

CHAPTER 26

EQUIPMENT AND INSTRUMENTATION FOR LAPAROSCOPIC BARIATRIC SURGERY

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Laparoscopic bariatric surgery performed skillfully, accurately, and successfully, has been increasing. These minimally invasive but potentially complex operations offer rapid recovery and beneficial results. This challenging surgery requires masterful use of an array of specialized laparoscopic equipment and instrumentation. These include proper video monitors, cameras, visualization, peritoneal entrance, trocars, insufflation, scopes, cutting, coagulation, retraction, staplers, suturing, graspers, suction-irrigation, laparoscopic operating-rooms, tables, robotics and awareness of newer equipment. This chapter details this equipment and instrumentation.

Laparoscopic surgery is considered to be a discipline by some and a tool or technique by others. Nevertheless, it is technologically intensive, requiring that the surgeon understands the equipment and instrumentation of laparoscopy, as well as understanding the disease being treated or the treatment being applied. Specifically, the surgeon must know when and how to apply the technology and must possess the skill to use it effectively. In short, the surgeon must not only become a student of the disease being treated, but also a student of the technology being employed.

The basic equipment and instrumentation

are the same for most laparoscopic procedures; however, certain advanced and complex operations may require alternative uses of the basic equipment or some special instruments. Furthermore, specific patient characteristics may put excessive demands on equipment. Laparoscopic bariatric surgery in general involves complex operations in morbidly obese patients that present multiple obstacles for the surgeon to overcome. Table 1 lists some of the challenges of laparoscopic bariatric surgery that make it one of the more demanding areas in laparoscopic surgery today.

In this chapter, we will focus on the application of laparoscopic instruments and equipment as they apply to the bariatric patient, assuming that the surgeon has a general working knowledge of the basic equipment and technology. More detailed information regarding the engineering and technology behind the equipment is available from many excellent sources.¹⁻⁵ Equipment recommendations in this chapter are based on the authors' experience with over 300 laparoscopic Roux-en-Y gastric bypass procedures but should apply as well to the other laparoscopic bariatric procedures^{6,7} The authors recognize that in many cases there may be alternative equipment or approaches

TABLE 1. TECHNICAL CHALLENGES IN LAPAROSCOPIC BARIATRIC SURGERY

Excessive abdominal adiposity
—Insufficient trocar length
—Insufficient scope and instrument length
—Limited freedom of movement
—Air leaks
—Viscera obscured by fat
—Exposure/retraction challenges
—Fatty viscera, especially liver
Severe obesity and high comorbidity
—ASA III or greater
—Significant cardiopulmonary disease
—Decreased tolerance of CO ₂ pneumoperitoneum
—Difficult airway requiring advanced intubation techniques
Operating in multiple abdominal compartments
Advanced intracorporal stapling techniques
Advanced suturing techniques
Advanced hemostasis techniques
Advanced flexible endoscopy

that are equally or more suitable.

VISUALIZATION EQUIPMENT AND ACCESSORIES

Of all the technical instruments used for advanced laparoscopy, the most important include the components that create and maintain the image. Since the surgeon must forfeit touch and palpation, a clear, crisp, bright image is mandatory at all times. There are no “blind” maneuvers in laparoscopy. Performance of a laparoscopic procedure safely and effectively is dependent upon the quality of visualization.

Conditions specific to laparoscopic bariatric surgery make obtaining an adequate image challenging. In the morbidly obese patient, the voluminous abdominal cavity expanded by the pneumoperitoneum requires exceedingly more light for visualization than what is

necessary for the non-obese patient. Viscera enlarged by fatty infiltration and copious adipose tissue covering mesentery, omentum, and viscera often crowd the view and obscure the landmarks of interest. Instrumentation that will allow viewing around or over or under such objects is necessary, as well as instruments that enable adequate exposure. Inadvertent contact of the laparoscope lens with abundant adipose tissue causes soiling of the lens, which results in a poor quality image. Equipment that minimizes such contacts as well as equipment that allows quick and effective cleaning of the lens is also critical. Bariatric patients are also prone to small air-leaks at the trocar sites which lead to lens fogging because of rapid insufflation of relatively cool CO₂. Equipment to prevent or rapidly correct lens fogging is highly desirable.

Laparoscope

The laparoscope provides the means of acquiring an image of the abdominal cavity. It is based on the Hopkins rod lens system, consisting of a series of quartz rod lenses and a fiber bundle surrounding the rod lens for transmission of light.^{3,4} The eyepiece of the telescope is connected to the camera by means of an adapter.

Laparoscopes come in various sizes, with a standard length of 32 cm and diameters that range from 2 to 10 mm. Various angled scopes are available from 0 to 90° orientation. Angled scopes provide more flexibility in viewing internal structures and provide access to areas that would be “blind” to 0° scopes. They require additional skills to operate and decrease light transmission slightly.

For the Roux-en-Y gastric bypass (RYGBP), we typically use a 5-mm 30° scope (Stryker Endoscopy®, Santa Clara, CA, USA), initially at the 5-mm entrance site to visualize the other port placements (Figure 1). A 10-mm diameter, 45° angled laparoscope (Stryker Endoscopy®) is used for the balance of the procedure, because we have found that it provides the best viewing flexibility espe-

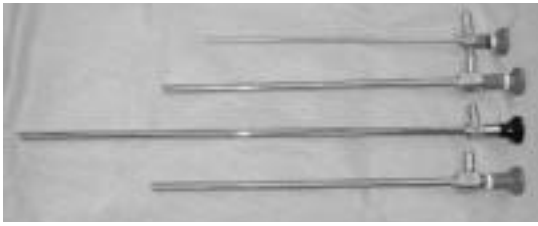


FIGURE 1. Laparoscopes used in laparoscopic Roux-en-Y gastric bypass.

cially in extremely obese patients (Figure 1). An extra long laparoscope (45 cm) is sometimes necessary and very helpful in super obese patients (Figure 1). Excessive abdominal wall thickness together with a large expanded abdominal cavity does not allow for a close-up view of distant sites (e.g. the esophagogastric junction) using the standard-size scopes. At the present time, no manufacturers have developed a long scope with optimal image quality and light transmission. An important scope accessory is a stainless steel thermos filled with hot sterile water for cleaning the scope and to prevent it from fogging. We have generally found that the anti-fog solutions are not helpful.

Light Source and Light Cable

A high intensity light source is a requisite for a satisfactorily bright laparoscopic image. Most units employ either a xenon or metal halide bulb, as both these sources provide a color temperature that is in the range of daylight (5500 k). Bulbs have a life-span in the 250-hour range. Interaction between the camera and the light source allows automatic adjustment of the illumination intensity with changes in light level at the camera CCD surface. This will greatly reduce annoying glare and blooming. Manual overrides are available to over- or under-illuminate if desired.

Light is transmitted from the light source to the scope through a fiberoptic light cable. Any cable with more than 15% broken fibers is not suitable for a video procedure and should be replaced. Improper connection of the cable to the light source or the telescope will result in a loss of significant amount of light. Light cables must be sterilized in either ethylene-

oxide or glutaraldehyde and should not be autoclaved.

Video Camera

Miniature, light-weight cameras, weighing as little as 40 grams, are used to deliver the image from the laparoscope to the video monitor. The essential component of the miniature camera is the CCD chip, which contains approximately 300,000 light sensitive pixels on the chip surface that measures only about 1/2 inch on the diagonal. The greater the pixel content of a CCD, the higher the resolution of the final image. Three chip cameras have become the industry standard, with each chip dedicated to one of the three primary colors—red, green and blue. They provide excellent resolution and color rendition which are essential for laparoscopic bariatric surgery. Many excellent 3-chip cameras are available. We are currently using the Stryker Endoscopy® 6th generation 3-chip camera (model 888), which has a resolution of greater than 900 lines (compared to 470 to 560 lines for most single chip cameras) and is extremely light sensitive (<1 Lux) (Figure 2). The light sensitivity of a camera is an indication of the amount of light that is required to produce an image.



FIGURE 2. Three-chip video camera used in laparoscopic Roux-en-Y gastric bypass.

The camera is mounted to the eyepiece of the laparoscope with a C-mount endoscopic coupler that permits rapid attachment when switching from one scope to another. The coupler also has a focussing knob. The camera head contains control buttons which enable the user to adjust gain, digital zoom, and printer modalities. The power supply and electronic control are connected to the camera by cable. The power unit contains controls for white balance, gain, shutter, and digital enhancement which can be controlled by the operating-room staff or the surgeon using the Hermes™ (Stryker® Endoscopy) voice activation technology (see section on optional equipment).

Video Monitor

The monitor on which the laparoscopic image is viewed should be of the highest quality. The picture should be flicker-free, with enhanced black performance for better contrast and efficient white balance circuitry that can deliver more stable color and high resolution. We use two 19-inch high (47.5 cm) resolution color video monitors (Sony Corporation, Japan), which are placed opposite the surgeon and the assistant on towers (Figure 3).

Insufflator

In laparoscopic surgery, exposure is achieved by insufflation of the peritoneal cavity with CO₂ to create a pneumoperitoneum. CO₂ is the preferred gas for laparoscopy

because it is inexpensive, readily available, and highly soluble, allowing relatively large quantities to be safely absorbed and excreted by the lungs. It is also noncombustible, permitting the use of lasers and electrocautery. The insufflator (Stryker Endoscopy®) regulates the flow of CO₂ from a pressurized reservoir and monitors intraabdominal pressure (Figure 4).

The flow of gas ceases automatically when a preset intraabdominal pressure is achieved. The panel on the insufflator displays the preset level and current level of intraabdominal pressure, the set-rate and current-rate of CO₂ insufflation, the volume of gas infused and the residual volume in the CO₂ tank. Alarms signal high intraabdominal pressure, excessive gas leak, and low gas level in the CO₂ tank. The rate of insufflation can be adjusted from 1 litre/minute up to 20 liters/minute. We usually set the intraabdominal pressure at 15 mmHg but will intermittently use higher pressure (16-18 mmHg) when better exposure is needed or lower pressure when instrument length is insufficient.

Gas leakage is common during laparoscopic bariatric procedures and can be very troublesome. A high flow insufflator (20 liters/minute) is highly recommended to accommodate for gas leakage from small air leaks at port sites, instrument exchanges, and intraabdominal suction. We usually use two insufflators set at high flow during gastric bypass procedures to provide added compen-



FIGURE 3. Video monitor.

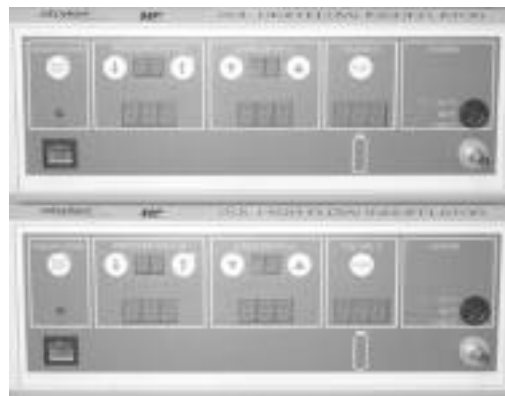


FIGURE 4. Dual, high flow insufflators.

sation for gas leakage and to insure that at least one gas tank is always running while one is being exchanged (Figure 4).

Laparoscopic Access Instruments and Trocars

A Veress needle is used to establish a pneumoperitoneum in the obese patients, as it is technically very difficult to perform an open cut-down (Hasson) technique due to the thick layer of subcutaneous fat. A long-length Veress needle of 150 mm (U.S. Surgical Division of Tyco, Norwalk, CT) is used through a subcostal incision in the left upper quadrant (Figure 5). The 2-mm needle has a spring-loaded blunt inner cannula that automatically extends beyond the needle-point once the abdominal cavity has been entered. This blunt cannula has a side-hole to permit entry of CO₂ gas into the abdominal cavity. S-shaped retractors are helpful in bluntly dissecting through the subcutaneous fat to expose the anterior fascia (Figure 6). Correct position of the Veress needle after it has passed through the abdominal wall can be verified by various methods such as the water drop test. In obese patients, opening

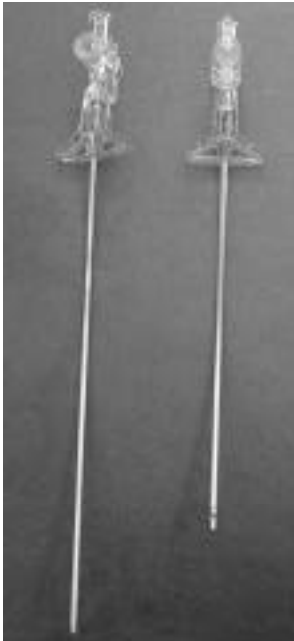


FIGURE 5. Long and standard Veress needles.



FIGURE 6. S-retractors to assist Veress needles.

intraabdominal pressures may be high (up to 10 to 12 cm of H₂O), and anterior traction on the abdominal wall with the S-retractors is sometimes required to facilitate gas-flow.

Trocars and Closing Devices

In addition to being safe and reliable, trocars and cannulas for laparoscopic bariatric surgery should minimize air leaks, secure readily to the abdominal wall, allow rapid exchange of instruments of various diameters, and be of sufficient length to reach the peritoneal cavity. We use the disposable ports (Versaport™, United States Surgical Corp.) of three sizes: 5 mm, 11 mm, and 12 mm (Figure 7). Rarely, extra long trocars are required for patients with excessively thick abdominal walls (Figure 8). These ports have retractable pro-



FIGURE 7. Trocars 5 mm, 10 mm, 12 mm.



FIGURE 8. Extra-long trocars.

protective sheaths that cover the trocar tip when not in use. During insertion, the sheath retracts until the trocar tip penetrates the peritoneum, at which time the sheath automatically pops back into place to cover the tip and minimize the likelihood of unwanted trauma. These cannulas have an insufflation port along the side of the head of the cannula. The cannula head also has a flap valve which allows insertion and removal of various instruments without loss of pneumoperitoneum.

A spiral cannula sheath that screws into the fascia can be inserted onto the shaft of the trocar to reduce the risk of dislodgment. We usually secure the trocars to the skin with sutures for added security (Figure 9). To prevent trocar site hernias, we close all ports that are 10 mm or greater with a strong absorbable suture such as O-polysorb (United States Surgical Corp.). A suture-passing instrument (Karl Storz Endoscopy, Tuttlingen, Germany) (Figure 10) facilitates full-thickness closure.

Laparoscopic Retractors and Instrument Stabilizers

To expose the esophagogastric region, retraction of the left lobe of the liver anteriorly is required. Many types of retraction devices are available that work efficiently. Most important, they should be strong enough to retract large, heavy livers and not traumatize the liver in the process. We use a 5-mm diameter endoflex retractor (Genzyme, Tucker, GA) that assumes a triangular configuration when tightened (Figure 11). The retractor is usually held stationary by means of



FIGURE 9. Securing trocar to skin with suture.



FIGURE 10. Suture passer to close trocar sites.



FIGURE 11. Flexible 5-mm Liver Retractor.

an external holding device attached to the OR table (Mediflex Division of Flexbar Machine Corp., Glandia, NY) (Figure 12). For extremely large livers, sometimes two retractors are necessary (Figure 13).

HAND INSTRUMENTS

Grasping, Cutting and Dissecting Instruments

The hand instruments are available with

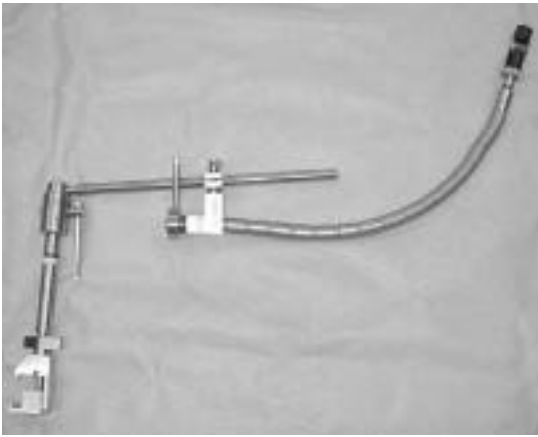
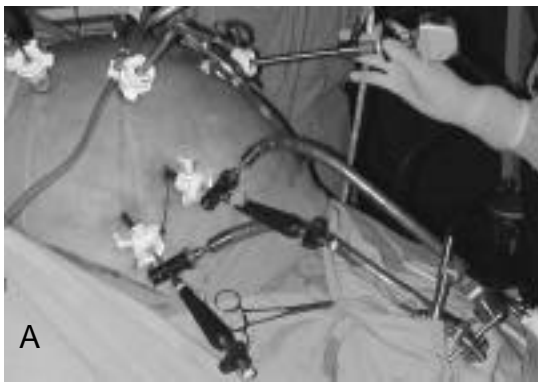


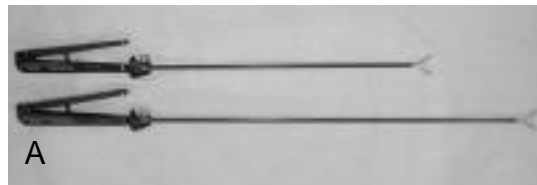
FIGURE 12. External holding device.



FIGURES 13 A and B. Placement of multiple liver retractors for the very large liver.

many different features and preferences. In general, for all hand instruments we prefer an in-line (as opposed to a pistol grip), ratcheted (optional) handle with finger-controlled rotation of the shaft. Many are available in extra-long lengths for the super obese patients. An atraumatic grasper is required for laparo-

scopic bariatric surgery to manipulate bowel without causing injury. We use a 5-mm in-line atraumatic grasper (Genzyme) that features fine, pyramid-shaped teeth which provide a secure, yet gentle grip of tissue (Figure 14). The 5-mm in-line crocodile grasper (Genzyme) has long contoured jaws with tissue herniation channels to ensure superior grasping ability (Figure 15). It is excellent for holding the stomach and omentum. The fenestrated articulating grasper instrument (Genzyme) shown in (Figure 16) has an articulating tip which forms a gentle curve of about 45° angle when the handles are closed. The instrument is very useful in passing the Roux-limb through the retrocolic and retro-



FIGURES 14 A and B. 5-mm atraumatic grasper.



FIGURE 15. 5-mm crocodile grasper.

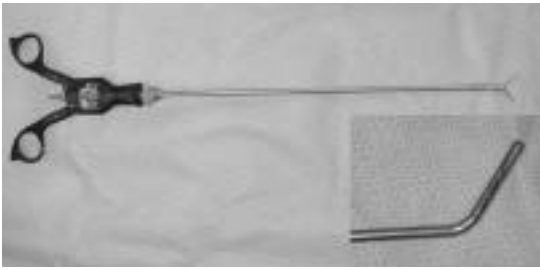


FIGURE 16. Fenestrated articulating grasper.

gastric tunnel up to the gastric pouch before performing the anastomosis.

The laparoscopic Babcock instrument is similar in design to the conventional Babcock clamp (Figure 17). It is used for grasping bowel atraumatically.

Another instrument suitable for handling bowel is the fenestrated grasper (Karl Storz Endoscopy); it has broad, fenestrated jaws which provide a large surface for gently grasping and holding tissue (Figure 18). This is used primarily for handling the small bowel and for measuring the length of the Roux-limb during RYGBP.

The endoscopic bowel clamp is a 10-mm diameter instrument that has long jaws with serrations which provide a secure atraumatic grip (Figure 19). It has a ratcheted handle for locking the jaws. It is used to clamp the small bowel (Roux-limb) before performing endoscopy to prevent distal insufflation of the small bowel.

For endoscopic scissors we use the 5-mm diameter Endo Shears™ (United States



FIGURE 17. Laparoscopic Babcock.



FIGURE 18. Bowel grasper.

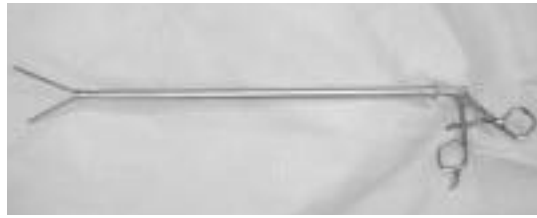


FIGURE 19. Bowel clamp.

Surgical Corporation,). It is a disposable scissors that has a rotating shaft and a 16-mm curved blade (Figure 20). A reliably sharp blade is one of its major advantages.



FIGURE 20. 5-mm endoscopic scissors.

Endoscopic Clip Applicators and Staplers

The multiload disposable clip applicator (U.S. Surgical Corporation) is used for application of titanium clips to secure hemostasis (Figure 21). It is available in 5-mm and 10-mm diameter sizes. The multiload units considerably increase the speed and efficiency with which hemostasis can be accomplished as compared with single clip units.

Endo-GIA Stapler

An endoscopic linear stapler that creates at least two (preferably three) rows of staples on each side of the transected tissue is an extremely important instrument required for laparoscopic vertical banded gastroplasty (VBG) and RYGBP. It can be used to transect



FIGURE 21. Multiload disposable clip applicator.

hollow viscera, divide highly vascular tissue (ie. mesentery), and create an anastomosis. We use the Endo-GIA II™ (U.S. Surgical Corporation #3044402) disposable stapler (Figure 22). It is a 12-mm linear stapler that applies two triple rows of staples before dividing the tissue with an advancing knife. The stapler is fired by repeated compression of the handles after pressing the green button located on the shaft. The stapler can be fired multiple times (25) using disposable cartridges of various lengths (30 mm, 45 mm, 60 mm) containing staples of various heights (2.0 mm, 2.5 mm, 3.5 mm, 4.8 mm) for use with varying tissue thickness. A finger-controlled knob can rotate the shaft of the stapler which also comes with cartridges that can roticulate at 45° angles.



FIGURE 22. Endoscopic linear stapler.

Endoscopic EEA Stapler

An endoscopic EEA stapler can be used for the VBG to create a full thickness window in the stomach, to allow placement of the vertical staple-line. It can be used for the RYGBP to create the gastrojejunal anastomosis (end-to-end or end-to-side). The Endopath ILS™ (Ethicon Endosurgery, Cincinnati, OH, #ECS21) and the Endo-EEA™ (U.S. Surgical Corporation) both create a double, circular row of staples with varying diameter sizes (21 mm and 25 mm most commonly used for bariatric surgery) and are designed to be airtight for laparoscopic use (Figure 23). For the gastrojejunal anastomosis, we prefer the 21-mm diameter size resulting in a stoma diameter of approximately 12-14 mm. The endoscopic EEA staplers can be inserted directly through a dilated port site or through a large trocar. Various methods of anvil insertion into



FIGURE 23. Endoscopic EEA staplers.

the gastric pouch have been devised, including insertion through a gastrostomy or insertion through the mouth with guidance into the pouch through the esophagus using a pull-wire. The later technique requires a flexible endoscope, snare and a pull-wire.

OTHER HAND INSTRUMENTS

Suction Instruments

An effective and reliable suction/irrigation instrument is critical to keep the surgical field clear of pooling blood and the abdominal cavity free from smoke and vapor. The Surgiwand™ (United States Surgical Corp.) is a 5-mm disposable instrument which performs the function of both suction and irrigation through a single common channel (Figure 24).



FIGURE 24. Suction/irrigation instrument.

Endoscopic Suturing Instruments

Conventional endoscopic suturing technique using standard laparoscopic needle drivers and sutures are suitable for laparoscopic bariatric surgery. Alternatively suturing devices such as the Endostitch™ (Tyco U.S. Surgical Corp.) may be employed to facilitate endoscopic suturing (Figure 25). The 10-mm diameter, disposable Endostitch™ utilizes a double pointed shuttle needle with the thread mounted at the center of the needle. Double action jaws allow the needle to be passed back and forth by squeezing the handle and maneuvering the toggle switch. As opposed to conventional suturing, regrasping and repositioning the needle is unnecessary. A variety of absorbable (Polysorb™) and nonabsorbable sutures (Surgidek™, Surgilene™) are available for use with the Endostitch. We use the Endostitch during the RYGBP for approximating the bowel for the entero-enterostomy and for oversewing the gastrojejunostomy (two layer closure).



FIGURE 25. Endostitch™ and conventional laparoscopic needle-driver.

ENERGY SOURCES FOR COAGULATION AND CUTTING

Standard unipolar or bipolar electrocautery can be used for hemostasis and dividing tissue. For extremely vascular tissue such as mesentery, alternative energy sources such as ultrasonic coagulation may be more suitable. The Ultrasonic Shears™ (Tyco, U.S. Surgical) and the Harmonic Scalpel™ (Ethicon Endosurgery) are ultrasonically activated instruments that provide excellent hemostasis while eliminating the problem of

electrical arc injury associated with unipolar electrocautery (Figure 26). The instruments have a stationary jaw and a blade that vibrates at a frequency of 55,000 Hertz. The mechanical action denatures collagen, forming a coagulant that instantly seals small blood vessels. Although heat is generated in the tissue through friction, the lateral spread of thermal energy is minimal (1-2 mm) compared with electrocautery.

The ultrasonic instruments, which are foot pedal activated, are available in 5-mm and 10-mm diameter sizes with a finger-controlled rotating shaft. By varying blade frequency, the speed of cutting through the tissue and degree of hemostasis can be adjusted. Similar to smoke from an electrocautery, these instruments produce water vapor that can obscure vision. Intermittent evacuation of the vapor is sometimes necessary. During RYGBP, we employ ultrasonic dissection liberally, especially for dissection along the lesser and greater curves of the stomach for gastric pouch creation. An ultrasonic dissector is also used for making enterotomies in the stomach and small intestine, for stapler insertion and for creating the window through the transverse mesocolon.



FIGURE 26. Ultrasonic dissecting shears.

FLEXIBLE ENDOSCOPE

We routinely use a flexible gastroscope (Olympus GIF XQ40, Strongville, OH) at the completion of the RYGBP to examine the gastrojejunal anastomosis (Figure 27). After submerging the anastomosis under water, we institute intraluminal insufflation and look for air-leaks. The endoscope is also useful to assess



FIGURE 27. Flexible endoscope.

the size and patency of the anastomosis, as well as examine for bleeding and viability of the gastric pouch. When using the EEA stapler for the gastrojejunal anastomosis, we also use endoscopy to facilitate placement of the anvil into the gastric pouch. An endoscopic snare and pull-wire are also necessary for this technique.

To facilitate simultaneous use of endoscopy and laparoscopy, we prefer the use of two camera systems: one each for the laparoscope and endoscope. Both camera systems are fed through a digital mixer, so that both images are displayed on the same monitor as a "picture-in-picture" format. This greatly helps both the surgeon and the endoscopist visualize both activities simultaneously. The relative size of the two images can be increased or decreased, and the mixer's joystick allows the surgeon to see both images or only one as needed.

OPERATING-ROOM TABLE

The operating table for laparoscopic bariatric surgery is a key component of the operating-room equipment. Not only must the operating table have the capacity to support super obese patients up to 350 kg but also it must provide maximum tilt and rotation, required in laparoscopy to gain adequate exposure (Figure 28). Important bed accessories include foot-boards, straps and



FIGURE 28. Bariatric operating table.

padding to safely secure the patient to the bed and prevent pressure injuries.

ACCESSORY EQUIPMENT

Pneumatic compression devices that accommodate the super obese patient are highly encouraged to counter potentially severe venous stasis resulting from the pneumoperitoneum and reverse Trendelenberg position (Figure 29). Heating blankets are helpful in preventing hypothermia related to heat loss from evaporation and continuous insufflation, particularly during operations of long duration. A bougie (30 French) can be helpful in sizing the gastrojejunostomy stoma when an endo-GIA stapler is used. A Baker tube with a 15 ml capacity terminal balloon



FIGURE 29. Pneumatic compression garment.

can be inserted orally into the stomach to aid identification of the gastroesophageal junction and size the gastric pouch. A Jackson-Pratt drain may be placed posterior to the gastrojejunal anastomosis, to drain residual fluid or a potential anastomatic leak.

OPTIONAL AND ADVANCED EQUIPMENT

Voice Control Technology

Voice control technology such as Hermes (Computer Motion, CA and Stryker Endoscopy) serves as a centralized and simplified interface for a surgeon to voice-control multiple Hermes-compatible medical devices (Figure 30). Hermes consists of a computer control unit that is networked with multiple Hermes-ready devices. The surgeon, wearing a headphone attached to Hermes, controls and operates the devices by using simple verbal commands. A voice card, programmed for each individual surgeon, is inserted into the control unit and allows Hermes to recognize and execute the voice commands. Hermes currently allows the surgeon to voice-control the camera, light source, insufflator, video printer, video cassette recorder and Computer Motion's robotics systems such as AESOP.

Other operating-room devices such as the operating-room lights, O.R. table, telephone, etc., are likely to be Hermes-ready in the near future. Hermes also provides both visual (on the video monitor) and digitized voice feedback to the surgical team. Increasing surgeon

control can improve safety and augment the quality of patient care, as it enables the operating-room staff to concentrate on the patient instead of controlling multiple complicated medical devices by hand. A voice-control system appears particularly suitable for laparoscopic bariatric surgery, since many adjustments of those key devices are made throughout the procedure.

Robotic Assistance

AESOP is an FDA-approved surgical robot capable of holding the laparoscope and altering its position in response to a surgeon's verbal commands (Figure 31). The robotic device consists of two main parts: the computer controller and the articulating robotic arm. The computer chassis weighs about 64 kg (140 lb), requires its own cart, and is connected by cable to the robotic arm. The articulating robotic arm attaches directly to the O.R. table and weighs about 18 kg (40 lb). It has 35 cm (14") of vertical movement with a 68 cm (27") reach, and has a maximum speed of 7.5 cm (3") per second. It can store in its memory several set arm positions, allowing the surgeon to rapidly return or advance to optimal viewing positions. AESOP provides the surgeon complete control of the surgical visual field, eliminating the need for a human camera holder and eliminating the shortcomings of some human assistants, ie. non-purposeful movement, delayed movement, and inadvertent lens soiling.

There is a definite learning curve associated with the use of AESOP particularly involving bariatric operations, because significant complex scope maneuvering in the upper and mid-abdomen is required. An extra-long scope is often required for superobese patients to avoid the arm abutting against the patient's abdominal pannus. Studies have shown that the robotic arm not only outperforms human camera holders, but also reduces operating time, resulting in improved efficiency and cost-savings to the institution.^{8,9}



FIGURE 30. Hermes voice activation unit.



FIGURES 31 A and B. AESOP robotic arm.

Operating-Room Set-up

An efficiently set-up and organized operating-room for laparoscopic bariatric surgery is just as important as having all the right equipment. The room should be spacious to allow for unencumbered transfer of the morbidly obese patient to and from the O.R. table. The room must also be spacious enough to adequately position the vital equipment in easy to reach locations, so that the O.R. staff do not stumble over equipment. Much of the laparoscopic visualization and insufflation equipment can be



FIGURE 32. Video equipment cart.

grouped together on mobile towers (Figure 32).

Specialized operating-rooms specifically for endosurgery are gaining appeal. Some of these “endosurgery suites” employ boom technology that keeps the equipment off the floor and within easy reach of the surgeon or operating-room staff (Berchtold Corp., Charleston, NC)(Figure 33). Efficient design of these oper-



FIGURE 33. Operating-room booms for laparoscopic equipment.

ating-rooms will likely improve overall operating efficiency and safety.

CONCLUSION

Laparoscopic bariatric surgery involves unique technical challenges for the advanced laparoscopic surgeon. Not all of the technology presented in this chapter is necessary to safely complete these operations. However, many of the technical challenges can be overcome by proper use and understanding of a wide array of laparoscopic equipment and instrumentation. As these procedures evolve, new and improved technology will

hopefully simplify the procedures, adding enhanced efficiency and safety.

REFERENCES

1. Coller JA, Murray JJ. Equipment. In Ballantyne GH, Leahy PL, Modlin IL, eds, *Laparoscopic Surgery*. Philadelphia: WB Saunders 1994:3-14.
2. Spencer MP, Madoff RD. Imaging. In Ballantyne GH, Leahy PL, Modlin IL, eds, *Laparoscopic Surgery*. Philadelphia: WB Saunders 1994:15-21.
3. Berci G, Paz-Partlow. Videoendoscopic technology. In: Toouli J, Gossot D, Hunter JG, eds, *Endosurgery*. New York: Churchill Livingstone 1996:33-9.
4. Prescher T. Video imaging. In: Toouli J, Gossot D, Hunter JG, eds, *Endosurgery*. New York: Churchill Livingstone 1996:41-54.
5. Melzer A. Endoscopic Instruments-conventional and intelligent. In: Toouli J, Gossot D, Hunter JG, eds., *Endosurgery*. New York: Churchill Livingstone 1996:69-95.
6. Schauer PR, Ikramuddin S, Gourash W. Laparoscopic Roux-en-Y gastric bypass: A case report at one-year follow-up. *Laparoendosc Adv Surg Tech* 1999;9:101-6.
7. Schauer PR, Ikramuddin S, Gourash W et al. Outcomes after laparoscopic Roux-en-Y gastric bypass for morbid obesity. Submitted for publication.
8. Kavoussi LR, Moore RG, Adams JB et al. Comparison of robotic versus human laparoscopic camera control. *J Urol* 1995;154:2131-6.
9. Dunlap KD, Wanzer L. Is the robotic arm a cost effective tool? *AORN* 1998;68:265-72.