Patient Positioning, Instrumentation, and Trocar Placement

2

Mehraneh Dorna Jafari, Michael J. Stamos, and Steven Mills

Key Points

- Position patients in a manner to pad all pressure points and maximize gravity's effects, while avoiding nerve damage and undue traction.
- Appropriate abdominal access should be based on patient factors and surgeon preference.
- Avoid complications by understanding the limitations and strengths of laparoscopic instruments.

Introduction

The utilization of laparoscopy in general surgery became popularized over the decade following its introduction by Erich Mühe in 1982 [1]. The observation of decreased postoperative pain and length of stay following laparoscopic cholecystectomy, when compared to the conventional Kocher incision for an open cholecystectomy, further supported this approach [1]. The improved outcomes, in conjunction with the advent of new technology, led many surgeons to rapidly apply these approaches to their practice, resulting in laparoscopic cholecystectomy becoming the standard of care in a relatively short time span. Yet, this has not always translated to all operative procedures. Consider that the first laparoscopic colectomy was reported by Moises Jacobs and J. C. Verdeja in Miami, Florida, in 1990. Furthermore, Joseph Uddo performed the first sigmoid resection utilizing a circular end-to-end anastomotic stapler in 1990 [2]. Yet, here we are almost 25 years later, and still less than 50 % of colon resections are being performed via a laparoscopic approach. In part, the technical difficulties of laparoscopic colectomies, combined with the fear of port-site recurrence and the possibility of poor oncological outcomes for cancer, initially hindered the wide acceptance of this approach [2]. These concerns were subsequently dissipated by numerous multicenter randomized control trials that concluded that no differences between conventional open colectomy and minimally invasive colectomy exist in terms of long-term survival, disease-free survival, and local and distant recurrence [3].

Laparoscopic Instrumentation

Since the introduction of laparoscopy in 1902, minimally invasive surgery has been evolving and has expanded dramatically over the past two decades [4]. This expansion can mainly be attributed to the exponential growth in technology over this period of time. The evolution of laparoscopic instrumentation and, most importantly, the laparoscope have allowed for the growth of this approach.

Trocars

There are a variety of precision-engineered laparoscopic trocars available on the market. Most institutions will have a set of available trocars, each of which will have advantages and disadvantages to their use. The design of trocars has been evolving since their introduction in 30 AD (Fig. 2.1) [5].

Electronic supplementary material: Supplementary material is available in the online version of this chapter at 10.1007/978-1-4939-1581-1_2. Videos can also be accessed at http://www.springerimages.com/videos/978-1-4939-1580-4.

M.D. Jafari, M.D.
Department of Surgery, University of California, Irvine School of Medicine, 333 City Blvd. West, Suite 850, Orange, CA 92868, USA
e-mail: Jafarim@uci.edu

M.J. Stamos, M.D. • S. Mills, M.D. (✉)
Department of Surgery, Division of Colorectal Surgery, University of California, Irvine School of Medicine, 333 City Blvd. West, Suite 850, Orange, CA 92868, USA
e-mail: mstamos@uci.edu; sdmills@uci.edu

H.M. Ross et al. (eds.), *Minimally Invasive Approaches to Colon and Rectal Disease: Technique and Best Practices*, DOI 10.1007/978-1-4939-1581-1_2, © Springer Science+Business Media New York 2015

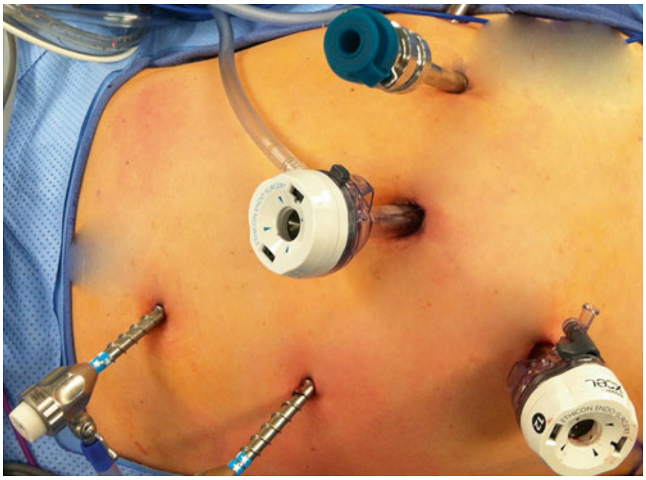

Fig. 2.1 Outer port/cannula of a 10 mm dilating/non-cutting trocar

All modern trocars generally include a gas-tight valve, which allows for removal and introduction of instruments without the loss of pneumoperitoneum. In addition, new valveless trocars have been introduced that use the pressurized curtain of gas at the top of the instrument to reduce carbon dioxide leakage. There exists a variety of single-use and reusable laparoscopic trocars. Although reusable trocars may have advantages in terms of cost, with use their tips may become blunt and valves may become incompetent.

Trocar sizes range from 3 mm to 30 mm, with the size referring to the inside diameter. The 5, 8, 10, and 12 mm trocars are the most commonly used in advanced laparoscopic and robotic colorectal surgery. The trocar itself is made of an inner, removable obturator and outer port or cannula (Fig. 2.2), which remains in place for the passage of instruments. The sleeve may be metal, plastic, smooth, and/or threaded. The transparent trocars have the advantage of allowing the laparoscope to monitor the trocar as it passes through the abdominal wall. While metal trocars are more durable, they run the risk of capacitive coupling, resulting in unintentional thermal spread and injury, with improper use of energy devices such as the electrocautery.

The trocar can be further categorized into cutting or dilating trocars. Cutting trocars can be metal or plastic and cut through the tissue as force is applied. There are designs that include a spring-loaded plastic shield that are intended to automatically cover the blade as it enters the abdominal cavity. The dilating trocars use a blunt, tapered tip that separates and dilates the tissue as it is inserted. The cutting trocars can decrease the amount of force required to enter the abdomen compared to the blunt-tipped dilating trocar. Although easy to insert, these bladed trocars were initially associated with occasional vascular and visceral complications, as well as abdominal wall hematoma, trocar site pain, and hernia. The newer-generation retracting tips seem safer

Fig. 2.2 Multiple ports used in one case: robotic ports and two varieties of laparoscopic non-cutting dilating trocars

but have not been proven to have a better safety profile [5]. Blunt tip/dilating trocars require a smaller skin incision and stretch the remaining abdominal wall, rather than incising, which may result in improved retention. The dilating trocars have been associated with decreased postoperative pain, port-site bleeding, smaller scars, and increased patient satisfaction. In summary, radially dilating trocars require an increased insertion force and have a smaller defect size compared to cutting trocars [6, 7]. Our preference for colorectal surgery is a variety of blunt tip/dilating 5, 10, and 12 m trocars to minimize risk to bowel and abdominal wall.

Instruments

Laparoscopic instrumentation is continuously evolving with new technology allowing for better ergonomics and tissue handling. Multiple companies manufacture the laparoscopic instruments; however, the principles remain uniform.

Camera/Laparoscope

Adequate visualization is an essential aspect of laparoscopic surgery. There is a wide range of available laparoscopes with regard to diameter and viewing angles. There are also flexible tip laparoscopes, which are advantageous in providing versatility in the angle viewed. Laparoscopes can be classified as a telescopic rod lens system, which are connected to a video camera, or a digital laparoscope with an integrated

Fig. 2.3 Camera light source and video unit

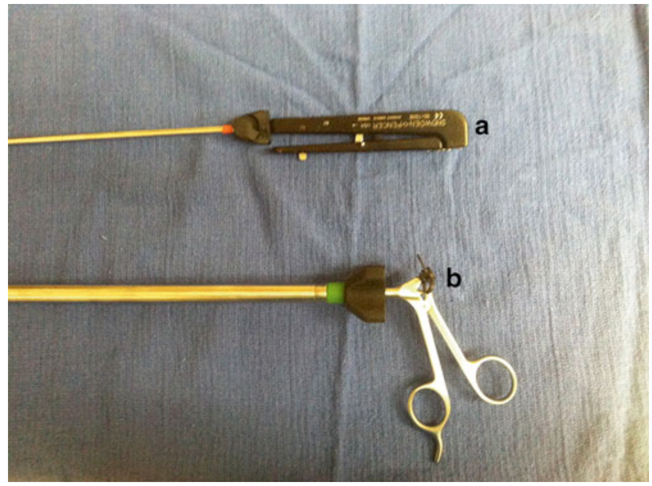

Fig. 2.4 Handles of different instruments, demonstrating that ring handle offers a greater precision (**a**) secondary to the pincer grip compared to handles (**b**) that allow for a greater form of a palm grip can be used for tasks involving power over precision

light source. Camera processor unit, light source, recording device, and monitors with articulating arms should be available (Fig. 2.3). Recently, high-definition scopes have become available. Individual choice of cameras is often dictated by surgeon preference and the hospital purchasing body or Value Analysis Committee. Regardless of which camera is used, it is important to test the camera and light source prior to gaining access to the abdomen as well as to "white balance" the camera for optimal color resolution. Typically, the surgeon stands on the opposite side of the abdomen from the pathology (and thus the expected resection segment), and the laparoscope points toward the pathology. A laparoscopic warmer and antifog solution should be available to allow for enhanced visualization. In many cases, the most junior member of the operative team is charged with "driving the camera." Unfortunately, this often results in unnecessary confusion in the anatomy, lack of unity during the case (i.e., focusing in on a different viewpoint), prolonged operations, poor ergonomics, and overall increased frustration. The traditional guidance to "keep the camera buttons toward the ceiling" is ill advised and incorrect in colorectal surgery. Rather, proper education regarding recognition of the horizon and maintaining camera orientation to identify the correct field of view is crucial for colorectal operations, especially when transitioning between the various abdominal quadrants.

Insufflator

Once abdominal access is gained, pneumoperitoneum is essential in providing adequate visualization and space to perform the operation. This is achieved via an insufflator. At the beginning of each case, prior to the incision, assure that the insufflator is working. Turn the insufflator on and check carbon dioxide cylinders to ascertain that adequate gas is available for the case. Always have an extra available container, as inevitably the tank will run out at a crucial moment if not prepared. Advanced, integrated surgical rooms will often have carbon dioxide lines directly attached to the insufflator, thus obviating the need for a tank. The insufflator will display the intra-abdominal pressure and contain an adjustable pressure selector and digital flow and volume displays. Once pneumoperitoneum is established, the setting should be placed on high flow (20–40 L/min), typically to achieve a steady 15 mmHg pneumoperitoneum. Select patients with cardiopulmonary issues may require lower levels of abdominal pressure to be maintained. The anesthesiologist will monitor the patient's hemodynamics during insufflation, and it is important to continue good communication.

Graspers

Laparoscopic graspers represent the most varied yet most used type of instrument in laparoscopic colon surgery. They can be reusable or disposable and can have various types of handles, insulated shafts, and tips. Some versions can also have attachments for monopolar cautery. Diameters range from 1.8 to 12 mm, and lengths range from 30 cm upward. We prefer 5 mm, 30–35 cm length instruments for our average patients. However, 45 cm or even longer instruments should be available and are typically used when mobilizing the splenic flexure. The type of grasper used will be dependent on the task. Surgeon preference is key with regard to the handle of the instruments. A ring handle offers a greater precision compared to the diamond or pincer grip. However, handles that allow for a greater form of a palm grip can be used for tasks involving power over precision (Fig. 2.4). Certain graspers may also have a locking mechanism, which is ideal when position of the grasper must be maintained for a prolonged period of time.

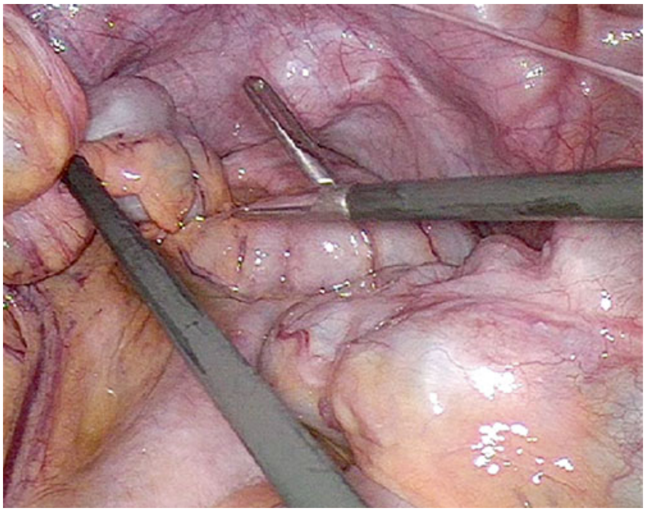

Fig. 2.5 Fenestrated nontraumatic graspers, used for grasping bowel

Graspers used for bowel retraction should allow for a secure grip, without exerting excessive pressure. A variety of tips, including straight or flared, traumatic or atraumatic, single or dual, and fenestrated or solid, are available. To decrease traction injury, we prefer atraumatic fenestrated graspers (Fig. 2.5) with dull dual ends for most bowel retraction and bowel handling. Dual action is preferred, since single action type graspers with one movable jaw exert greater pressure on the tissue. Fenestrated tips exert less friction on grasped tissue, which also means they can be prone to slippage on the tissue. Care should be taken not to exert too much pressure, especially in directions perpendicular to the tip orientation. It is also pertinent to remember that the tip of the grasper, given its smaller surface area, exerts the greatest force. When retracting with the tip, avoid pushing blindly or excessively into the bowel wall to prevent inadvertent enterotomies.

Dissector graspers, such as Maryland graspers, and right angle graspers should be available for blunt dissection as needed but are generally not to be used for handling the bowel.

Scissors

Laparoscopic scissors are also available as reusable, reposable (e.g., the tip is disposable while the shaft is reusable), or disposable. They can be used for sharp dissection and, with care, limited blunt dissection. In patients with prior abdominal surgery, scissors are invaluable with taking down adherent loops of bowel to the anterior abdominal wall. Monopolar cautery can be attached, allowing for use of energy during dissection for better hemostasis. Similar to graspers, these instruments are available in a variety of sizes and lengths.

Laparoscopic Staplers

There are a variety of surgical stapling devices available on the market. Laparoscopic staplers can be used in lieu of energy devices or suturing for vessel ligation, as well as in the creation of anastomoses. Large prospective randomized trials have failed to demonstrate superiority of either stapled or hand-sewn anastomoses [8, 9]. The linear stapler (e.g., laparoscopic GIA) places 4 staggered rows of titanium staples and then divides the tissue between the staple lines. The device failure rate has been reported as 0.2–0.3 % [10, 11].

The appropriate stapler should be selected based upon the required function. Staplers are also classified into linear versus circular staplers, articulating versus straight, and cutting versus non-cutting. Staplers are also offered in a powered design (Video 2.1). Theoretically, powered staplers may optimize stapler deployment thereby achieving superior tissue apposition. However, to date no studies have validated their superiority. Cartridge length is variable for the staplers and is generally available in 30–60 mm lengths, and appropriate size should be selected to decrease the number of staple lines. However, shorter cartridges may be easier to deploy in the narrow pelvis.

Staples come in a variety of heights (2–5 mm) and are color-coded based upon the height. There is no uniform color-coded standard for labeling the stapling heights, and each manufacturer has their own color code. Height should be chosen based upon the tissue thickness. Failure to choose an appropriate height may result in incomplete tissue apposition or conversely inadequate compression of tissue (Fig. 2.6a) [12]. Ideal staple height selection to match the tissue thickness should result in formation of a “B” shape of the staples (Fig. 2.6b). The rectum, which is typically thicker than the colon, should be divided with at least a 4.0 mm staple, while the small bowel and colon can be stapled with ~3.5 mm staples. Staple line buttressing is also available with a variety of reinforcement material, though various studies have failed to show a significant difference in outcomes, and in our general practice, we do not use reinforcement [13].

Low anterior resection (LAR) can pose specific challenges to the surgeon, notably during division of the rectum. Division low in the pelvis can be challenging in terms of both articulation of the stapler and in the length of the staple line, especially in a narrow pelvis. A curved stapler has recently become available for bowel division, and one study has demonstrated feasibility and safety [14].

Other Laparoscopic Instrumentation

Laparoscopic instruments that should also be available include needle driver for intracorporeal suturing, suction/irrigator device, and clip appliers for control of vessels. Clip appliers are indicated for ligation of appropriate size vessels or ducts. Clips vary in lengths (6–11 mm) and material (metallic or nonabsorbable plastic). They are available offered as disposable or reusable, and shaft diameters range from 5 to 11 mm.

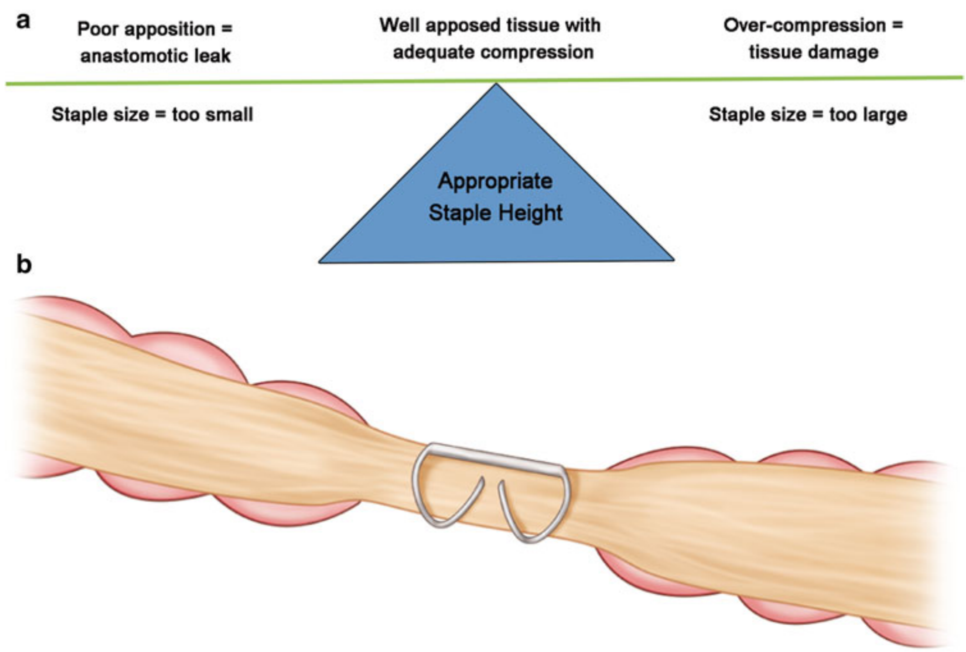

Fig. 2.6 (**a**) Failure to choose an appropriate height may result in incomplete tissue apposition or conversely inadequate compression of tissue. (**b**) Ideal "B"-shaped staple configuration. *With Permission from Davis B, Rafferty JF. Technical Aspects. In: Steele SR, Maykel JA, Champagne BJ, Orangio GR, eds. Complexities in Colorectal Surgery: Decision-making and management. Springer, New York, 2014 © Springer in 2014*

Energy Devices

Adequate hemostasis is key in any surgical procedure and is critical in laparoscopic surgery. The rapid control of vessels and hemorrhage will allow for maintenance of visualization and for the procedure to continue laparoscopically. However, hemostasis remains a challenge in laparoscopic surgery, given that traditional methods of controlling/dividing a vessel (i.e., suture ligation) is technically challenging in the laparoscopic setting; therefore, we have come to rely more heavily on surgical clips and staplers. However, these devices do have limitations in function. The surgical evolution of energy devices has become central in the laparoscopic era, for they allow for rapid control and division of named vessels. A general understanding of principles and knowledge of the advantages and complications of energy devices should be appreciated by all users.

Monopolar Energy

Monopolar energy relies on electrical current flowing from the generator through the patient and return via a grounding pad. It can be used to facilitate dissection, achieve hemostasis, and ligate small vessels. Devices such as scissors, hook cautery, or graspers can be utilized, and the energy can be set as cutting or coagulation. Similar to monopolar "Bovie Electrocautery," advantages include speed, low voltage, and rapid hemostasis. It is important to recognize, however, that standard monopolar devices rely on heat and time to perform their duty. They also require the circuit to be intact. Inadvertent alternate site burns can occur if energy is allowed to complete the circuit outside of the designated grounding pad. Other disadvantages to standard monopolar energy include an increased lateral thermal spread when compared to the bipolar devices. This may be critical when dissecting in confined spaces adjacent to critical structures such as the pelvic plexus during the anterior portion of an LAR, where thermal damage to the nerves may have long-term consequences.

Bipolar Energy

Traditional bipolar energy still relies on using electricity to perform its function. Unlike monopolar energy, bipolar energy requires no grounding pad, as the circuit is completed between the two instrument tips adjacent to one another. This results in a higher degree of current density at the tissue between the tips of the instrument. Advanced bipolar energy systems (i.e., LigaSure™, Covidien, CT, and Enseal™, Ethicon, Cincinnati, OH) add in the third component of vessel sealing (along with heat and time)—compression. This allows lower voltage to be used and, hence, lower heat to complete much larger tasks. Bipolar energy is used in a variety of vessel sealing devices and delivers a much smaller lateral thermal spread footprint. This energy, combined with the increased pressure delivered by the jaws of the instrument, allows for permanent sealing of up to 7 mm vessels (Video 2.2). The size of the vessel and thermal spread is variable depending on the instrument (Table 2.1). Many of these instruments are shaped in a blunt-tipped, versatile fashion. The advantage of bipolar devices is that these instruments can be used to grasp, dissect, and coagulate, thereby reducing the need to change instruments.

Table 2.1 Bipolar energy devices [30]

Device	Company	Thermal spread (mm) (reported)	Vessel seal (mm)
Enseal Trio®	Ethicon	1	7
Trissector PKS™	Gyrus	3.6	7
LigaSure™	Covidien	0–4.5	7
HALO PKS™	Olympus	–	7
OMNI PKS™	Olympus	–	7

Fig. 2.7 Patient positioning demonstrating appropriate padding of bony prominences and avoidance of nerve injuries

Ultrasonic Energy

Devices such as Harmonic Scalpel® (Ethicon, Cincinnati, OH) and SonSurg® (Olympus, Southborough, MA) use ultrasonic technology. In essence, these devices convert electrical energy at the generator into mechanical motion at the jaw blade. Unlike monopolar and bipolar instruments, no energy flows through the patient. In fact, these instruments are more in line with surgical staplers than they are with the advanced bipolar devices. Yet, these devices can still reproducibly and reliably seal vessels ≤5 mm with minimal thermal damage, and newer models are FDA approved up to 7 mm vessels [15]. They only have one active blade that can be rotated. Depending on several factors such as the power setting at the generator, "max" or "min" activation at the device and degree of tissue tension applied by the user will all determine which end of the coagulation versus cut spectrum the device will function. These devices also have the advantage of serving multiple purposes (i.e., cut, coagulate, coapt, cavitate) and thereby eliminating the need to change instruments (Video 2.3).

Hand-Assisted Devices

Although our practice does not include the use of hand-assisted devices, this option is available to aid in hand-assisted advanced laparoscopic operations. A variety of hand-assisted ports are available to provide a seal against the abdominal wall and allow for one of the surgeons' gloved hand to be inserted. Devices include Gelport (Applied Medical, Rancho Santa Margarita, CA), Dextrus (Ethicon Endosurgery, Cincinnati, OH) (Video 2.4), HandPort System (Smith & Nephew Inc., London, England), Dexterity Pneumo Sleeve device (Dexterity Inc., Roswell, GA), Omniport (Advance Surgical Concepts, Dublin, Ireland), and Intromit Device (Medtech Ltd, Dublin, Ireland).

Positioning

Patient positioning should provide best possible access while maintaining patient safety (Fig. 2.7). Patient position should be discussed with the entire surgical team prior to the operation, and adequate personnel should be available for patient positioning. Optimal patient positioning involves adhering to basic principles, including avoiding those positions that may cause peripheral nerve injury and/or pressure ulcers. Peripheral nerve injuries have been reported as the second most common class of injury (16 %) by the Society of Anesthesiologists Closed Claims Project database [16]. Given that during laparoscopy the table incline is used to aid in retraction and dissection, the patient must be secured to the operating room table to avoid sliding.

Padding

At our institution we use a large high-density foam mat and a Velcro belt to prevent sliding. A beanbag, memory foam, and Z-flo (Sundance, White Plains, NY) can also be used to achieve the same results. Egg crate foam (Allen Medical Group, Acton, MA) can be used for padding and stabilization of the legs in stirrups.

Depending upon the specific procedure, patients are generally placed in a supine or modified lithotomy position for laparoscopic colorectal surgery. We prefer to have both arms tucked next to the patient's body, when feasible. If the arms are to be placed out on arm boards, care must be taken to avoid injury to the brachial plexus, and therefore they should not be abducted >90 degree. For supine procedures, the occiput, sacrum, and heels are at risk for pressure ulcers and should be padded, ideally with gel pads. Knees should maintain some degree of flexion to avoid hyperextension injuries. For modified lithotomy position, legs are placed into Yellow Fin® or Allen® stirrups with hips slightly flexed and abducted, feet flat within the stirrups, and pressure avoided along the lateral aspects of the legs. The ankle, knee, and contralateral shoulder should be aligned [16].

We prefer our patients to be placed supine with (at least) the left arm tucked to allow for both surgeon and assistant to stand on the left side of the patient for laparoscopic right colectomy. However, the patient can also be placed in modified lithotomy position, which will allow the operating surgeon to stand between the legs. For laparoscopic total abdominal colectomy, sigmoidectomy, low anterior resection, and abdominoperineal resection, we prefer our patients in the modified lithotomy position with both arms tucked. This will allow access to the perineum for rectal/vaginal exams, use of endoscopy, and the insertion of the circular stapler or access for hand-sewn anastomosis.

Gaining Access to the Peritoneal Space

Laparoscopic Entry Techniques

The majority of major complications (>50 %) during laparoscopic surgery occur while gaining access to the abdomen [17–19]. There are multiple ways to gain access to the abdomen including Veress needle, direct trocar insertion, open "Hasson" technique and visual entry via optical needle or trocar technique. Each technique has potential complications and advantages. The decision of which method is most appropriate to gain entry should be dictated by patient's body habitus, history, and surgeon experience.

Veress Needle

The first report of Veress needle utilized for gaining pneumoperitoneum was described in 1947 by Raoul Palmer [20] and is the most commonly practiced method to access the abdomen [5, 17]. The disposable needle is a one-piece design with an external diameter of 2 mm, gauge of 14, and length of 70 and 120 mm. Reusable Veress needles are metal. Prior to entry to the abdomen, flush the needle to assure patency. The Veress needle has a blunt tip that will retract as it contacts resistance and spring forward when the needle is pulled away from the point of resistance. The use and exact location of Veress placement is surgeon dependent. In a patient without prior operation, we prefer placement 3 cm lateral to the umbilicus, which will be our preferred camera position. In patients with prior operation, we typically utilize Palmer's point (1–2 cm below the left costal border in the midclavicular line) (Fig. 2.8). The umbilicus is a less preferred option if the patient has had no prior operation. While the umbilicus is ideal in terms of cosmesis, its location is not ideal, as it is too close to the area of vessel division in many patients. The right upper quadrant is also an option; however, care must be taken to avoid injury to the liver.

Fig. 2.8 Veress needle placement at Plamar's point

Fig. 2.9 Proper placement technique of a Veress needle. *With Permission from Shin J, Lee SW. Laparoscopic Complications. In: Steele SR, Maykel JA, Champagne BJ, Orangio GR, eds. Complexities in Colorectal Surgery: Decision-making and management. Springer, New York, 2014 © Springer in 2014*

Once optimal position is determined based on patient history and surgeon preference, the needle is inserted. Grasping and elevating the anterior fascia with a tonsil clamp may decrease the risk of intra-abdominal injury (Fig. 2.9). As the needle traverses the anterior and then posterior fascia, there will be a sensation of resistance followed by a release at each layer of fascia, and then an absence of resistance as it enters the peritoneum. Once in the peritoneum, a click may be heard as the blunt tip of the needle inserts into the abdomen. Once entry is achieved, the needle should be aspirated to assure that no visceral or vascular injury has occurred. A drop test, which consists of observing the fluid enter the abdomen through the Veress rapidly, can help demonstrate accurate placement. It should be noted that the above maneuvers to ensure correct placement have not been proven to decrease complications, though remain, in general, good practice patterns to adhere to [21]. Once the above maneuvers are completed, pneumoperitoneum should then be attempted and initial pressure should be <10 mmg [5]. If high pressure is noted, the needle can be rotated to assure that the opening is not next to the abdominal wall. Maximal flow through a Veress needle (14 gauge) is 2.5 L/min regardless of flow settings. Avoid swaying the needle from side to side, given that this may enlarge a small visceral injury. However, if pressures continue to be high, attempt at repositioning should be made.

Direct Trocar Insertion

Dingfelder first described direct trocar insertion in 1978 [22]. It involves the placement of the first trocar without prior pneumoperitoneum. This may allow an easier grasping and lifting of the abdomen and decrease complications related to Veress needle. Controversy continues to exist regarding the use of this technique [5, 17]. We do not practice, nor recommend, this technique.

Hasson (Open) Technique

The open technique was introduced by Hasson in 1971 [23] and was designed to provide surgeons with a safe method of entry into the abdomen, thereby eliminating vascular and visceral injury [24]. It is mainly used in the high-risk population with prior abdominal surgeries, where blind entry into the abdominal is felt to be unsafe or is not feasible. It allows for direct visualization and division of abdominal wall layers. However, to date controversy exists regarding the best method to use for abdominal entry, and there is no definitive evidence that using an open technique will reduce intra-abdominal injury [17, 24, 25].

The open cannula system consists of an obturator, a plastic sheath, and a sleeve, with two rods that allow for fascial suture fixation. The two fascial sutures secure the cannula to the abdominal wall. However, this technique can be time-consuming, especially in the morbidly obese, and can cause difficulty in maintaining pneumoperitoneum due to gas leakage.

An incision is made at the selected entry site. In patients with previous abdominal surgery, this site should be away from preexisting abdominal scars or in the periumbilical skin incision. The abdominal wall is dissected with the aid of S-shaped retractors until the peritoneum is encountered. The peritoneum is then grasped and opened sharply. The surgeon's index finger is then placed intra-abdominally and adhesions are cleared. This is followed by trocar placement and securement to the fascia.

Optical Trocar (Video 2.5)

This is a variation of the direct trocar technique with the exception that the trocar used is a clear visual trocar that allows for visualization during entry. The incision is usually made and two anterior fascial sutures are placed, the fascia is divided to the size of the trocar. These stay sutures will lift the abdominal wall against the advancing trocar. The entrance of the trocar can then be visualized via the 0-degree laparoscope, which is inserted simultaneously through the head of the trocar. Some surgeons have modified this technique to be used after achieving pneumoperitoneum with the Veress needle.

Re-operative Surgery and Its Implications

As mentioned above, the decision for access to the abdomen should be made based upon patient history, body habitus, and surgeon experience. In patients who have had previous abdominal surgery, the initial access point and method should be considered carefully, taking into consideration prior incisions, prior areas of dissection, and expected pathology. Palmer's point entry and/or right upper quadrant access entry is often a safe option for previous midline laparotomy. An open technique or a visualized entrance should be considered if the Veress needle cannot be placed safely within the abdomen. After a failed attempt with the Veress needle, the area should be eventually carefully examined below the attempted insertion site to make sure that there is not any vascular or visceral injury.

Trocar Positioning

As mentioned above, a wide variety of trocars are available. Once full pneumoperitoneum has been achieved, the Veress needle is removed. The first trocar is then placed. Some surgeons advocate that the initial insertion should occur while augmenting the pneumoperitoneum by lifting up the abdominal wall with a clamp at the fascia, a move we have found unnecessary. The trocar should be placed at 90-degree angle to the abdominal wall. However, care should be taken in the thin patient to avoid injury; aiming the trocars toward the pelvis to avoid injury may be necessary. There is typically moderate resistance; however, if excessive force is being used, the skin incision may be too small. Once within the abdomen, the valve should be opened to confirm intraperitoneal placement. The camera should be placed, and evaluation near the site should be made to ensure that no injury has occurred. All subsequent trocars should be placed under direct vision.

Hand Assist

Hand-assisted laparoscopic surgery was introduced in the late 1990s, and it provided a means to overcome the limited tactile feedback and allow for gentle dissection of the tissue with the surgeon's hand [26]. Opponents feel its use can adversely affect the benefits of minimal invasive surgery given the need for a 7–8 cm incision [26]. However, in colorectal surgery, proponents note that the short-term outcomes have been found to be equivalent [27]. Long-term outcomes with regard to postoperative hernia rates favor a total laparoscopic approach. If a handport is to be used, we recommend using the extraction incision site (Pfannenstiel or minilaparotomy). Our preferred approach for extraction is a Pfannenstiel approach given its potential benefits for cosmesis and lower hernia rates [28]. Handports can also be placed at the site of planned ileostomy or colostomy. Despite the above considerations, the basic principles of laparoscopic surgery must be followed. Visualization is key to any surgical procedure, and therefore the port should be placed in a location that does not obscure laparoscopic view, and principles of triangulation will need to be maintained.

Pearls and Pitfalls

Avoiding Complications

Prior to starting any case, ensure:

1. The room step-up is sufficient for the anesthesiologist and surgeon.
2. Check all equipment.
3. Visualization is key in laparoscopic surgery; check the position of all monitors and place in optimal position.
4. Position cables in a manner to allow for maximal working space.

Trocars/instruments:

1. Minimally invasive surgery decreases tactile feedback and depth perception compared to open surgery [29]. Therefore, graspers should be used with caution given that it is difficult to judge how much force to apply.
2. Large "bites" of bowel, rather than small bites, should be taken during retraction to avoid tearing or perforating the bowel, as the larger surface area will spread out the applied force. This is especially true for the novice surgeon.
3. Monopolar devices can cause injury with the tip of the device and have a larger lateral thermal spread.
4. Inspect insulation of laparoscopic instruments. Failure of insulation can cause damage to the surrounding tissue.
5. Avoid tissue sticking when using monopolar devices by using Teflon-coated instruments.
6. When using bipolar devices, decrease tension during coagulation of the vessels to assure that the vessel is sealed and divided while still in the jaws [30].
7. For heavily calcified vessels, consider the use of clips or stapling devices.
8. Use the correct staple-height load for a laparoscopic stapler to decrease the risk of staple line failure.
9. Use appropriately sized cartridges for stapling devices. Using a longer load may lead to spillage of staples within the abdomen causing adhesions, while using too small of a staple load may lead to need for multiple staple lines. Similarly, ensure your staple height matches that of the tissue you are working on.
10. For pelvic procedures, consider the use of articulating staplers.
11. Avoid stapling of ischemic tissue.
12. Avoid creating a bridge of the tissue between two staple lines.

Positioning:

1. Ensure that the operating room table is in proper working condition and will allow for tilt. For cases in which perianal access is necessary, position the patient low on the table to allow for adequate access and visualization.
2. Assess joint mobility and motor deficit prior to the OR.
3. When placing a patient in modified lithotomy, be sure to avoid extreme flexion of the hip joints.
4. For lithotomy, flex both the hip and knees simultaneously.
5. Keep in mind that prolonged lithotomy may cause compression of the calves, and be aware of the risks of compartment syndrome after any procedure >5 h.

Abdominal access:

1. Obtain a full surgical history prior to beginning the case to aid in decisions of selecting the appropriate abdominal access site and technique.
2. Avoid multiple attempts with Veress needle and consider other options if unable to gain access easily.
3. Keep in mind the body habitus of the patient when inserting a Veress needle. For example, in a thin patient, the major vessels are approximately 1–2 cm below the umbilicus.
4. Avoid swaying the Veress needle once in the abdomen.
5. If pressures are high, reposition the Veress needle.
6. Avoid using previous scars to enter the abdomen blindly.

Conclusion

Proper positioning, trocar placement, and instrumentation selection can either set you up for success right from the beginning or play a major role in your failure. Prepare well ahead of time, and have various selections available depending on your patient and your procedure. While standardization goes a long way in efficiency and avoiding errors, take the time up front to ensure things are exactly how you need them to be prior to embarking on the operation.

References

1. Reynolds Jr W. The first laparoscopic cholecystectomy. JSLS. 2001;5(1):89–94. PubMed PMID: 11304004. Pubmed Central PMCID: 3015420.
2. Shukla PJ, Barreto G, Gupta P, Shrikhande SV. Laparoscopic surgery for colorectal cancers: current status. J Minim Access Surg. 2006;2(4):205–10. PubMed PMID: 21234147. Pubmed Central PMCID: 3016481.
3. Jayne DG, Thorpe HC, Copeland J, Quirke P, Brown JM, Guillou PJ. Five-year follow-up of the Medical Research Council CLASICC trial of laparoscopically assisted versus open surgery for colorectal cancer. Br J Surg. 2010;97(11):1638–45. PubMed PMID: 20629110.
4. Hatzinger M, Kwon ST, Langbein S, Kamp S, Hacker A, Alken P. Hans Christian Jacobaeus: inventor of human laparoscopy and thoracoscopy. J Endourol. 2006;20(11):848–50. PubMed PMID: 17144849.
5. Vilos GA, Ternamian A, Dempster J, Laberge PY. The Society of O, Gynaecologists of C. Laparoscopic entry: a review of techniques, technologies, and complications. J Obstet Gynaecol Can. 2007;29(5):433–65.
6. Passerotti CC, Begg N, Penna FJ, Passerotti AM, Leite KR, Antunes AA, et al. Safety profile of trocar and insufflation needle access systems in laparoscopic surgery. J Am Coll Surg. 2009;209(2):222–32. PubMed PMID: 19632599.
7. Theodoropoulou K, Lethaby DR, Bradpiece HA, Lo TL, Parihar A. Direct trocar insertion technique: an alternative for creation of pneumoperitoneum. JSLS. 2008;12(2):156–8. PubMed PMID: 18435888. Pubmed Central PMCID: 3016192.
8. Docherty JG, McGregor JR, Akyol AM, Murray GD, Galloway DJ. Comparison of manually constructed and stapled anastomoses in colorectal surgery. West of Scotland and Highland Anastomosis Study Group. Ann Surg. 1995;221(2):176–84. PubMed PMID: 7857145. Pubmed Central PMCID: 1234951.
9. Slieker JC, Daams F, Mulder IM, Jeekel J, Lange JF. Systematic review of the technique of colorectal anastomosis. JAMA Surg. 2013;148(2):190–201. PubMed PMID: 23426599.
10. Chan D, Bishoff JT, Ratner L, Kavoussi LR, Jarrett TW. Endovascular gastrointestinal stapler device malfunction during laparoscopic nephrectomy: early recognition and management. J Urol. 2000;164(2):319–21. PubMed PMID: 10893574.
11. Deng DY, Meng MV, Nguyen HT, Bellman GC, Stoller ML. Laparoscopic linear cutting stapler failure. Urology. 2002;60(3):415–9. discussion 9-20. PubMed PMID: 12350475.
12. Mery CM, Shafi BM, Binyamin G, Morton JM, Gertner M. Profiling surgical staplers: effect of staple height, buttress, and overlap on staple line failure. Surg Obes Relat Dis. 2008;4(3):416–22. PubMed PMID: 18226977.
13. Ho YH, Ashour MA. Techniques for colorectal anastomosis. World J Gastroenterol. 2010;16(13):1610–21. PubMed PMID: 20355239. Pubmed Central PMCID: 2848369.
14. Brescia A, Mari FS, Favi F, Milillo A, Nigri G, Dall'oglio A, et al. Laparoscopic lower anterior rectal resection using a curved stapler: original technique and preliminary experience. Am Surg. 2013;79(3):253–6. PubMed PMID: 23461949.
15. Phillips CK, Hruby GW, Durak E, Lehman DS, Humphrey PA, Mansukhani MM, et al. Tissue response to surgical energy devices. Urology. 2008;71(4):744–8. PubMed PMID: 18289646.
16. Knight DJ, Mahajan R. Patient positioning in anaesthesia. Continuing Education Anaesthesia. Critical Care & Pain. 2004;4(5): 160–3.
17. Jiang X, Anderson C, Schnatz PF. The safety of direct trocar versus Veress needle for laparoscopic entry: a meta-analysis of randomized clinical trials. J Laparoendosc Adv Surg Tech Part A. 2012; 22(4):362–70. PubMed PMID: 22423957.
18. Hashizume M, Sugimachi K. Needle and trocar injury during laparoscopic surgery in Japan. Surg Endosc. 1997;11(12):1198–201. PubMed PMID: 9373293.
19. Jansen FW, Kolkman W, Bakkum EA, de Kroon CD, Trimbos-Kemper TC, Trimbos JB. Complications of laparoscopy: an inquiry about closed- versus open-entry technique. Am J Obstet Gynecol. 2004;190(3):634–8. PubMed PMID: 15041992.
20. Palmer R. Safety in laparoscopy. J Reproduct Med. 1974;13(1):1–5. PubMed PMID: 4276707.
21. Teoh B, Sen R, Abbott J. An evaluation of four tests used to ascertain Veress needle placement at closed laparoscopy. J Minim Invasive Gynecol. 2005;12(2):153–8. PubMed PMID: 15904620.
22. Dingfelder JR. Direct laparoscope trocar insertion without prior pneumoperitoneum. J Reproduct Med. 1978;21(1):45–7. PubMed PMID: 151144.
23. Hasson HM. A modified instrument and method for laparoscopy. Am J Obstet Gynecol. 1971;110(6):886–7. PubMed PMID: 4254516.
24. Lal P, Vindal A, Sharma R, Chander J, Ramteke VK. Safety of open technique for first-trocar placement in laparoscopic surgery: a series of 6,000 cases. Surg Endosc. 2012;26(1):182–8. PubMed PMID: 21853393.
25. Merlin TL, Hiller JE, Maddern GJ, Jamieson GG, Brown AR, Kolbe A. Systematic review of the safety and effectiveness of methods used to establish pneumoperitoneum in laparoscopic surgery. Br J Surg. 2003;90(6):668–79. PubMed PMID: 12808613.
26. Litwin DE, Darzi A, Jakimowicz J, Kelly JJ, Arvidsson D, Hansen P, et al. Hand-assisted laparoscopic surgery (HALS) with the HandPort system: initial experience with 68 patients. Ann Surg. 2000;231(5):715–23. PubMed PMID: 10767793. Pubmed Central PMCID: 1421059.
27. HALS Study Group. Hand-assisted laparoscopic surgery vs standard laparoscopic surgery for colorectal disease: a prospective randomized trial. Surg Endosc. 2000;14(10):896–901. PubMed PMID: 11080399.
28. DeSouza A, Domajnko B, Park J, Marecik S, Prasad L, Abcarian H. Incisional hernia, midline versus low transverse incision: what is the ideal incision for specimen extraction and hand-assisted laparoscopy? Surg Endosc. 2011;25(4):1031–6. PubMed PMID: 20737171.
29. den Boer KT, Herder JL, Sjoerdsma W, Meijer DW, Gouma DJ, Stassen HG. Sensitivity of laparoscopic dissectors. What can you feel? Surg Endosc. 1999;13(9):869–73.
30. Smith R, Pasic R. The role of vessel sealing technologies in laparoscopic surgery. Surg Technol Int. 2008;17:208–12. PubMed PMID: 18802904.

Springer

http://www.springer.com/978-1-4939-1580-4

Minimally Invasive Approaches to Colon and Rectal Disease
Technique and Best Practices
Ross, H.M.; Lee, S.; Mutch, M.G.; Rivadeneira, D.E.; Steele, S.R. (Eds.)
2015, XVIII, 415 p. 453 illus., 200 illus. in color., Hardcover
ISBN: 978-1-4939-1580-4