Continuing Education Independent Study Series

Operative Laparoscopy

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Association of Surgical Technologists

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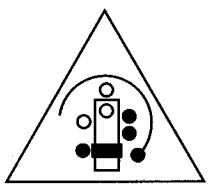

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PREFACE

"Operative Laparoscopy" is part of the AST Continuing Education Independent Study Series. The series has been specifically designed for surgical technologists to provide independent study opportunities that are relevant to the field and to support the educational goals of the profession and the Association.

Acknowledgments

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INTRODUCTION

Purpose

The purpose of this module is to acquaint the learner with operative laparoscopy techniques. Upon completing this module, the learner will earn 2 continuing education credits in category 1.

Objectives

Upon completing this module, the learner will be able to do the following:

1. Describe the equipment required to perform laparoscopic surgery.
2. Explain why equipment and instrumentation for laparoscopic procedures are unique.
3. Describe the surgical technique for laparoscopic procedures.
4. Explain potential complications with laparoscopic surgery.

Using the Module

1. Read the information provided, referring to the appropriate figures.
2. Complete the enclosed exam without referring back to the text. The questions are in a multiple choice format. Select the best answer from the alternatives given.
3. Mail the completed exam to AST, CEIS Series, 7108-C S. Alton Way, Suite 100, Englewood, CO 80112-2106. Please keep a copy of your answers before mailing the exam. You must return the original copy of the answer sheet; this exam may not be copied and distributed to others.
4. Your exam will be graded, and you will be awarded continuing education credit upon achieving a minimum passing score of 70%. If you are an AST member, your credits will be automatically recorded and you do not need to submit the credits with your yearly CE report form.
5. You will be sent the correct answers to the exam. Compare your answers with the correct answers to evaluate your level of knowledge and to determine what areas you need to review.

Studying Technical Material

To study technical material, find a quiet place where you can work uninterrupted. Sitting at a desk or work table will be most conducive to studying.

Having a medical dictionary available as you study is very helpful so you can look up any words with which you are unfamiliar. Make notes in the margins of any new definitions so that you can review them.

The ultimate test of how well you learn this material is your ability to relate your knowledge to what is happening in the surgical field. Apply your knowledge to what you observe in the surgical field.

Operative Laparoscopy

Although laparoscopy has been used in surgery and gastroenterology for two decades, it did not reach prominence until 1990 when general surgeons began accepting laparoscopic cholecystectomy as the method of choice for removing the gallbladder. Since that time, almost all procedures that can be performed open have been tried laparoscopically, although none have reached the prominence of laparoscopic cholecystectomy.

Herniorrhaphy, operations for gastroesophageal reflux disease (GERD), appendectomy, and hysterectomy are all frequently performed laparoscopically. Splenectomy, colectomy, and some thoracic procedures are performed less often. Almost any procedure that can be performed open can be performed laparoscopically; however, some require too much time and some are too expensive for the benefit received.

Room Setup

The room setup is similar to a standard operation with the exception of placement of the massive amounts of equipment needed for laparoscopic surgery. The patient is placed on the table in the same position as for similar open surgery so that the case can be converted to an open procedure in the event of difficulties. Video monitors are mounted on tables or ceiling arms so they may be manipulated for optimum visualization for the entire operative team. For upper abdominal surgery, they are either at either side of the head at 45 degrees to the table (two-monitor systems) or at the head of the table above the anesthetist (single-monitor system). For lower abdominal and pelvic surgery, the monitors are placed similarly at the foot of the table. The monitors should be elevated to eye level to decrease neck and back strain. The monitors should be at least 300 lines of resolution and should match the resolution of the camera.

It is best to place the insufflator, camera module, light source, and videotape player near the anesthetist. This allows the anesthetist to change settings and adjustments and frees the circulator for other duties. The cautery, laser, harmonic scalpel, or other cutting and coagulating devices should be behind the operative team to keep the cords from crossing the operative site.

Basic Instrumentation

Most pieces of equipment and instruments are unique to laparoscopy, from the handpieces to the insufflator. Hand instruments generally have a handle angled at 45 to 90 degrees from the shaft to accommodate the position of the hand during laparoscopic surgery. Some surgeons prefer the straight handle, particularly on the needle holder, because it more closely resembles what they use in open surgery. Although it is a matter of personal preference, the straight handle is somewhat more awkward for most surgeons.

The instruments are designed for a "standard body," being 32 cm long, so that approximately one-half of the instrument is inside the body and one-half outside. With this design, when the surgeon moves the instrument 1 in. outside, the tip moves 1 in. inside. If the patient is obese, more instrument is needed inside to accommodate the depth of the abdomen. Therefore, the fulcrum is moved toward the handle of the instrument. When the surgeon moves the instrument 1 in. outside, it moves a much greater distance inside, making precise surgery difficult, if not impossible. For obese patients, longer instruments (38 to

42 cm) are available. Although not as much a problem, thin patients and pediatric patients require shorter instruments (28 cm) to keep the fulcrum at the midpoint of the instrument.

The camera should have at least 300 lines of resolution, have excellent color balance, be lightweight, have an adjustable iris (or automatic iris), have a long focal length, and have an easy-to-use mount. It is difficult to buy a camera without excellent resolution. However, some of the cheaper models may not have good color reproduction, giving a washed-out appearance on the screen. Although many manufacturers are producing three-chip cameras, which give better resolution and color reproduction, a high-grade, single-chip camera can give almost as high quality for about half the cost. Single-chip cameras require white balancing at the beginning of the case, which takes minimal time and is not a disadvantage. The mount, which allows attachment to the scope, should be easy to use and should not easily disconnect. Some cameras are connected to the scope permanently, have a lens-to-lens interface, or are a chip camera on the end of the scope so no light is actually transmitted through lenses. This not only gives better depth perception and color balance, but also is a maintenance problem. If the scope or camera breaks, the entire system is down, whereas individual components can be replaced with separate camera and scope systems. The component system is obviously cheaper. Three-dimensional cameras are also available, but have not progressed in quality or decreased in price to be in widespread use.

Because of the light absorptive differences of different organs, a single light source power setting can be perfect one second and too bright or too dark the next. Some instruments are still reflective, and when the light hits them, bright reflection can destroy the vision in the field. Some cameras can automatically adjust for this by changing the size of the iris, admitting more or less light as needed. This feedback system may also be a part of the light generator. The system should have some type of light control mechanism that can be used automatically or overridden and controlled manually. All light sources should be xenon or halogen. Older incandescent systems do not provide enough light for today's advanced procedures.

The range of focus of the camera is extremely important. The scope tip may be as close to the organ as 1 cm or as far away as 15 cm. The camera should stay in focus throughout that range. Otherwise, precious time is consumed refocusing between movements.

Sufficient insufflation is necessary for adequate exposure, and a high-flow insufflator is essential with frequent instrument changes, multiple trocars, and suctioning. Units that produce 6- to 10-L/min flow are acceptable, but a 15-L/min insufflator is desirable. With a high-flow insufflator, adequate pneumoperitoneum can be maintained while performing advanced procedures and while working on obese patients.

Access into the abdomen is gained through trocars, which consist of a sharp knife passed through a sleeve. Once inside the abdomen, the knife is removed and instruments are passed through the sleeve. Escape of air is prevented with a valve mechanism, consisting of a flapper valve or diaphragm on disposable units or a trumpet valve on reusable units. Most disposable trocars have safety shields or retractable tips. The safety shields stay retracted until they enter the peritoneal cavity, then move forward quickly to cover the exposed tip. Retractable tips retract upon entering the peritoneal space. These mechanisms lock the tip in the retractable position and lock the shield over the tip. The trocar must be manually rearmed for the tip to expose. Some "safety shield" trocars do not lock and therefore are not true safety trocars.

Operative Techniques

Cholecystectomy

The diseased gallbladder may or may not have stones and may be acutely inflamed, chronically inflamed, or have no inflammation at all. The diseased gallbladder causes upper abdominal pain, usually on the right side, as well as heartburn and indigestion. There is no known medical treatment for the disease; therefore, removal is indicated when symptoms occur.

There are no contraindications to laparoscopic cholecystectomy except the inability of a patient to undergo general anesthesia. The supine patient is placed in a Trendelenburg position on the table. The abdomen is prepped and draped as for an open operation. The umbilicus is incised, and the abdominal wall is elevated with a hand or towel clips. An insufflation needle is placed into the abdomen, aspirated with a syringe, and connected to the insufflator that is set at 1-L/min flow. The low flow will prevent insufflation of large amounts of carbon dioxide until the needle position is found to be correct. Once safe insufflation is begun, the flow rate can be advanced to maximum (the needle will only allow 2.5 L/min because of its size). Once the abdomen is filled to 15 mm Hg pressure, the needle is removed, and a 10-mm trocar is inserted through the umbilicus. A laparoscope with attached camera is placed through the trocar, and the abdomen is examined. Under visual guidance of the laparoscope, three other trocars are placed 5 cm below the xiphoid (10 mm), in the midclavicular line 2 cm below the costal margin (5 mm), and in the anterior axillary line at the level of the umbilicus.

The first assistant stands on the patient's right, and the surgeon stands on the patient's left with the camera operator below the surgeon. Some surgeons use a stationary arm for the camera and the first assistant because of lack of personnel, but an animate assistant is preferable. The first assistant grabs the top of the gallbladder with a 5-mm grasper and pushes it toward the patient's right shoulder. The surgeon grabs Hartmann's pouch with the other 5-mm grasper in the left hand and operates with the right hand through the xiphoid port. Application of lateral retraction on Hartmann's pouch "splays out" the anatomy and makes dissection easier and safer. Medial retraction compresses the anatomic structures together and makes dissection less safe. The cystic duct, cystic artery, and common bile duct are identified. It is important to identify the cystic duct as it enters both the gallbladder and the common bile duct to decrease the chances of injury. To further decrease the chances of cutting the wrong ductal structure, an intraoperative cholangiogram should be performed routinely and should show both the upper and lower ductal system.

After identification of the anatomy, the cystic duct and artery are clipped and transected with the scissors. Care should be taken to always see both jaws of the clip applier. Burying the clip applier during placement of clips predisposes to injury of posterior structures such as the common hepatic or right hepatic duct. Cautery should never be used for dissection in the triangle of Calot and should not be used to transect the duct or artery. Unrecognized cautery injury can occur easily in this situation.

The gallbladder is removed from the bed with scissors, laser, harmonic scalpel, or cautery. Care should be taken to control bleeding during the dissection. Before the gallbladder is completely transected from the liver bed, the area should be irrigated and checked for bleeding and small bile leaks. This can best be done with an intraabdominal pressure of 9 mm Hg. This decreases the pressure on the liver and allows small leaks to be recognized. Heavy cautery in the bed is not indicated. For bleeding that will not cease, use of simple stitches or a topical clotting agent similar to EndoAvitene (MedChem) usually suffices.

After suctioning all blood and fluid from the gutters, the gallbladder is removed through the umbilicus. The gallbladder can usually be pulled through the 10-mm hole easily, but may require decompression and fracturing of stones through the neck of the gallbladder. The neck of the organ should be pulled into the trocar, and the trocar slowly removed. This exposes the neck of the gallbladder to the outside of the abdomen and allows manipulation of stones through the neck. The umbilical incision should be closed with interrupted suture.

Antireflux Procedures

As with open surgery, there are many operations for reflux disease; however, the Nissen procedure is most common and will be covered here. Patients with reflux have "heartburn" and "water brash" (an acid burning in the throat), usually a short time after eating, because of acid from the stomach refluxing into the esophagus. The esophageal lining can not tolerate acid as the stomach does; therefore, a burn occurs. Numerous medical regimens are used for treatment, but surgery is indicated when medical management fails. Surgery is also indicated when patients develop precancerous lesions (Barrett's esophagus) or stricture.

The patient is placed supine with the table flat. Using an open technique, a 10-mm trocar is placed 5 cm superior to the umbilicus for camera insertion. Four other 10-mm ports are placed in or near the midclavicular line just under the costal margins bilaterally and two more bilaterally about 8 cm below the upper two. The first assistant and camera operator stand on the patient's right. The first assistant holds the liver superiorly with a fan retractor through the upper right port, and the stomach is held inferiorly with a Babcock through the lower right port.

The surgeon stands on the left, operating through the upper port and providing counter traction with his left hand through the lower port. The peritoneum overlying the esophagus is incised until both crura can be seen. Using blunt dissection, the esophagus is cleaned of all attachments. This dissection can not be performed unless the assistant provides excellent traction on the stomach and liver, thereby stretching the esophagus from the chest cavity into the abdominal cavity. The posterior aspect of the fundus is grasped and pulled behind the esophagus. Using three interrupted permanent 2-0 sutures, the stomach is fixed anteriorly around the esophagus. Frequently, there is a large defect between the crura (ie, hiatal hernia). This can be repaired with 0 permanent suture prior to making the wrap. The wrap and crura repair should be done while a 50-54 bougie is in place within the esophagus. This will prevent the wrap from becoming too tight and inhibiting swallowing and belching.

The area is checked for hemostasis. All trocar sites are closed with interrupted suture.

Inguinal Hernia

Inguinal hernias may be repaired using either a transabdominal-preperitoneal (TAPP) or a true preperitoneal approach using a balloon. Both repairs are the same, but the accesses are different. Although there are some exceptions, most hernias should be repaired when they are diagnosed since they tend to enlarge and may strangulate intestine.

Using the balloon, a cutdown is made through the umbilicus to the peritoneum or the posterior sheath of the rectus muscle. A specialized blunt introducer is placed in this space and advanced to the pubic symphysis. The balloon is then inflated, creating a space in the preperitoneal area and exposing the major anatomy of the inguinal area bilaterally. Two trocars are placed in the midline below the umbilicus. The hernia sac is dissected and sometimes tied and transected. A 3-in. x 5-in. polypropylene patch (Goretex, Marlex, or other substance may also be used) is placed through the trocar into the space and

arranged to cover the defect. Staples are applied anchoring the patch to the ileopubic tract, the conjoined tendon, and Cooper's ligament. Care should be taken to avoid the sensory nerves coursing posterior to the ileopubic tract and lateral to the internal ring. Staples should never be placed in the "triangle of doom" (bounded by the gonadal vessels laterally and the vas deferens medially). The iliac neurovascular bundle lies in this area and can be easily injured.

Insufflation of the peritoneal cavity is required for the TAPP procedure. A 12-mm trocar is placed in the umbilicus with two 10-mm trocars lateral and slightly inferior to the umbilicus. The peritoneum is opened over the inguinal area and peritoneal flaps are made, creating an oval opening in the peritoneum. The patch is placed as in the previously described procedure, stapled into position, and the peritoneum is closed.

Appendectomy

The patient with acute appendicitis has a severe pain in the right lower quadrant over an area called McBurney's point. The patient is usually nauseated and vomiting, has an elevated temperature, and has an elevated white blood cell count. Emergency surgery is the only treatment.

A 10-mm trocar is placed at the umbilicus using the open technique. A 5-mm trocar is placed below the hairline in the right lower quadrant lateral to the epigastric vessels, and a 10-mm or 12-mm trocar is placed in the suprapubic area. The surgeon and camera operator stand on the patient's left. The appendix is grasped through the right lower quadrant port. All dissection is performed through the suprapubic port with the surgeon's right hand. The mesentery is either divided between clips or with the EndoGIA (US Surgical, Norwalk, CT). The appendix is divided with the EndoGIA or is tied with three suture loops, two near the base and one about 1 cm distally. The appendix is divided with scissors and removed in a bag.

Hysterectomy

Hysterectomy is performed for dysfunctional bleeding, tumors of the uterus, and in association with ovarian removal. The laparoscopic approach does not replace vaginal hysterectomy, but is utilized when abdominal hysterectomy is indicated. It is performed with the patient supine in low stirrups. A laparoscope is inserted through an umbilical trocar and two 12-mm trocars are placed laterally slightly below the umbilicus. The ovaries and tubes are mobilized and may be removed with the specimen or left in vivo. The infundibulopelvic ligament is transected with the EndoGIA using a vascular cartridge. A bladder flap is raised anteriorly using sharp and blunt dissection. The cautery is not used due to possible injury to the bladder. The staple line is stopped at the uterosacral ligaments. The remainder of the operation is performed using a Doderlein or a Haney technique through the vagina. The vaginal cuff is closed from below using standard techniques. A final examination is performed laparoscopically to check for hemostasis.

Avoiding Complications

Complications can be avoided by careful identification of anatomy and attention to the details of laparoscopic technique. Although some aspects of safety have been covered in the previous sections, special mention needs to be made concerning the more common injuries.

The initial trocar should be inserted only after complete insufflation to 15 mm Hg pressure. The insufflation needle should be inserted through the umbilicus aimed in the midline toward the coccyx. The abdominal wall should be elevated to provide a space between the abdominal wall and the intestine

and retroperitoneal organs. Aspiration of the needle should be performed before any insufflation to ensure it is extravascular. Insufflation into a large vein could cause imminent death from an air embolus. Initial insufflation pressures should be 5 mm Hg or less. Higher than this indicates misplacement of the needle.

The initial trocar should be similarly placed by elevating the abdominal wall and remaining in the midline toward the coccyx. This should prevent vascular and intestinal injury. If the patient is placed in Trendelenburg position, the intestine moves cephalad, leaving an open space for insertion in the pelvis. All secondary trocars should be placed while being visualized through the laparoscope. Using these techniques, injury should be rare, if at all. For all patients who have had previous surgery or have peritonitis, the open technique is preferable since adhesions may be present under insertion sites. If a vessel is injured during insertion, there should be an immediate conversion to an open case since laparoscopic management is nearly impossible.

Common bile duct injuries can be stopped or greatly reduced by carefully identifying the anatomy and using proper retraction techniques. Hartmann's pouch should be pulled laterally during the dissection to facilitate exposure of the cystic duct and artery and the common bile duct. Medial retraction, which is a more natural movement, collapses the anatomy together and forces dissection to start lower, near the common bile duct. Before the ductal structures are clipped or cut, a cholangiogram should be performed to further delineate the anatomy. If these procedures are performed, the chances of a common duct injury are greatly reduced.

Burns from coagulation devices are common and usually occur when adhesions are being removed with monopolar electrocautery. If this device were never used to remove adhesions, cautery burns would decrease by 80% to 90%. Since other devices are available (scissors, harmonic scalpel, clips, endocoagulator, bipolar cautery), the use of monopolar electrocautery for dissection of adhesions is questionable at best. Other burns can be prevented by using lower energy settings, burning smaller masses of tissue, and pulsing the energy instead of letting it stay on during the entire burning cycle.