

Large bowel injuries during gynecological laparoscopy

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Abstract

Laparoscopy is one of the most frequently preferred surgical options in gynecological surgery and has advantages over laparotomy, including smaller surgical scars, faster recovery, less pain and earlier return of bowel functions. Generally, it is also accepted as safe and effective and patients tolerate it well. However, it is still an intra-abdominal procedure and has the similar potential risks of laparotomy, including injury of a vital structure, bleeding and infection. Besides the well-known risks of open surgery, laparoscopy also has its own unique risks related to abdominal access methods, pneumoperitoneum created to provide adequate operative space and the energy modalities used during the procedures. Bowel, bladder or major blood vessel injuries and passage of gas into the intravascular space may result from laparoscopic surgical technique. In addition, the risks of aspiration, respiratory dysfunction and cardiovascular dysfunction increase during laparoscopy. Large bowel injuries during laparoscopy are serious complications because 50% of bowel injuries and 60% of visceral injuries are undiagnosed at the time of primary surgery. A missed or delayed diagnosis increases the risk of bowel perforation and consequently

sepsis and even death. In this paper, we aim to focus on large bowel injuries that happen during gynecological laparoscopy and review their diagnostic and management options.

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Key words: Colon; Gynecology; Intraoperative complications; Laparoscopy; Wounds and injuries

Core tip: Large bowel injury during laparoscopy is a serious complication because 50% and 66% of bowel and visceral injuries are undiagnosed at the time of primary surgery. A missed or delayed diagnosis increases the risk of bowel perforation and consequently sepsis and death.

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INTRODUCTION

Four decades ago, laparoscopic surgery was being performed by a limited number of surgeons and most of the procedures were limited to diagnostic laparoscopy and tubal sterilization. However, through the years laparoscopy has evolved and become one of the major management choices for many surgical diseases. Cameras and hand instruments with improved visual quality and better manipulation capabilities, respectively, along with the accumulation of the data obtained from previous studies and case reports have contributed to the evolution of laparoscopy.

Today, laparoscopy is one of the most frequently preferred surgical options in gynecological surgery. In the United States, roughly 350000 bilateral tubal sterilizations and 200000 hysterectomies are performed using

laparoscopy each year. The popularity of laparoscopy has increased around the world and many gynecologists, including inexperienced and junior surgeons in training, have begun to perform laparoscopic procedures. Thus, the number of patients prone to complications during laparoscopy has increased^[1].

Laparoscopy has advantages over laparotomy, including smaller surgical scars, faster recovery from surgery, less pain and earlier return of bowel functions. Generally, it is also accepted as safe and effective and patients tolerate it well^[2]. However, it is still an intra-abdominal procedure and has the similar potential risks of laparotomy, including injury of a vital structure, bleeding and infection^[3-6]. Intra and postoperative complications are below 1% and 4 to 8 patients are lost per 100000 laparoscopic procedures.

Besides the well-known risks of open surgery, laparoscopy also has its own unique risks related to abdominal access methods, pneumoperitoneum created to provide adequate operative space and the energy modalities used during the procedures. Bowel, bladder or major blood vessel injuries and passage of gas into the intravascular space may result from laparoscopic surgical technique. In addition, the risks of aspiration, respiratory dysfunction and cardiovascular dysfunction increase during laparoscopy^[5-9]. Blood loss is generally lower than in open surgery; however, in some cases, massive blood loss necessitates immediate laparotomy.

Because of its advantages over laparotomy, such as less pain, hospital stay and recovery time, laparoscopy is generally perceived as a minor surgical procedure by patients. Thus, the medico legal aspects of the complications of laparoscopy are prone to exaggeration. In order to minimize complications and their unavoidable consequences, surgeons should learn the probable complications and their management. In this paper, we aim to focus on large bowel injuries that happen during gynecological laparoscopy and review their diagnostic and management options.

CLASSIFICATION, EPIDEMIOLOGY AND RISK FACTORS

Complications related to laparoscopic surgery can occur during either intra or postoperative phases. Intraoperative complications can further be divided into complications of access and complications of the operative procedure. More than half of complications occur at the setting up phase, particularly during the creation of the abdominal access pathways necessary for the telescope and trocars^[10,11].

The complication rate during the placement of the initial abdominal access port is less than 1%. Complications following the initial access are also rare. In contrast, port site hernia as a late complication can affect 6% of patients^[12-14]. Although rare, severe complications including vascular and bowel injuries, may cause serious morbidity and even result in the death of the patient.

The study conducted by Chandler *et al*^[10] in 2001 showed that the incidence of injury during abdominal access varied between 5 and 30 per 10000 procedures. Large bowel was the third most frequent injury site after the small bowel and iliac artery, with 12% of all injuries at the large bowel. In their review published in 2012, Jansen *et al*^[15] reported that access related bowel injury was seen in 4.4 per 10000 gynecological procedures. In addition, Hasson's open abdominal access technique did not significantly lower the complication rates compared to the closed technique.

Bhoynul *et al*^[16] studied 32 deaths following 629 trocar injuries and found that six patients died following bowel injury. Delay in the diagnosis of gastrointestinal perforation resulted in a mortality rate of 21%.

A history of previous intra-abdominal surgery, vertical incision, endometriosis and pelvic infection increases the risk of bowel injury. Extensive bowel distension obscuring the operative field, large abdominal or pelvic mass (in the case of hysterectomy, uterine size over 500 g) and diaphragmatic hernia increase the risk of complications. In addition, major operative laparoscopy, extensive adhesiolysis and concomitant major surgery are the other factors that increase the risk of complications. Moreover, surgeon experience and the type and the difficulty of the cases also contribute to complication rates^[17-21].

LARGE BOWEL INJURIES DURING THE SETTING UP PHASE OF GYNECOLOGICAL LAPAROSCOPY

Bowel injury may be encountered at any stage of laparoscopic surgery, beginning from abdominal access until the end of port site closure. It is the third most frequent mortal complication of laparoscopy, following anesthesia and major vessel injuries^[22]. Gastrointestinal tract injury during laparoscopy ranged between 0.03 and 0.18%^[6,23-26] and its incidence was 0.13% in the meta-analysis performed by van der Voort *et al*^[27].

Before the study performed by Levy *et al*^[28], energy modalities used in laparoscopic surgery were mistakenly considered to be the leading cause of gastrointestinal injuries. However, 30% to 50% of the bowel injuries occur during Veress needle or trocar insertion into the abdominal cavity^[6,11,29-31]. Gastrointestinal injuries occur more often at the small bowel; however, other intra-abdominal organs, including the large bowel and stomach, may also be injured. Preoperative bowel preparation and decompression of the stomach with an orogastric or nasogastric tube may prevent potential injuries occurring during abdominal access.

In the retrospective case review study conducted by Chapron *et al*^[5], 32.1% of the gastrointestinal injuries occurred during the initial set up procedure. Pneumoperitoneum needle, umbilical trocar and suprapubic trocar were isolated as the causes of injuries in 10.7%, 16.1% and 5.3% of the cases, respectively. Of the 62 gastrointestinal injuries of the 56 patients, 57.2% occurred during the

operative phase of the procedure, and electrosurgery and sharp dissection were the causes of injuries with the rates of 10.7% and 46.5%, respectively. The authors could not define whether the injuries occurred during initial set up or operative phases in 10.7% of the cases.

Of the 62 gastrointestinal injuries of the 56 patients reviewed by Chapron *et al*^[5], 30 (48.4%) injuries involving the large intestine had the highest frequency and were followed by the 21 (33.9%) small bowel and 10 (16.1%) epiploon injuries. Of the 30 large bowel injuries, 18 injuries were at the sigmoid colon, followed by four cecum, four rectum and four colon injuries.

It is not clear whether the frequency of bowel injury during abdominal access is affected by the complexity of the operative phase. Some studies reported higher rates of bowel injury during access in diagnostic laparoscopy and laparoscopic tubal sterilizations^[30], in contrast to others reporting higher injury rates in major laparoscopic surgeries^[6].

The surgeon's experience affects the rate of injury; however, the frequency of injuries during abdominal access is still high for more experienced surgeons^[32]. Depending on the fact, investigators are trying to improve the outcomes of abdominal access during laparoscopy by using various access techniques. Blind Veress introduction followed by pneumoperitoneum and the primary trocar, direct trocar insertion and open access techniques are examples. In addition, investigators are trying to improve the already known techniques. As an example, in their recently published study, Ozdemir *et al*^[33] used umbilical stalk elevation (USE) technique to improve the success rate of Veress needle insertion in obese patients and concluded that the USE technique seemed safe and required a significantly fewer number of attempts to create pneumoperitoneum.

Excellency in Veress needle and trocar use may prevent some major complications. Although wiggling of the needle movements to ascertain intra-abdominal entry may enlarge the diameter of an injury^[32], the correct placement of the needle is usually checked by most surgeons. In addition to the classical safety checks, foul smell, observation of the gastrointestinal contents and asymmetrical abdominal distention due to insufflation of the bowel should raise the suspicion of bowel injury^[34]. Moreover, passage of flatus may be a sign of intra-intestinal insufflation.

Although Hasson's open technique did not lower the total complication rates, theoretically open techniques may decrease the risk of life threatening major vascular injuries during abdominal access. In addition, the chance of an earlier diagnosis is higher. In contrast to the theoretical advantages of an open technique, there are articles reporting a higher incidence of bowel injury with an open technique^[29,35,36]. However, many surgeons prefer open access techniques for patients with anticipated risks. Thus, in order to avoid selection bias, final judgment will be appropriate after randomized prospective studies.

In addition to their theoretical advantages, open techniques are also used during gasless laparoscopies and may help in lowering the CO₂ related risks of laparo-

scopic surgery. Thus, gasless laparoscopy may decrease some risks of laparoscopic surgery that occur during abdominal access. In our practice, we have experienced the single incision, gasless technique called keyless abdominal rope-lifting surgery (KARS)^[37-40] and did not observe any internal organ injury. However, among the various access techniques, the best probably is the one in which the surgeon has more experience and advanced skills.

LARGE BOWEL INJURIES DURING THE OPERATIVE PHASE OF GYNECOLOGICAL LAPAROSCOPY

During the operative phase of laparoscopy, bowel injury may occur as a result of trauma secondary to tissue dissection and manipulation or electrosurgical energy use. It is a serious complication because 50% and 66% of bowel or visceral injuries are undiagnosed at the time of primary surgery^[41]. A missed or delayed diagnosis increases the risk of bowel perforation and consequently sepsis, and even death^[6].

In the study conducted by Chapron *et al*^[5], of the 56 patients suffering from gastrointestinal injury, 32 had injuries at the operative phase of the procedures and 26 injuries were due to sharp dissections. Thus, experienced surgeons with advanced surgical skills are expected to have lower complication rates. Not surprisingly, experience significantly decreases the complication rates of the operative phase and the surgeon's advanced skills in fine adhesiolysis also decreases the complication rates^[6].

Brummer *et al*^[42] compared the incidence of injuries of laparoscopy performed between 1992 and 1999 with the injury incidence of 2000 and 2005, emphasizing the importance of the learning curve in laparoscopic and vaginal hysterectomies. The incidence of all kinds of injuries was significantly lower between 2000 and 2005. Similarly, bowel injuries during laparoscopic hysterectomies decreased from 0.14% to 0.09% during the same period and large bowel injuries involved half of all bowel injuries^[42]. The use of proper hand instruments while manipulating and dissecting the tissues may decrease the injury rates.

The use of electrosurgical energy during operative laparoscopy causes injury of the target tissue. The injured tissue may become necrotic or heal slowly during the postoperative period^[43]. In addition to the target tissue, increased local temperature may cause injury of the nearby vital structures, *e.g.*, the large bowel. Thus, the surgeon should be familiar with the used energy modality. A monopolar current travels through the tissues of the patient; however, a bipolar current passes between the two electrodes of the instrument and thus influences only the tissue between electrodes.

Monopolar energy causes more lateral thermal spread and produces the highest temperatures compared to bipolar electrocautery, the Harmonic scalpel and LigaSure^[44]. The degree of lateral thermal spread varies with various energy modalities and is as follows: 2-22 mm for

traditional bipolar, 0-3 mm for ultrasonic cutting and coagulation, 1.1 mm for the Enseal, 1.8 mm for LigaSure and 6.3 mm for Gyrus Plasma Trisector^[45-48]. In addition, the monopolar electrosurgical instrument insulating layer is not foolproof and the current may spread to the adjacent tissue^[49]. Thus, in a case where the operative field is close to the bowel, the risk of bowel injury increases and the unnoticed injury may present postoperatively.

PREVENTION, DIAGNOSIS AND MANAGEMENT

Most gynecologists learn traditional gynecological procedures during residency; however, they generally gain skills required for laparoscopic procedures during their postgraduate clinical practice without supervision. The learning curve is lengthy and becomes longer with the advancement of new techniques and instruments. The complication risk is highest during the initial stages of a surgeon's laparoscopic experience^[50].

A comprehensive preoperative evaluation, proper consultations, patient selection and risk assessment help lessen the risk of complications. Besides a gynecologist having the required skills for laparoscopic surgery, the operating room staff and assistants should also be properly trained. The operating room should be ready for an emergency laparotomy. The infrastructure required for a multidisciplinary surgical approach should be maintained during the laparoscopic procedures.

During the initial stages of the experience of laparoscopy, it is better for a surgeon to perform minor procedures. Previous studies reported that the complication rates were higher in the first 100 procedures of surgeons beginning to perform laparoscopy.

Sudden and uncontrolled Veress needle and trocar entry can lacerate the rectum and sigmoid colon. The transverse colon may be displaced by the distended stomach and become vulnerable to injuries. A nasogastric tube helps to eliminate this potential risk.

Obliteration of the pouch of Douglas and the presence of dense adhesions between the rectum and uterus increase the chance of bowel injury. In these circumstances, blunt dissection may increase the chance of rectal laceration and thus sharp dissection with scissors or CO2 laser should be preferred. Placement of a probe or finger in both the vagina and the rectum helps to identify the tissue planes. Nezhat *et al*^[51] and Redwine^[52] advise beginning the dissection lateral to the uterosacral ligaments and proceeding toward the obliterated cul-de-sac. In addition, preoperative bowel preparation may help in cases with high risks for bowel injury.

One to two thirds of bowel injuries can be detected intraoperatively^[5] and half of the injuries can be identified between first and seventh postoperative days. Most patients do not have the typical symptoms of bowel injury, such as low-grade fever, nausea, vomiting, ileus, severe abdominal pain, leucopenia or a normal leukocyte count, and the diagnosis is delayed. Thus, in many cases, patients

present with peritonitis and the situation increases the rates of morbidity and mortality^[10,16]. Sepsis and acute abdominal pain are typically observed 1-2 d after surgery.

Brownish fluid in a saline aspiration test may sometimes diagnose large bowel perforation. In addition, fecal smell strengthens the suspicion. In cases where the suspicion of bowel perforation arises, the Veress needle should be replaced with a sterile one and the field beneath the primary entrance should be examined after the introduction of the telescope. Intraoperative sigmoidoscopy may be helpful in identifying the injury site^[53]. Recently, in an experimental study conducted by Ülker *et al*^[54], insertion of a rectal catheter attached to a urine bag was recommended to identify large bowel injuries. It was suggested that the accumulation of gas in the connected bag would signal small and hardly demonstrable large bowel injuries. A computerized tomography examination can reveal fecal material outside the large bowel and/or free air in the abdominal viscera. Additional imaging work up, including imaging with a gastrografin enema, can also help to detect an injury site.

Large bowel injuries should be managed at the time when they are recognized, if possible, at the same operative section. Small injuries secondary to a Veress needle may be managed conservatively with close observation in hospital, intravenous hyperalimentation and antibiotics^[55]. However, 6% of cases with superficial electrocautery bowel injuries require open exploration due to acute perforation during the observation period and thus intraoperative repair of the damaged bowel is significantly safer and should be performed in every suspicious electrocautery bowel injury.

Most trocar injuries need a primary closure in one or two layers. However, larger injuries with an ambiguous tissue injury may necessitate colostomy. In these conditions, incorporation of a general surgeon experienced with bowel surgery is advisable. Depending on the skills of the surgical team, bowel repair may be performed laparoscopically^[56]. Extensive intra-abdominal lavage, use of combined broad-spectrum antibiotics and drainage may decrease the infection risk.

Injury at the right ascending colon generally requires resection of the injured section and a primary anastomosis. Ileostomy with diversion of the intestinal contents speeds up healing. In a case where the bowel is not prepared preoperatively and the descending colon, sigmoid or rectum is injured, primary closure or resection with primary anastomosis are not good treatment options. In these circumstances, a diverting colostomy with resection of the injured portion is recommended. Colonic lacerations of preoperatively prepared bowel can be repaired laparoscopically^[50].

CONCLUSION

Large bowel injuries during gynecological laparoscopy are rare but serious complications. Approximately one third can be diagnosed intraoperatively and delayed diagnosis increases the rates of morbidity and mortality. They

should be managed immediately when recognized, if possible, at the same operative section.

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