2. Access to Abdomen

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A. Equipment

Two pieces of equipment are needed to gain access to the abdomen: an insufflator and a Veress needle (or Hasson cannula, see Section C).

1. Insufflator

Turn the insufflator on and check the carbon dioxide (CO₂) cylinder to ascertain that it contains sufficient gas to complete the procedure. If there is any doubt, bring an extra CO₂ container into the operating room. In any event, always keep a spare tank of CO₂ immediately available.

Check the insufflator to assure it is functioning properly. Connect the sterile insufflation tubing (with in-line filter) to the insufflator. Turn the insufflator to high flow (>6 L/min); with the insufflator tubing not yet connected to a Veress needle, the intra-abdominal pressure indicator should register 0 (Fig. 2.1).

Lower the insufflator flow rate to 1 L/min. Kink the tubing to shut off the flow of gas. The pressure indicator should rapidly rise to 30 mm Hg and flow indicator should go to zero (Fig. 2.2). The pressure/flow shutoff mechanism is essential to the performance of safe laparoscopy. These simple checks verify that it is operating properly.

Next, test the flow regulator at low and high inflow. With the insufflator tubing connected to the insufflator and the Veress needle (before abdominal insertion), low flow should register 1 L/min and at high flow should register 2 to 2.5 L/min; measured pressure at both settings should be less than 3 mm Hg. A pressure reading 3 mm Hg or higher indicates a blockage in the insufflator tubing or the hub or shaft of the Veress needle; if this occurs, replace the needle. Maximal flow through a Veress needle is only about 2.5 L/min, regardless of the insufflator setting, because it is only 14 gauge. A Hasson cannula has a much larger internal diameter and can immediately accommodate the maximum flow rate of most insufflators (i.e., >6 L/min).

During most laparoscopic procedures, the pressure limit should be set at 12 to 15 mm Hg; intra-abdominal pressures higher than this limit can diminish visceral perfusion and vena caval return.
Figure 2.1. **Insufflator testing.** With insufflator tubing open (i.e., not connected to Veress needle) and flow rate set at 6 L/min, the intra-abdominal pressure reading obtained through the open insufflation line should be 0 mm Hg.

Figure 2.2. **Insufflator testing.** With the insufflation tubing kinked, the intra-abdominal pressure should rapidly rise (e.g., 30 mm Hg), thereby exceeding the preset 15 mm Hg pressure set point. The flow of CO₂ should immediately cease (0 L/min) and an alarm should sound.
2. Veress Needle

Both disposable and reusable (nondisposable) Veress needles are available. The former is a one-piece plastic design (external diameter, 2 mm; 14 gauge; length, 70 or 120 mm), whereas the latter is made of metal and can be disassembled. Check the Veress needle for patency by flushing saline through it. Then occlude the tip of the needle and push fluid into the needle under moderate pressure to check for leaks. Replace a disposable Veress needle if it leaks; check the screws and connections on a reusable Veress needle.

Next, push the blunt tip of the Veress needle against the handle of a knife or a solid, flat surface to be certain that the blunt tip will retract easily and will spring forward rapidly and smoothly (Fig. 2.3). A red indicator in the hub of the disposable needle can be seen to move upward as the tip retracts.

B. “Closed” Technique with Veress Needle

1. Umbilical Puncture

Place the supine patient in a 10- to 20-degree head-down position. If there are no scars on the abdomen, choose a site of entry at the superior or inferior
border of the umbilical ring (Fig. 2.4). There are several ways to immobilize the umbilicus and provide resistance to the needle. The inferior margin of the umbilicus can be immobilized by pinching the superior border of the umbilicus between the thumb and forefinger of the nondominant hand and rolling the superior margin of the umbilicus in a cephalad direction. Alternatively, in the anesthetized patient, a small towel clip can be placed on either side of the upper margin of the umbilicus; this makes it a bit easier to stabilize the umbilicus and lift it upward.

Next, make a stab incision in the midline of the superior or inferior margin of the umbilicus. With the dominant hand, grasp the shaft (not the hub) of the Veress needle like a dart and gently pass the needle into the incision—either at a 45-degree caudal angle to the abdominal wall (in the asthenic or minimally obese patient) or perpendicular to the abdominal wall in the markedly obese patient. There will be a sensation of initial resistance, followed by a give, at two points. The first point occurs as the needle meets and traverses the fascia and the second as it touches and traverses the peritoneum (Fig. 2.5). As the needle enters the peritoneal cavity, a distinct click can often be heard as the blunt-tip portion of the Veress needle springs forward into the peritoneal cavity.

Connect a 10-mL syringe containing 5 mL of saline to the Veress needle. There are five tests that should be performed in sequence to confirm proper placement of the needle.

a. Aspirate to assess whether any blood, bowel contents, or urine enter the barrel of the syringe.

b. Instill 5 mL of saline, which should flow into the abdominal cavity without resistance.

c. Aspirate again. If the peritoneal cavity has truly been reached, no saline should return.

d. Close the stopcock and disconnect the syringe from the Veress needle, then open the stopcock and observe as any fluid left in the hub of the

Figure 2.4. Site of Veress needle insertion at superior crease of umbilicus; stab incision has been made. Transverse oblique section at superior crease of umbilicus; the peritoneum is closer to the skin at the umbilicus and is more densely adherent to the umbilicus than at any other site along the abdominal wall.
syringe falls rapidly into the abdominal cavity (especially if the abdominal wall is elevated slightly manually). This is the so-called drop test. If free flow is not present, the needle either is not in the coelomic cavity, or it is adjacent to a structure.

e. Finally, if the needle truly lies in the peritoneal cavity, it should be possible to advance it 1 to 2 cm deeper into the peritoneal cavity without

Figure 2.5. A. Veress needle inserted at umbilicus (sagittal view; the blunt tip retracts as it encounters the fascia of the linea alba). B. As the sharp edge of the needle traverses the fascia, the blunt tip springs forward into the preperitoneal space and then retracts a second time as it encounters the peritoneum. C. Blunt tip springs forward as Veress needle passes across the peritoneum to enter the abdominal cavity.
encountering any resistance. Specifically, the tip indicator or the hub of the needle should show no sign that the blunt tip of the needle is retracting, thereby indicating the absence of fascial or peritoneal resistance. Similarly, resistance to the needle tip may be caused by impingement on intra-abdominal viscera or adhesions.

Always be cognizant of anatomic landmarks when placing the needle, and carefully stabilize the needle during insufflation. Minimize side-to-side and back-and-forth movements of the needle to avoid inadvertent injuries.

After ascertaining that the tip of the Veress needle lies freely in the peritoneal cavity, connect the insufflation line to the Veress needle. Turn the flow of CO₂ to 1 L/min, and reset the indicator on the machine for total CO₂ infused to 0. The pressure in the abdomen during initial insufflation should always register less than 10 mm Hg (after subtracting any pressure noted when the needle was tested by itself and with the insufflator) (Fig. 2.6).

If high pressures are noted or if there is no flow because the 15 mm Hg limit has been reached, gently rotate the needle to assess whether the opening in the shaft of the needle is resting against the abdominal wall, the omentum, or the bowel. The opening is on the same side of the needle as the stopcock. If the abdominal pressure remains high (i.e., needle in adhesion, omentum, or preperitoneal space), withdraw the needle and make another pass of the Veress needle. If necessary, repeat this process several times until you are certain that the needle resides within the peritoneal cavity. Do not continue insufflation if you are uncertain about the appropriate intraperitoneal location of the tip of the Veress needle. Multiple passes with the Veress needle are not problematic, provided the error is not compounded by insufflating the “wrong” space.

One of the first signs that the Veress needle lies freely in the abdomen is loss of the dullness to percussion over the liver during early insufflation. When the needle is correctly placed, the peritoneum should effectively seal off the needle around the puncture site; if CO₂ bubbles out along the needle’s shaft during insuf-
flation, suspect a preperitoneal location of the needle tip. During insufflation, a previously unoperated abdomen should appear to expand symmetrically, and there should be loss of the normal sharp contour of the costal margin.

Monitor the patient’s pulse and blood pressure closely for a vagal reaction during the early phase of insufflation. If the pulse falls precipitously, allow the CO₂ to escape, administer atropine, and reinstitute insufflation slowly after a normal heart rate has returned.

After 1 L of CO₂ has been insufflated uneventfully, increase the flow rate on the insufflator to \( \geq 6 \text{ L/min} \) (Fig. 2.7). When the 15 mm Hg limit is reached, the flow of CO₂ will be cut off. At this point approximately 3 to 6 L of CO₂ should have been instilled into the abdomen (Fig. 2.8). When percussed, the abdomen should sound as though you are thumping a ripe watermelon.

2. Alternate Puncture Sites

Prior abdominal surgery mandates care in selection of the initial trocar site, and may prompt consideration of use of the open technique (see Section C). If the previous incisions are well away from the umbilicus, the umbilical site may still be used, with either a closed or open technique.

A midline scar in the vicinity of the umbilicus increases the risk that adhesions will be tethering intra-abdominal viscera to the peritoneum at that level. In this situation, the closed technique may still be used, but it is safer to use an alternate insertion site. This site should be well away from the previous scar and lateral to the rectus muscles, to minimize the thickness of abdominal wall traversed and avoid the inferior epigastric vessels.
In general, patients with prior low vertical midline scars should be approached through a trocar placed at the lateral border of the rectus muscle in either the left or right upper quadrant (Fig. 2.9). With previous upper vertical midline incision or multiple incisions near the midline, the right lower quadrant site may be appropriate. Alternatively, it is possible to perform an open technique with the Hasson cannula.

**Upper abdomen.** In the upper abdomen, the subcostal regions are good choices. Carefully percuss the positions of the liver and spleen to avoid inadvertent injury to these organs, and decompress the stomach with a nasogastric or orogastric tube.

**Lower abdomen.** The right lower quadrant, near McBurney’s point, is preferable to the left because many individuals have congenital adhesions between the sigmoid colon and anterior abdominal wall. Decompress the bladder when using a closed insertion technique at, or caudad to, the umbilicus.

### 3. Placement of Trocar

A wide variety of trocars are available in both disposable and reusable forms. Most have sharp tips of either a tapered conical or pyramidally faceted configuration. Several new disposable trocar designs incorporate unique design features such as direct serial incision of the tissue under visual control, or serial dilatation of the Veress needle tract. This section describes blind entry with the basic sharp trocar, with or without a “safety shield.”

Always inspect the trocar to ensure that all valves move smoothly, that the insufflation valve is closed (to avoid losing pneumoperitoneum), and that any
Figure 2.9. Optional trocar sites in previously operated abdomen. Consider the open-cannula technique.
safety shields work properly. Make sure you are familiar with the trocar; with the variety of designs available, it is not uncommon to be handed a different device (especially if it is less costly!).

Once you have attained a full pneumoperitoneum, remove the Veress needle. Most surgeons augment the pneumoperitoneum by lifting up on the fascia or abdominal wall to provide additional resistance against which to push the trocar. In a slender individual, the distance to the viscera and retroperitoneal structures is slight, and it is prudent to aim the trocar down into the pelvis. In an obese patient, this is less a problem and the trocar may be passed in a more direct path. There should be moderate resistance as the trocar is inserted. Excessive resistance may indicate that the trocar is dull or the safety shield (if one is present) has not released, or that the skin incision is too small. The resistance suddenly decreases when the peritoneum is entered. Open the stopcock briefly to confirm intraperitoneal placement by egress of CO₂. Insert the laparoscope and visually confirm entry. Connect the insufflator tubing and open the valve to restore full pneumoperitoneum. Subsequent trocars may be placed under direct vision.

If the trocar has been placed preperitoneally, it is rarely possible to redirect it. Time is often saved in this situation by converting to an open technique for placement of the initial trocar.

C. “Open” Technique with Hasson Cannula

The open (e.g., Hasson) cannula provides the surgeon with an alternative, extremely safe method to enter the abdomen, especially in a patient who has previously undergone intra-abdominal procedures. In these patients in particular, the blind insertion of a trocar would be fraught with the potential for injury to the abdominal viscera. Some surgeons use the open cannula routinely in all patients for placement of the initial umbilical trocar.

The open cannula consists of three pieces: a cone-shaped sleeve, a metal or plastic sheath with a trumpet or flap valve, and a blunt-tipped obturator (Fig. 2.10). On the sheath or on the cone-shaped sleeve, there are two struts for affixing two fascial sutures. The cone-shaped sleeve can be moved up and down the sheath until it is properly positioned; it can then be tightly affixed to the sheath. The two fascial sutures are then wrapped tightly around the struts, thereby firmly

![Figure 2.10. Open (Hasson) cannula, reusable type.](image)
seating the cone-shaped sleeve into the fasciotomy and peritoneotomy. This creates an effective seal so the pneumoperitoneum will be maintained.

Make a 2- to 3-cm transverse incision at the selected entry site (in the quadrant of the abdomen farthest away from any of the preexisting abdominal scars or in the periumbilical skin crease if there has been no prior midline surgery). Dissect the subcutaneous tissue with scissors, and identify and incise the underlying fascia (Fig. 2.11). Exposure is usually facilitated by the use of small L- or S-shaped retractors. Gently sweep the preperitoneal fat off the peritoneum in a very limited area. Grasp the peritoneum between hemostats and open sharply. This incision should be just long enough to admit the surgeon’s index finger. Confirm entry into the abdominal cavity visually and by digital palpation, to ensure the absence of adhesions in the vicinity of the incision. Place a #0 absorbable suture on either side of the fascial incision. Some surgeons place the fascial sutures first, use these to elevate the fascia, and then incise the fascia and peritoneum under direct vision.

Insert the completely assembled open cannula through the peritoneotomy with the blunt tip of the obturator protruding. When the obturator is well within the abdominal cavity, advance the conical collar of the open cannula down the sheath until it is firmly seated in the peritoneal cavity. Secure the collar to the sheath with the setscrew. Next, twist or tie the two separate fascial sutures around the struts on the sheath or collar of the open cannula, thereby fixing the cannula in place. Connect the CO₂ line to the sidearm port of the cannula and withdraw the blunt-tipped obturator. Establish pneumoperitoneum with the insufflator set at high flow. Increase intra-abdominal pressure to 12 to 15 mm Hg.

With facility, it is possible to establish pneumoperitoneum just as fast (or faster) with the open technique as can be done with Veress needle and “closed” trocar passage. Indeed, many surgeons consider this to be the safest way to establish pneumoperitoneum.

If a Hasson cannula is not available, a standard laparoscopic cannula can be placed by an open technique. For this maneuver, place two concentric purse-stringing monofilament sutures in the midline fascia and make an incision into the free peritoneal cavity through the center of the purse strings. Keep both sutures long, and pass the tails of each suture through a 3-cm segment of a red rubber catheter, thereby creating two modified Rummel tourniquets. Place a standard laparoscopic sheath (with the sharp-tipped trocar removed), cinch the purse-stringing sutures against the sheath, and secure by placing a clamp on the red rubber catheter. At the conclusion of the operation, close the fascia by simply tying the sutures.

D. Avoiding, Recognizing, and Managing Complications

1. **Bleeding from abdominal wall**
   a. **Cause and prevention.** This problem usually manifests itself as a continuous stream of blood dripping from one of the trocars, and/or as blood seen on the surface of the abdominal viscera or
Figure 2.11. A. Retractors expose peritoneum. B. Peritoneum is elevated and sharply incised. Two fascial sutures are secured to the struts on the sheath of the open cannula. The cone-shaped sleeve is then pushed firmly into the incision and the setscrew is tightened, thereby fixing the sleeve to the sheath of the open cannula. The sutures are wound tightly around the struts on the sheath, thereby securing it in place and sealing the incision.
omentum. Less commonly, delayed presentation as a hematoma of the abdominal wall or rectus sheath may occur. This source of bleeding is usually the inferior epigastric artery or one of its branches. Abdominal wall hemorrhage may be controlled with a variety of techniques, including application of direct pressure with the operating port, open or laparoscopic suture ligation, or tamponade with a Foley catheter inserted into the peritoneal cavity (Fig. 2.12).

b. Recognition and management. To determine the point at which the vessel is injured, cantilever the trocar into each of four quadrants until the flow of blood is noted to stop. Then place a suture
in such a manner that it traverses the entire border of the designated quadrant. Specialized devices have been made that facilitate placement of a suture, but are not always readily available. The needle should enter the abdomen on one side of the trocar and exit on the other side, thereby encircling the full thickness of the abdominal wall. This suture can either be passed percutaneously using a large curved #1 absorbable suture as monitored endoscopically, or using a straight Keith needle passed into the abdomen and then back out using laparoscopic grasping forceps. The suture, which encircles the abdominal wall, is tied over a gauze bolster to tamponade the bleeding site.

2. **Visceral injury**
   a. **Cause and prevention.** Careful observation of the steps enumerated just will minimize the chance of visceral injury. However, placement of the Veress needle is a blind maneuver, and even with extreme care puncture of a hollow viscus is still possible.
   b. **Recognition and management.** If aspiration of the Veress needle returns yellowish or cloudy fluid, the needle is likely in the lumen of the bowel. Due to the small caliber of the needle itself, this is usually a harmless situation. Simply remove the needle and repuncture the abdominal wall. After successful insertion of the laparoscope, examine the abdominal viscera closely for significant injury.

If, however, the laparoscopic trocar itself lacerates the bowel, there are four possible courses of action, depending on the surgeon’s experience: formal open laparotomy and bowel repair or resection; laparoscopic suture repair of the bowel injury; laparoscopic resection of the injured bowel and reanastomosis; minilaparotomy, using an incision just large enough to exteriorize the injured bowel segment for repair or resection and reanastomosis (similar to the technique of laparoscopic-assisted bowel resection). If possible, leave the trocar in place to assist in identifying the precise site of injury.

3. **Major vascular injury**
   a. **Cause and prevention.** Major vascular injury can occur when the sharp tip of the Veress needle or the trocar nicks or lacerates a mesenteric or retroperitoneal vessel. It is rare when the open (Hasson cannula) technique is used.
   b. **Recognition and management.** If aspiration of the Veress needle reveals bloody fluid, remove the needle and repuncture the abdomen. Once access to the abdominal cavity has been achieved successfully, perform a full examination of the retroperitoneum to look for an expanding retroperitoneal hematoma.

If there is a central or expanding retroperitoneal hematoma, laparotomy with retroperitoneal exploration is mandatory to assess for and repair major vascular injury. Hematomas of the mesentery and those located laterally in the retroperitoneum are generally innocuous and may be observed. If during closed insertion of the initial trocar there is a rush of blood through the trocar
with associated hypotension, leave the trocar in place (to provide some tamponade of hemorrhage and assist in identifying the tract) and immediately perform laparotomy to repair what is likely to be an injury to the aorta, vena cava, or iliac vessels.

E. References


