-139
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3407433/pdf/jls130.pdf>

Moorthy K. Bowel Injury After Laparoscopic Surgery. AHRQ PSNet WebM&M: Case Studies 2015; January 1, 2015
<https://psnet.ahrq.gov/web-mm/bowel-injury-after-laparoscopic-surgery>

Hodges MM. Thermal injuries during robotic surgery. YouTube video of a talk at the Robotics/Advanced Technologies Abstracts session during the 2020 SAGES Virtual Meeting.
https://www.youtube.com/watch?v=-cO_VrudHgw



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