Gynecology and Minimally Invasive Therapy 3 (2014) 39–42

Contents lists available at ScienceDirect

Gynecology and Minimally Invasive Therapy

journal homepage: www.e-gmit.com

Review article

Complications of electrosurgery in laparoscopy

Hui-Yu Huang [a], Chih-Feng Yen [a], Ming-Ping Wu [b, c, d, *]

[a] Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital, Linkou Medical Center, Chang Gung University College of Medicine, Taoyuan, Taiwan
[b] Division of Urogynecology and Pelvic Floor Reconstruction, Department of Obstetrics and Gynecology, Chi Mei Foundation Hospital, Tainan, Taiwan
[c] College of Medicine, Taipei Medical University, Taipei, Taiwan
[d] Chia Nan University of Pharmacy and Science, Tainan, Taiwan

ARTICLE INFO

Article history:
Received 28 January 2014
Received in revised form
20 February 2014
Accepted 22 February 2014
Available online 8 June 2014

Keywords:
Complication
Electrosurgery
Electrothermal injury
Laparoscopy
Tissue effect

ABSTRACT

Electrosurgery is widely used in laparoscopic surgeries. It is essential to understand the principles of using appropriate electric currents and techniques to achieve the desired tissue effect and avoid complications. We reviewed the literature concerning the incidence of electrosurgical injuries, the mechanisms of injury, and recognition and management of electrosurgical complications. Alertness to postoperative warning signs, patient education prior to discharge, and the detection of delayed manifestations with salvage maneuvers may minimize catastrophic complications.

Introduction

Since the introduction of the small medical video camera in the mid-1980s, laparoscopic surgery has brought a revolution in surgical techniques with shorter hospitalization and convalescence.[1,2] Minimally invasive surgery has become a gold standard for benign gynecologic lesions, and surgical laparoscopy is widely accepted as an efficacious technique in the management of gynecologic lesions.[3] Patients as well as the surgeons may enthusiastically accept these new minimally invasive techniques for treatment of gynecologic as well as surgical diseases.[4]

The growing trend of laparoscopic electrosurgery

According to a 10-year (1996–2005) nationwide population-based study in Taiwan, the use of the laparoscopic approach for hysterectomy has increased dramatically from 5.20% in 1996 to 40.40% in 2005, along with a concomitant decrease of abdominal hysterectomy from 77.33% in 1996 to 45.68% in 2005.[5] The use of laparoscopic surgery for benign ovarian pathology has increased significantly from 35.78% in 1997 to 71.66% in 2007, with a significant decrease in laparotomy from 64.22% in 1997 to 28.34% in 2007.[6] For ectopic pregnancy, use of laparotomy has significantly decreased from 81.08% in 1997 to 26.05% in 2007; however, the use of laparoscopic procedures for the condition have significantly increased from 18.9% in 1997 to 73.95% in 2007.[7] The spatial orientation, hand-eye coordination, and manipulative skills required for laparoscopy are different from an open approach.[8] Therefore, surgeons who are skilled in open techniques may require further training to adapt to laparoscopic techniques. Surgeons are aware of these learning curves, during which time complication rates may be appreciable.[8,9] Multiple technological advances have allowed surgeons to treat extensive disease and perform complicated procedures by laparoscopy. The complication rate may decrease with increasing experience with the laparoscopic procedure; however, the increasingly advanced and complicated procedures performed by the gynecologists via laparoscopy further potentiates the risk of complications.[10] As surgeons seek to treat more complicated cases via laparoscopy, the need for versatile and reliable hemostasis is important. Labor-intensive laparoscopic suturing techniques were being used for hemostasis; currently, titanium clips, stapling devices, and electrosurgery are being used.

The mechanisms of electrosurgical trauma

The rate of electrosurgical complications during delivery of energy to the surgical site is estimated to be 25.6% (70/273) and is the

Conflicts of interest: All authors declare no conflicts of interest.

* Corresponding author. Division of Urogynecology and Pelvic Floor Reconstruction, Department of Obstetrics and Gynecology, Chi Mei Foundation Hospital, 901, Chung-Hwa Road, Yung-Kang, Tainan, 710, Taiwan.
E-mail address: mpwu@mail.chimei.org.tw (M.-P. Wu).

http://dx.doi.org/10.1016/j.gmit.2014.05.004
2213-3070/

second most common laparoscopic complication after a misplacement of trocar or Veress needle, which is 41.8% (114/273).[11] Surgical techniques are more difficult if the surgeon's spatial orientation and hand-eye coordination are not well established. Injuries during laparoscopic electrosurgical procedures are similar to those during laparotomy and can be attributed to misidentification of anatomic structures, mechanical trauma, or electrothermal injuries.[12] The possible mechanisms are listed in the next paragraphs.

Direct application

Injury by direct application of the electrosurgical probe can arise either from mistaken targeting or unintended activation. The speed of the procedure will result in either less or more coagulation and thermal spread.[13] Proximity between the electrode and the tissue can determine contact (desiccation) or noncontact tissue effect (fulguration).[14] The dwell time determines the amount of tissue effect. Prolonged activation will produce wider and deeper tissue damage more than the anticipated desired tissue effect.[13]

Stray current

A stray current arising from defective insulation can injure the bowel or blood vessels. A careful preoperative inspection of equipment and after use is the best means of identifying defective insulation.[15] The two major causes of insulation failure include the use of high voltage currents and the frequent resterilization of instruments, which can weaken and break the insulation.[16] The risk of an insulation break increases when using a 5-mm insulated instrument through a 10-mm sleeve, or by repeated use of disposable equipment.[15]

Direct coupling

Direct coupling occurs when the active electrode is accidentally activated or is in close proximity to another metal instrument within the pelvic cavity, e.g., laparoscope or, metal grasper forceps.[16] Direct coupling can be prevented with visualization of the electrode and avoiding contact with any other conductive instruments prior to activating the electrode.[15,17]

Capacitive coupling

Capacitive coupling occurs when the electric current is transferred from one conductor (the active electrode), through intact insulation, into adjacent conductive materials (e.g., bowel) without direct contact. Longer length of instruments, thinner insulation, higher voltages, and narrow trocars increase the risk of this type of injury.[18] Capacitor coupling can be minimized by activating the active electrode only when it is in contact with target tissues and limiting the time length of high-voltage peaks.[13,14]

Return electrode or alternative site burns

The grounding (dispersive) pad offers the path of least resistance from the patient back to the generator and ensures an area of low current density.[19] If the return electrode is not completely in contact with the patient's skin, or is not able to disperse the current safely, then the exiting current can have a high enough density to produce an unintended burn.[16] It is important to have good contact between the patient and a dispersive pad.[15] A burn at an alternative site can occur if the dispersive (ground) pad is not well attached to the patient's skin.[15] When the dispersive pad is compromised in the quantity or quality of the pad or patient interface, the electrical circuit can be completed by some small grounded contact points such as electrocardiogram leads, towel clip, intravenous stand, etc., and produce high current densities, causing a burn.[19]

The management of electrosurgical injury

Bipolar electrosurgical injury, compared with monopolar injury, can be readily identified by viewing the area of blanch on the surface of the colon. The spread of electrothermal injuries is greater than the initial area of blanching, creating a large area of necrosis. Thus, the depth of injury is difficult to assess even if it is noticed intraoperatively. Thermal injury of the bowel necessitates segmental resection with a wide margin around the site of injury because thermal damage may extend several centimeters away from the site of thermal contact.[20]

When bladder injury is recognized intraoperatively, it can be repaired vaginally, laparoscopically, or by laparotomy. Early recognition with immediate salvage procedure, along with extended use of an indwelling catheter, may help overcome further sequelae.[21]

Intraoperative bladder injury can be detected by direct visualization of the bladder mucosa or Foley balloon or through the instillation of diluted dye via the Foley catheter.[22] A urine bag inflated with gas during the operation is suggestive of an injury.[23] Intraoperative ureteral injuries in gynecologic laparoscopy are usually not recognized during the procedure. Patients with persistent abdominal and/or flank pain, abdominal distention, and fever may raise concern during the postoperative phase.[24] Ureteral injuries recognized intraoperatively can be treated by direct laparoscopic end-to-end reanastomosis, or double-J ureteral stent with or without the assistance of ureteroscopy. If the initial salvage procedure fails, percutaneous nephrostomy and antegrade ureteral double-J stent is performed as a backup procedure to avoid the subsequent development of a ureteral fistula.

Detection and management of bowel injury

The timing of diagnosis

According to a review by van der Voort et al,[11] 61.6% (154/250) of bowel injuries were recognized intraoperatively; 5.2% (13/250) and 10.4% (26/250) were recognized during early (within the next 48 hours) and late (at least on the 3rd postoperative day or later) postoperative phases, respectively. Laparotomy was the most frequently performed procedure to manage laparoscopy-induced bowel injury (78.6%). Conservative and laparoscopic treatment were used considerably less often (7.0% and 7.5%, respectively).[11,25]

Injury to small bowel or prepped colon

A primary closure in two layers under laparoscopic guidance is recommended.[20] In selected cases with trocar-induced penetrating injuries of the bowel, institution of drainage and medical management with antibiotics may be possible, thereby precluding conversion to laparotomy.[26] Conservative management comprises percutaneous drainage of abscesses, antibiotics, or expectant treatment.[11]

Injury to the large bowel

It is appropriate to repair this injury at the time of surgery, usually with direct participation of a colorectal surgeon.[22] The exact technique of repair will depend on the size of the injury, the exact site, and if bowel preparation has been performed prior to surgery. As for colon injury, the transverse colon and sigmoid colon are most commonly traumatized by trocar insertion. The spillage of foul-smelling gas through the insufflation needle is a helpful diagnostic sign.[27] The treatment options include primary repair,