Introduction to laparoscopy

David C. Twedt DVM, DACVIM
Professor
Colorado State University
Fort Collins Colorado

Laparoscopy is a minimally invasive procedure for examination, biopsy or performing surgical techniques within the abdominal cavity. The technique involves distention of the abdominal cavity with gas followed by placement of a rigid telescope through a portal in the abdominal wall to examine the contents of the peritoneal cavity. Biopsy forceps or other instruments are then passed into the abdomen through adjacent portals to perform various diagnostic or surgical procedures. The limited degree of invasiveness, diagnostic accuracy, and rapid patient recovery make laparoscopy an ideal technique for tissue biopsy or to perform selected surgical procedures. Laparoscopy is easy to perform once the basic indications and the technique is learned.

Should laparoscopy be incorporated in your practice? The answer is yes, if you have a busy practice and want to include cutting edge minimally invasive diagnostics and surgical techniques to your patients. The capital investment of the laparoscopic equipment should easily pay for it’s self if basic indications are applied to your clinical cases. One should always ask “Can I do this with the laparoscope?”. Laparoscopy has an easy learning curve when compared to that of flexible GI endoscopy or ultrasonography. A routine diagnostic laparoscopic procedure can often be performed within 15-20 minutes and many of the diagnostic procedures I perform are done on an outpatient basis. Because of the minimal invasiveness of laparoscopy there is considerable client acceptance and willingness to have laparoscopy as an option.

Indications

Common indications for diagnostic laparoscopy includes examination and biopsy the abdominal organs or masses. Laparoscopy is frequently used as a method for obtaining liver, pancreas, kidney, splenic, and intestinal biopsies. Laparoscopy is also used to diagnose and to stage the extent of neoplastic conditions of the abdominal cavity or to determine the cause of an unexplained abdominal effusion. Other ancillary diagnostic techniques using laparoscopic guidance include gallbladder aspiration (cholecystocentesis), and splenoportography. Surgical laparoscopy in small animals is still in its infancy and techniques and procedures are being developed. One’s imagination and available surgical instruments limit surgical laparoscopy. Surgical procedures that have been performed on small animal clinical cases include: gastrostomy and jejunostomy feeding tube placement, adrenalectomy, gastropexy, ovariohysterectomy, cryptorchid removal, transabdominal cystoscopy with cystic calculi removal to name but only a few techniques performed.

The advantages of laparoscopy over a conventional surgical laparotomy include improved patient recovery because of smaller surgical sites, lower postoperative morbidity, and decreased infection rate, postoperative pain, and hospitalization time. Other less obvious benefits of laparoscopy are related to fewer stress mediated factors than do occur with surgery. Due to the limited degree of invasiveness of this procedure there are few contraindications of laparoscopy. Often, the high-risk patients become good candidates for the less invasive laparoscopic procedure than a full surgical
exploratory. Abdominal effusion, abnormal clotting times, and poor patient condition are only relative contraindications. Fluid can be removed prior to or during a laparoscopic procedure and has little influence over the success rate of the procedure. Abnormal clotting times may also not definitively preclude the use of laparoscopy. Abnormal coagulation from liver disease does not always correlate with excessive bleeding at the biopsy site. Laparoscopy further makes it possible to visually select areas that appear to be less vascular and to monitor the extent of bleeding following the collection of a biopsy. If bleeding is considered excessive various laparoscopic techniques can be used to control the hemorrhage. Absolute contraindications for laparoscopy include septic peritonitis or conditions for which surgical intervention is clearly indicated. Relative contraindications include the patient condition, small body size, or obesity. The procedure becomes difficult in extremely small (<2 kg body weight) or obese patients.

**Basic equipment**

The basic equipment required for diagnostic laparoscopy includes the telescope, corresponding trocar-cannula, light source, gas insufflator, veress needle (for insufflation), and various forceps and ancillary instruments. Telescopes most frequently used in small animal laparoscopy generally range in diameters from 2.7 to 10 mm. The author recommends and uses a 5-mm diameter 0-degree field of view telescope for routine diagnostic laparoscopy. The 0-degree designation means that the telescope views the visual field directly in front of the telescope in a 180-degree circumference. Angled viewing scopes enable the operator to look over the top of organs and see into small areas but the angulation also makes the orientation more difficult for the inexperienced operator. The telescope is connected to a light source using a light guide cable. It is generally recommended that a high-intensity light source such as a xenon light source be used for laparoscopy. Light sources used for gastrointestinal endoscopy are generally sufficient for laparoscopy. A video camera attached to the telescope allows the image to be viewed on a video screen. Video-assisted laparoscopy is imperative when performing surgical procedures.

A veress needle is used for initial insufflation of the abdominal cavity. The needle consists of an outer cutting tip and, contained within the needle, a spring-loaded obturator that retracts into the needle shaft as it traverses the abdominal wall. Once in the abdominal cavity the obturator is once again advanced beyond the sharp tip and prevents needle injury to internal abdominal organs. The needle is then connected to the automatic gas insufflator. Most automatic insufflators are similar and function to dispense gas at a prescribed rate while maintaining a predetermined intra-abdominal pressure. Carbon dioxide is the gas most often used in order to prevent air emboli and spark ignition during cauterization.

The trocar cannula units are required to enter the abdominal cavity and are of a corresponding size to receive either the telescope or the biopsy instruments. It consists of a sharp trocar housed in an outer cannula. Together they are used to penetrate the abdominal wall. Once in the abdomen the trocar is removed while the cannula remains in place traversing the abdominal wall and becomes a portal for introduction of the telescope or instruments into the abdominal cavity while maintaining the pneumoperitoneum.

Common accessory instruments include a palpation probe used to move and palpate abdominal organs and biopsy forceps. The author prefers a 5 mm diameter biopsy forceps with oval biopsy cups to obtain liver, spleen, abdominal mass, and lymph node biopsies. A variety of other biopsy forceps, tissue graspers, and aspiration needles are also available for diagnostic laparoscopy. A “true-cut” type or similar biopsy needle is required for both kidney and deep tissue biopsies. This type of biopsy needle is passed
directly through the abdominal wall and guided to the area to be sampled without the need for a cannula.

**Procedural considerations**
The patient should be fasted for at least 12 hours before the procedure and the urinary bladder should be evacuated. Laparoscopy is commonly performed using general gas anesthesia and most patients tolerate the anesthesia and laparoscopy well. In some situations the author will perform diagnostic laparoscopy using only heavy sedation in conjunction with local anesthesia at the entry sites. In order to select the appropriate cannula portal placement sites one must first determine the objectives of the laparoscopic procedure. The two most common approaches are a right lateral and a midline approach. The right lateral approach is recommended for diagnostic evaluation of the liver, gallbladder, right limb of the pancreas, duodenum, right kidney, and the right adrenal gland. A ventral approach is useful for many operative procedures, and offers good visualization of the liver, gallbladder, pancreas, stomach, intestines, reproductive system, urinary bladder, and spleen. With the ventral approach visualization is sometimes hindered by the location of the falciform ligament. A complete description of a step-by-step technique of the laparoscopy procedure is beyond the scope of this paper and has been previously described.

**Liver biopsy**
A major indication for diagnostic laparoscopy is for visualization and biopsy of the liver. I generally use a right lateral approach however a ventral or left lateral entry site can also be used. The entry sight is determined based on what one desires to view. For a liver biopsy I believe that a 5 mm oval cup shaped forceps provides excellent biopsy samples. The forceps are visually directed to the area of the liver to be sampled. A 3x5 mm biopsy sample is obtained using this technique. Either the edge or flat surface of the liver can be sampled using this method. Once the liver tissue is grasp the forceps are held closed for 15-30 seconds and then the sample is pulled away from the liver. Generally multiple liver samples are taken. The size of the sample is adequate for most all liver evaluations including quantitative hepatic metal analysis. Following liver biopsy the site is examined to assure adequate clotting. Normally only several milliliters of blood is lost from the biopsy site; however due to the magnification it often seems like a larger volume of blood. A palpation probe should be used to examine the site for excessive bleeding. The probe can also be used to apply local pressure over the bleeding area if necessary. Although infrequently required, excessive bleeding can be managed by placing a small piece of Gel Foam™ over the bleeding area using endoscopic grasping forceps. Electrocoagulation can also be performed at the bleeding area however this is rarely necessary. A recent report found that laparoscopic directed forceps liver biopsies had better diagnostic yield than two 18-gauge biopsy needle samples. The major difference being the sample size obtained with the two techniques.
Pancreatic biopsy
The pancreas is best evaluated with a right or ventral abdominal approach. Often the diagnosis of acute or chronic pancreatitis can be made based on visual inspection alone. Viewing the pancreas in acute pancreatitis is sometimes difficult when there is considerable inflammation and adhesions around the organ. Pancreatic samples are generally always taken using a punch type biopsy forceps. The samples should be obtained from an edge of the organ away from the pancreatic ducts that traverse the center of the gland. Complications from laparoscopic pancreatic biopsies are rare and the incidence of postoperative pancreatitis in our experience and in one experimental study was non-existent. We have also used laparoscopy to locally lavage the pancreatic area.

Renal biopsy
Renal biopsies are generally obtained using a standard biopsy needle. The right kidney is preferred for renal biopsies, because it is less movable than the left kidney. A right lateral approach is most often used. The abdominal entry site for the biopsy needle is determined during laparoscopy. A small skin incision is made at the needle entry site and the biopsy needle is passed directly through the abdominal wall and advanced toward the kidney. The biopsy needle is visually directed to obtain renal cortex, avoiding the large vessels at the cortico-medullary junction. Following the kidney biopsy there are usually several milliliters of blood lost at the biopsy site. If bleeding from the kidney biopsy is excessive, the palpation probe can be directed to the area and pressure applied at the site until the bleeding has stopped.

Intestinal biopsy
The small intestine can also be biopsied using laparoscopy by a technique of exteriorizing a piece of intestine through the abdominal wall using the accessory cannula entry site. A 5 mm grasping forceps with multiple teeth is used to grasp the intestine. The antimesenteric border of the intestine is firmly grasped and the intestine is then pulled to the cannula. Once the forceps with intestine are firmly approximated to the cannula, the cannula wall incision is elongated to exteriorize a small loop of the bowel. Stay sutures are placed in the intestine to prevent it from falling back into the abdomen. A small full thickness piece of intestine is obtained using the same technique as one would use for an open surgical procedure. The intestine is closed and returned to the abdominal cavity. If further diagnostics or more biopsies are to be obtained a pneumoperitoneum must be established and the trocar cannula reintroduced. A similar technique can be used for exteriorizing the jejunum or stomach for surgical placement of a jejunostomy or gastrostomy feeding tube. Laparoscopic tube placement requires a pexy of the bowel to the abdominal wall.

Other organ biopsy
Other organs that can be evaluated include the peritoneal surface, spleen, adrenal gland, urinary bladder ovaries and uterus. We have biopsied spleen and adrenal glands using the oval cup forceps. The normal prostate is difficult to view because of the paraprostatic fat that often obscures the organ. Prostatic enlargement and cysts can often be evaluated through laparoscopy. A complete evaluation of the female reproductive system can also be made using the laparoscope. Uterine samples for biopsy and culture have been performed using this technique. Ovarian cysts can also be aspirated using laparoscopic control.

Surgical procedures
There are many surgical laparoscopic procedures that can be performed but are beyond the scope of this presentation. Common surgical procedures include gastropexy, cystotomy, adrenalectomy, cholecystectomy, ovarioectomy and ovariohysterectomy and more.
Complications
The complication rate of laparoscopy is low. In a review by the author of a series of cases involving diagnostic laparoscopy the complication rate was less than 2%. Serious complications include anesthetic or cardiovascular related death, bleeding, or air embolism. Minor complications are generally operative and are associated with inexperience or failure to understand the limitations and potential complications.

Suggested references


