# 9 Operating Room Positioning, Equipment, and Instrumentation for Laparoscopic Bariatric Surgery

Stacy A. Brethauer and Esam S. Batayyah

## Introduction

The majority of bariatric operations are now performed laparoscopically. While it may seem second nature to experienced bariatric surgeons who have established techniques, there are many different techniques and devices available to perform gastric bypass and sleeve gastrectomy safely. For the surgeon starting a bariatric program, considerable thought and planning are required to obtain the proper operating room equipment and surgical instrumentation. Frequently, the instruments used during a surgeon's fellowship are not available at their new hospital and a case must be made to obtain the equipment necessary for the surgeon to perform the operations as they did during their training. Deviations from a standardized technique and the use of unfamiliar instrumentation can be stressful and may prolong operations or affect outcomes [1, 2]. This chapter reviews specialized equipment used for patient positioning, laparoscopic access, insufflation, visualization by camera, energy sources for transection and coagulation, staplers, hand instruments, flexible endoscopy, voice activation and robotics, and a "fully integrated" operating room layout.

Morbidly obese patients present multiple obstacles and specific patient characteristics which may require modifications to the technology normally used for laparoscopic procedures. In particular excessive abdominal adiposity interferes with visualization, freedom of instrument movement and frequently requires instruments of exceptional length and strength. Laparoscopic approaches in obese surgical patients require advanced skills in intracorporeal stapling techniques, suturing techniques, hemostasis techniques, and flexible endoscopy. Comorbid medical conditions may reduce patient tolerance of intra-abdominal $CO_2$ and necessitate alternative means of maintaining visualization [1].

For the purposes of this chapter, it is assumed that the surgeon is familiar with the application of laparoscopic instruments and equipment as they apply to the general patient undergoing minimally invasive surgery [3, 4]. Detailed information regarding the engineering and technology behind the equipment is available from many excellent sources [5–9]. It is certainly recognized that there may be alternative equipment or approaches that are equally or more suitable and that optimal choices will change with time and the availability or newer technologies.

## Patient Positioning

The main goals in the positioning of a morbidly obese patient in preparation for bariatric surgery are: safe transfer to the operating room table, neutral positioning of the major joints and extremities, avoidance of pressure injuries to skin or nerves, accessibility of the operative field by the surgical team, and security of the patient on the table [10, 11]. Due to anatomical considerations of some morbidly obese persons, standard fundamental patient positioning principles with attention to detail as well as some creativity will be needed to achieve these goals.

The patient is brought to the operating room by stretcher. We have found that lateral transfer devices which utilize hover technology (Hovermatt, HoverTech International) enable the team to move the patient to the operating table and back to the transport stretcher or bed in a secure and comfortable manner. It requires at least two staff members, one on each side of the patient with minimal lifting or pulling force. This device has decreased patient and staff injuries (Fig. 1).

During surgery, we use a supine position with legs together and arms abducted. The patient is positioned and secured at the waist with table straps. The patient is also secured at the legs with tape to keep the knees from flexing apart while in steep reverse Trendelenburg position. The patient's weight should be evenly distributed on the table without parts of the torso or limbs hanging over the side. Side rail extensions can be used to augment the width of the table.

S.A. Brethauer et al. (eds.), *Minimally Invasive Bariatric Surgery*,
DOI 10.1007/978-1-4939-1637-5_9, © Springer Science+Business Media New York 2015

Fig. 1. Use of lateral transfer device to move patient on and off operating table.

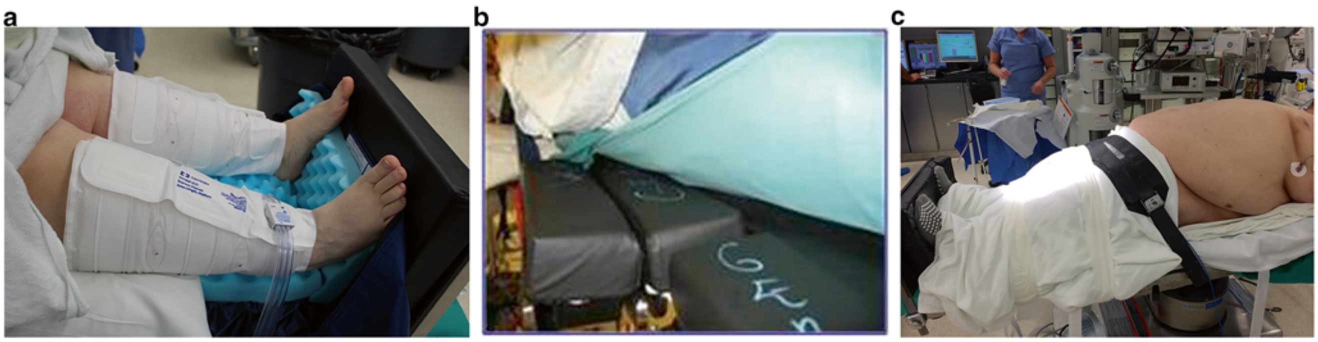

Fig. 2. Patient positioning and application of sequential compression device (**a**). Padded bed extensions should be used for larger patients (**b**). Inspect for areas of significant pressure, circulatory compromise, neutral positioning of extremities, and patient security to table prior to prepping and draping the abdomen (**c**).

Pneumatic compression devices that accommodate the super-obese patient are placed on the patient prior to induction of anesthesia [12].

After the induction of general anesthesia and endotracheal intubation, a urinary catheter is inserted (often requiring two staff members, one for retraction of skin folds and one for insertion), and a bovie grounding pad is placed usually on the anterior thigh. A foot board is placed on the table so the feet will have a secure base to rest when the patient is in extreme reverse Trendelenburg position.

The surgeon stands on the patient's right side along with the scrub nurse; the first assistant and the camera operator are on the patient's left side. The arms may be left out if adequate room is available or one or both may be tucked. Occasionally, when tucking an arm, a metal or plastic limb holder (sled) may be required to secure the arm at the side. This approach also serves to protect the arm.

The base of a stationary retractor-holding device may be attached to the table at this time. Care must be taken that it does not come in direct contact with the patient's skin to avoid pressure injury or electrocautery conduction.

Prior to prepping and draping the patient, a "final check" is important to be sure that all pressure points are avoided, especially along the side, arms, hands, head, and feet. Sequential compression devices should be placed and turned on (Fig. 2a). Table attachments must be padded appropriately to avoid pressure or nerve injuries (Fig. 2b). Security of the patient on the table and neutrality of joint positioning of the extremities are also confirmed again (Fig. 2c). Of special note is to be certain there is no undue pressure on the gluteal area. A rare complication of rhabdomyolysis has been reported, especially with patients with a BMI 60 or greater. Consequences of rhabdomyolysis include renal failure and death [13, 14]. Heating blankets are helpful in preventing hypothermia related to heat loss from evaporation and continuous insufflation, particularly during operations of long duration.

After prepping and draping the abdomen, setting up the equipment on the field, and assembling the OR team, the working field will appear as depicted in Fig. 3. Some surgeons prefer the "French" or "between the legs" positioning in which the patient's legs are abducted and the surgeon stands

FIG. 3. The operating team in their places. Primary surgeon is to the patient's right. First assistant is across from the primary surgeon. Second assistant and scrub nurse are at the foot of the bed.

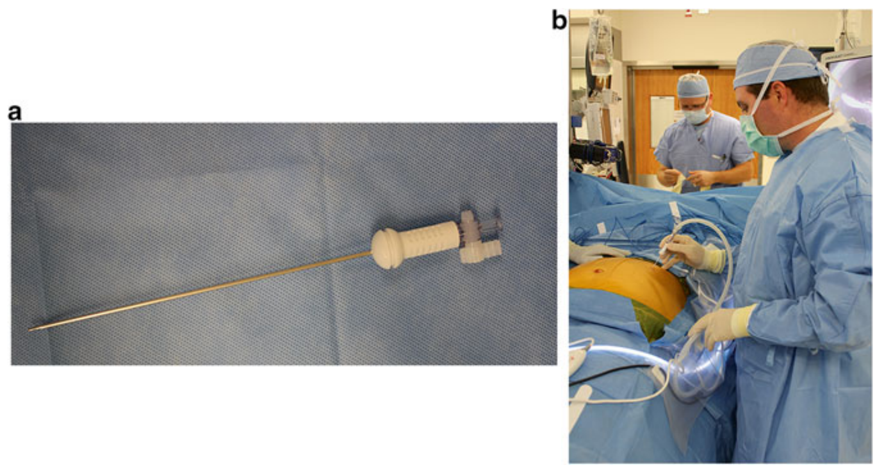

FIG. 4. Standard and long Veress needles.

between them with assistants and OR technician flanking him/her. This is described in other chapters. A limitation with this approach is that there may be a little space between the legs due to the girth of the thighs or of the surgeon.

## Laparoscopic Access

### *The Veress Needle Approach*

We utilize a Veress needle to establish a pneumoperitoneum in the obese patient because it is technically very difficult to perform an open cutdown (Hasson) technique. A long-length Veress needle of 150 mm (Autosuture, Division of Tyco Healthcare) (Fig. 4a, b) is inserted using a subcostal incision in the left upper quadrant. 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 $CO_2$ gas into the abdominal cavity. Correct position of the Veress needle after it has passed through the abdominal wall can be verified by methods such as the water drop test or by assessing $CO_2$ pressures and flow. In obese patients, opening intra-abdominal pressures may be high (up to 10–12 cm of $H_2O$).

### *Insertion of Trocars*

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 without causing excessive disruption of the abdominal fascia. We currently use a

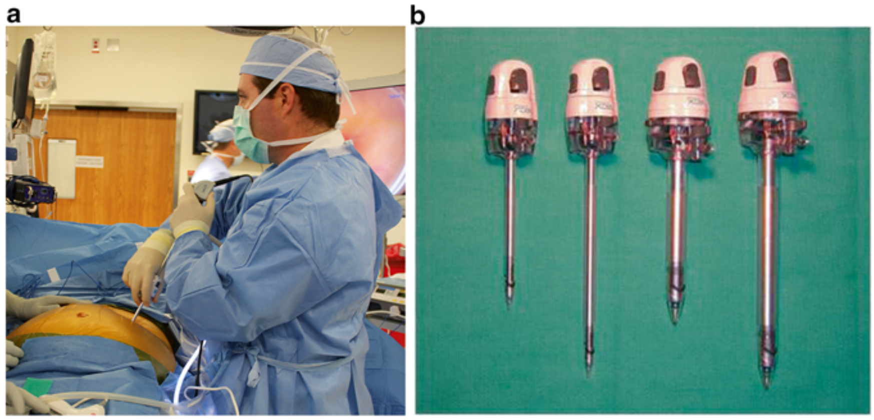

FIG. 5. (**a**) A 5-mm optical viewing trocar can be used to obtain direct access to the peritoneal cavity without pneumoperitoneum. The distinct layers of subcutaneous fat, fascia, muscle, preperitoneal fat, and the peritoneum are identified as the trocar passes through them (Endopath Xcel, Ethicon Endosurgery, Cincinnati, OH). (**b**) 5- and 12-mm trocars (100 and 150 cm lengths) (Endopath Xcel, Ethicon Endosurgery, Cincinnati, OH). These clear-tipped bladeless trocars can also be used for optical entry into the peritoneal cavity.

5-mm optical viewing trocar (Xcel, Ethicon Endosurgery, Cincinnati, OH) for initial access to the peritoneal cavity. The 5-mm scope is placed into the trocar after the camera is white balanced. The focus is adjusted on the end of the clear trocar tip. The trocar is placed through a 5-mm incision and the fatty, fascial, and muscular layers of the abdominal wall are directly visualized as the trocar passes through them (Fig. 5a). After the tip of the trocar passes through the preperitoneal fat and the peritoneum, the camera and obturator are removed, and the insufflations tubing is attached. Once adequate pneumoperitoneum is established, the remaining trocars are placed under direct laparoscopic vision. Trocars with 100-mm shafts are usually sufficient, but occasionally, extra-long trocars (150 mm) are required for the patient with an excessively thick abdominal wall (Fig. 5b).

After the insertion of the first trocar, a standard 25-gauge spinal needle can be helpful in locating the precise intra-abdominal location for the placement of additional trocars and providing preemptive analgesia with injection of local anesthetic (Fig. 6).

FIG. 6. Spinal needle placed through abdominal wall to help with port positioning. Local anesthetic is injected into the preperitoneal space under laparoscopic visualization prior to port placement.

## *Insufflator*

In laparoscopic surgery, exposure depends upon insufflation of the peritoneal cavity with $CO_2$ to create a pneumoperitoneum. The insufflator monitors the current intra-abdominal pressure and regulates the flow of $CO_2$ from a pressurized reservoir. A desired intra-abdominal pressure is selected and the flow of gas is automatically regulated. The front LCD screen on the insufflator displays the current intra-abdominal pressure, the preset desired pressure, the current rate of $CO_2$ insufflation, the volume of gas infused, and the residual volume in the $CO_2$ tank. Alarms signal high intra-abdominal pressures, excessive gas leak, and low gas level in the $CO_2$ tank. The rate of insufflation can be adjusted from 1 up to 40 L/min and higher flows are typically used. Our standard preset intra-abdominal pressure is 15-mmHg, but we will intermittently use higher pressure (16–18-mmHg) when better exposure is needed or a lower pressure when instrument length is insufficient or the patient isn't physiologically tolerating higher pressures.

Gas leakage can be very troublesome during laparoscopic bariatric procedures especially if a circular stapling technique is in use. A high flow insufflator (40 L/min) is highly recommended to accommodate for gas leakage from small air leaks at port sites, instrument exchanges, and during intra-abdominal suctioning (Fig. 7).

## Visualization

Technology which provides the surgeon with a clear view of the operating field has been critical to the development of advanced laparoscopic procedures. Safely and effective performance of a laparoscopic procedure is dependent upon the quality of visualization. Since the surgeon is not able to touch and palpate, a clear crisp bright image is mandatory at all times. There are no "blind" maneuvers in laparoscopy. Components that create and maintain the image have steadily improved.

There are several conditions specific to laparoscopic bariatric surgery that make obtaining an adequate image challenging. In the morbidly obese patient, the voluminous abdominal cavity expanded by the pneumoperitoneum requires more light for visualization than that required for the non-obese patient. Copious adipose tissue covering mesentery, omentum, and viscera may crowd the view and obscure the landmarks of interest. Instrumentation that will allow viewing around or over or under such objects is necessary. Additional instruments are needed to enable adequate exposure.

## *Laparoscope*

The laparoscope uses the Hopkins rod lens system which consists of a series of quartz rod lenses and a fiber bundle surrounding the rod lens for transmission of light [5, 6]. The eyepiece of the laparoscope is connected to the camera by means of a coupler adapter.


Fig. 7. High flow insufflator. Stryker.

Standard laparoscopes have a length of approximately 32 cm and have diameters that range from 2 to 10 mm. Scopes are angled to various degrees, most commonly from a 0° to 45° orientation. Angled scopes provide more flexibility in viewing internal structures and provide access to areas that would be "blind" to 0° scopes. However, they require some additional skill to operate and the angling decreases light transmission slightly.

For our bariatric procedures, we have a variety of laparoscopes available: 30° and 45° with 5 and 10 mm diameters (Fig. 8a, b) (Stryker Endoscopy). Typically we use a 5-mm 45° scope, initially at the 5-mm entrance site, to visualize the other port placements. A 10-mm diameter, 45° angled laparoscope is used for the rest of the procedure as we have found that it provides the best field of view especially in extremely obese patients. An extra-long laparoscope (45–50 cm) is sometimes necessary and very helpful in super-obese patients. 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. Extra-long scopes are also helpful during the use of any type of scope-holding instrument or robot which takes up functional scope length in establishing the connection.

An important scope accessory is a stainless steel scope warmer canister filled with hot sterile water for cleaning the scope and preventing lens fogging (Applied Medical) (Fig. 9).

## *Video Camera*

Miniature lightweight cameras, weighing as little as 40 g, are now in use providing excellent resolution and color rendition which are essential for laparoscopic bariatric surgery. The miniature camera uses an LCD chip containing approximately 300,000 light-sensitive pixels on the chip surface measuring only about ½ inch on the diagonal. Three-chip cameras have become the industry standard; each chip provides one of the three primary colors: red, green, and blue.

Fig. 8. Laparoscopes: angled 45° (*inset*) and 30°, 5 and 10 mm diameters and standard and long lengths.

Fig. 9. Laparoscope warmer decreases fogging (Applied Medical). The laparoscope warmer should be attached to the surgical drapes for easy access.

There are a number of options for this type of equipment including the Stryker Endoscopy® 3-chip camera (Fig. 10), which has 1920 × 1080p resolution.

A C-mount endoscopic coupler permits rapid attachment of the camera to whichever scope is in use. The coupler also has a focusing knob. The camera head control buttons enable the user to adjust gain, digital zoom, and printer modalities. The camera is connected to the power supply and electronic control by cable. The system is further enhanced using voice activation technology to control adjustments of white balance, gain, shutter, and digital enhancement.

## Light Source and Light Cable

Laparoscopy requires a high intensity light source for an adequate video image of the operative field. A xenon or metal halide bulb with a life span of about 250 h is typically used because these provide the desirable color temperature in the range of daylight (5,500 k). An automatic adjustment as well as a manual override is available (to over- or under-illuminate if needed). 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. The light is transmitted from the bulb to the scope through a fiber optic light cable which should be replaced if more than 15 % broken fibers are noted. A full benefit of the light source depends on proper connection of the cable to the light source and the telescope. The light cables should not be autoclaved and must be sterilized in either ethylene-oxide or glutaraldehyde.


Fig. 10. Three-chip video camera (Stryker).

## Video Monitor

The video monitor providing the laparoscopic image should be of the highest quality. There are many configurations and products available. We currently utilize a flat panel digital design mounted on an overhead boom. The boom facing the operating surgeon (right side) has two screens so that endoscopic and laparoscopic images can be simultaneously displayed (Fig. 11).

## Operating Tables

The operating table must provide maximum tilt and rotation and allow gravity to shift abdominal structures to allow full visualization. For bariatric procedures, the operating table must have the capacity to support super-obese patients up to the maximum weight with which the surgeon is comfortable. Many standard general purpose OR tables have weight limits of about 227 kg which are adequate for 95 % or more of the cases in most bariatric practices. It is advisable to check with the manufacturer regarding the specific weight limitations of the specific operating table model and vintage available to you. Bariatric practices which include patients with weights

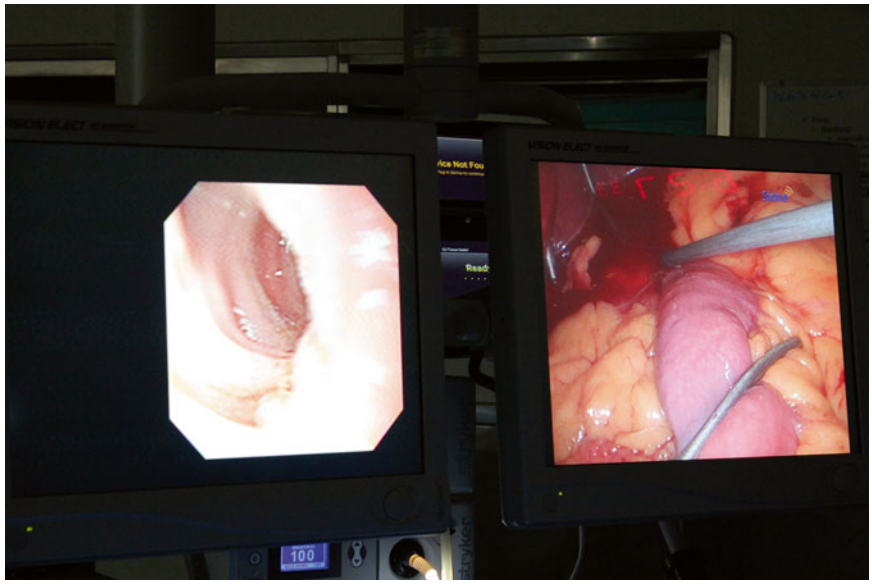

Fig. 11. Dual monitors facing the operation surgeon allow for simultaneous laparoscopic and endoscopic images which is particularly useful when performing an intraoperative leak test.

greater than 227 kg require access to an operating room table that can accommodate them safely. Many general purpose tables have been modified to accommodate the greater weight with some loss in the angle of tilt and Trendelenburg/reverse Trendelenburg in the interest of assuring stability. This trade-off has become less necessary due to improving weight ratings and articulation in recent operating table technology. Important bed accessories include side extenders, footboards, straps, and padding to safely secure the patient to the bed and prevent injuries.

Fig. 12. Hand instrumentation: standard and long-length grasper. Traumatic graspers are shown on top and atraumatic graspers for use on the small bowel are shown at the bottom (Snowden-Pencer).

## Hand Instrumentation

### *Grasping Instruments*

Hand instruments are available with many different features and preferences. Our preference has been for "in-line" design (as opposed to a pistol grip design and for instruments where ratcheted handle control can be turned on and off along with finger-controlled rotation of the shaft. For the super-obese patient, instrument length is an important factor. Many instruments are available in standard (32 cm) and extra-long lengths (45 cm) (Fig. 12). For laparoscopic bariatric surgery, atraumatic and traumatic grasping hand instruments are needed. An atraumatic grasper is required to manipulate bowel without causing injury. We use a 5-mm atraumatic grasper "duckbill" (Snowden-Pencer) that features fine teeth and a broad tip design which provide a secure grip without traumatizing the tissue. The 5-mm "alligator" grasper (Snowden-Pencer) features tissue channels and long contoured jaws to provide secure grasping ability. It is excellent for holding the stomach and omentum.

### *Retracting Instruments and Instrument Stabilizers*

Anterior and cephalad retraction of the left lobe of the liver is required to expose the gastroesophageal junction. A number of devices work effectively for this purpose; they must be strong enough to retract large, heavy livers without trauma to the organ tissue. The 5-mm diameter Endoflex Retractor (Snowden-Pencer) is effective; it assumes a triangular configuration when tightened (Fig. 13). The retractor is usually held in a stationary position by means of an external holding device attached to the OR table such as the Fast Clamp System (Snowden-Pencer) (Fig. 14). For extremely large livers, a modification of the Endoflex liver retractor called the "Big D" type is available to help stabilize and provide exposure. Occasionally in extremely large patients, it has been necessary to use two liver retractors. In these cases, the Endoflex can be used to hold up the right and medial left lobe of the liver and a Nathanson retractor placed

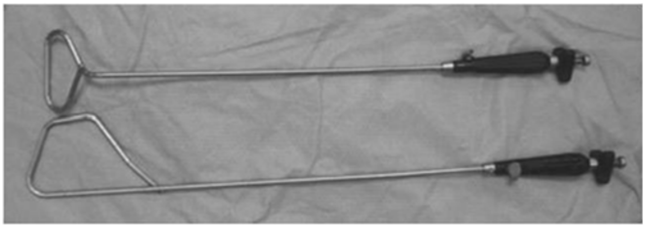

Fig. 13. 5-mm, flexible liver retractors: standard and "Big D" type.

Fig. 14. Table-mounted instrument holding device used for liver retractor.

Fig. 15. Suction irrigator: standard and long-length tips (Stryker Endoscopy).

through a subxiphoid incision can be added to lift the left lateral segment upward to provide adequate working space around the upper stomach.

## *Suction Irrigation Devices*

A suction/irrigation instrument clears the surgical field of pooling blood and keeps the abdominal cavity free from smoke and vapor. The StrykeFlow 2 (Stryker Endoscopy) is a 5-mm disposable instrument with reusable probe tips which performs the function of both suction and irrigation through a single common channel. The probe tips come in a standard (32 cm) working length as well as an extra-long (45 cm) working length which is crucial for the super-obese patient (Fig. 15). A larger diameter, 10-mm, suction tip is available and is useful when suctioning larger clots or thicker fluid from the abdominal cavity.

Fig. 16. Endo Stitch™ (US Surgical) and in-line laparoscopic needle driver.

## *Suturing Instruments*

Standard laparoscopic needle drivers and sutures and suturing devices such as the Endo Stitch are suitable for laparoscopic bariatric surgery. We utilize the Endo Stitch™ (Covidien) to facilitate endoscopic suturing. The 10-mm diameter, disposable Endo Stitch™ has a double-pointed shuttle needle with the thread mounted at the center of the needle (Fig. 16). Double action jaws allow the needle to be passed back and forth by squeezing the handle and maneuvering the toggle switch eliminating regrasping and repositioning the needle. The Endo Stitch is compatible with a variety of absorbable (i.e., Polysorb™) and nonabsorbable sutures (i.e., Surgidek™). The Endo Stitch is used during the RYGBP for approximating the bowel for the enteroenterostomy and for oversewing the gastrojejunostomy (two-layer closures).

## *Atraumatic Bowel Clamps*

The laparoscopic bowel clamp is a 10-mm diameter instrument that has long jaws with serrations that provide a secure atraumatic grip. It has a ratcheted handle for locking the jaws. It is available in a straight and curved jaw and is used to clamp the small bowel (Roux-limb) before performing endoscopy to prevent distal insufflation of the small bowel (Fig. 17).

## *Specialized Grasping Instruments*

The fenestrated articulating grasper instrument (Snowden-Pencer) has an articulating tip which forms a gentle curve at about a 45° angle when the handles are closed (Fig. 18). The instrument can be used to help in the dissection and identification of the angle of His and the development of a passage as a guide for the stapler to use as a guide. In the retrocolic retrogastric approach, this instrument is very useful in passing the Roux-limb through the retro colic and retro gastric tunnel up to the gastric pouch before performing the anastomosis.

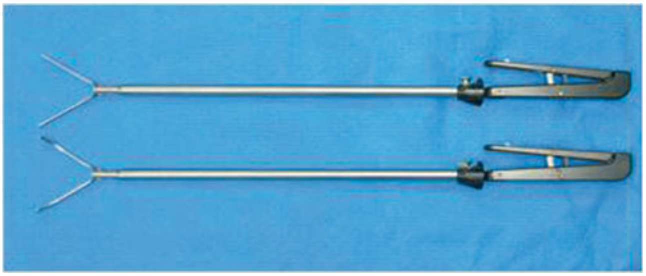

FIG. 17. Atraumatic bowel clamps: straight and curved tips.

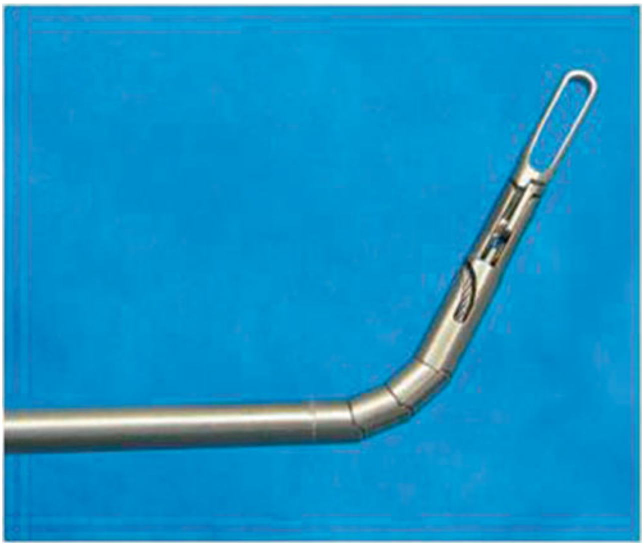

FIG. 18. Fenestrated articulating grasper helps with dissection at the angle of His.

## *Suture Passer for Trocar Site Closure*

To prevent trocar site hernias, we close all ports 10 mm or greater with a strong absorbable suture such. There are a number of devices available for passing sutures through the abdominal wall fascia. We use the Carter-Thomason CloseSure System (Inlet Medical Inc.) (Fig. 19) which facilitates full-thickness closure. It is a disposable device that comes with guides (pilots) of varying diameters and in a standard and long length to accommodate very thick abdominal walls. The angle projected by the guide allows for an adequate purchase of fascial tissue. The suture passer can also be used without the guide to ligate abdominal wall bleeders and to repair small umbilical, ventral, and incisional hernias noted at the time of laparoscopic bariatric surgery.

## *Other Hand Instruments*

We use disposable endoscopic shears for cutting tissues when a laparoscopic scissor is needed. These shears are 5 mm with a rotating shaft and a 16-mm curved blade. A reliably sharp blade is one of its major advantages.

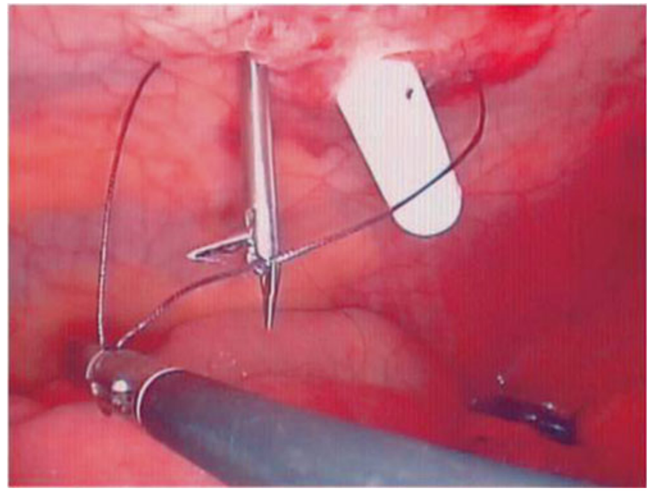

FIG. 19. Suture passer device facilitates closure of trocar sites and can be used to close small ventral hernias.

In the event of bleeding where a clip is needed, we use the multiload disposable clip applier with titanium clips. It is available in 5-mm and 10-mm diameter sizes. Compared to single-clip units, the multiload units considerably increase the speed and efficiency with which hemostasis can be accomplished.

# Energy Sources for Transecting and Coagulation

In general laparoscopy, dividing tissues and achieving hemostasis, can be obtained with standard unipolar or bipolar electrocautery. Ultrasonic transaction and coagulation may be preferable for extremely vascular tissue such as mesentery. These devises are ultrasonically activated instruments that provide excellent tissue transection and hemostasis while eliminating the problem of electrical arc injury associated with unipolar electrocautery. The instruments have a stationary jaw and blade that vibrate at a frequency of between 55,000 and 60,000 Hz. The mechanical action of a stationary jaw and blade that vibrate at that frequency denatures collagen. This allows the formation of a coagulant which instantly seals small blood vessels. Minimal heat is generated in the tissue through friction; the lateral spread of thermal energy is 1–2 mm.

Ultrasonic instruments are available in 5 mm diameter and come in short (15.7-cm working length) and long lengths (45-cm working length) with finger-controlled rotating shaft (Fig. 20). They are activated by foot switch or by a finger-controlled button, which adjusts the blade frequency and the speed of cutting through tissue and the degree of hemostasis. These instruments produce water vapor that can obscure vision requiring intermittent evacuation of the vapor.

FIG. 20. Ultrasonic dissecting shears with hand controls (*inset*) (Ethicon Endosurgery, Cincinnati, OH).

During LRYGBP, we employ ultrasonic dissection liberally, especially for dissection along the lesser and greater curves of the stomach for gastric pouch creation and for making enterotomies in the stomach and small intestine, for stapler insertion, and for creating the division of the omentum in the antecolic approach.

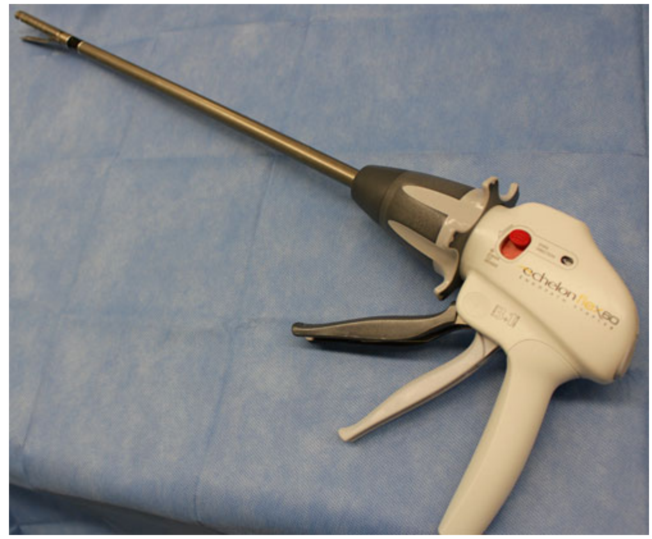


FIG. 21. Laparoscopic linear cutting stapler (Echelon 60, Ethicon Endosurgery, Cincinnati, OH).

FIG. 22. An EEA stapler used to create a circular stapled gastrojejunostomy (DST Series™ EEA Stapler™. All rights reserved. Used with permission of Covidien).

# Staplers: Linear and Circular

## *Linear Staplers*

The laparoscopic articulating linear stapler has allowed the techniques in bariatric surgery to be performed efficiently and safely. It can be used to transect hollow viscera, to divide highly vascular tissue such as mesentery, and to create an anastomosis. We use the Endopath Echelon 60 disposable stapler (Ethicon Endosurgery, Cincinnati, OH) that applies two triple rows of staples before dividing the tissue with an advancing knife (Fig. 21). The stapler can be reloaded for use with tissues of varying thickness including a white load (2.5 mm), blue load (3.5 mm), green load (4.1 mm), and a gold cartridge that is used primarily for thicker tissue compressible to 1.8 mm. The stapler fits down a 12-mm trocar. We use the blue load to create the gastric pouch and gastrojejunostomy and the white load to divide the small bowel and mesentery and to create the jejunojejunostomy. The green load is useful for revisional bariatric surgery or in cases where the tissue is unusually thick or indurated.

## *Circular Staplers*

A circular endoluminal stapler can be used to create the gastrojejunal anastomosis during laparoscopic RYGB. The Covidien EEA circular stapler (Covidien, Mansfield, MA) forms two rows of circular staples with an inner circular knife to create a circular anastomosis (Fig. 22). The stapler (21 or 25 mm) is typically inserted through an enlarged port site in the left upper quadrant. The anvil can be placed into the pouch using transoral or transgastric techniques. When using the transoral technique with the EEA, the anvil is attached to an orogastric tube which is used to pull the anvil into place through a gastrotomy in the pouch. The anvil rotates parallel with the shaft to facilitate transoral passage and removal.

# Flexible Endoscopy

Flexible endoscopy serves several useful functions during the course of the LRYGB. A two-camera system, one each for the laparoscope and endoscope, facilitates this approach.

Both camera systems are fed through a digital mixer producing the two images on the same monitor as a "picture-in-picture" format or on adjacent screens allowing both the surgeon and the endoscopist to visualize both activities simultaneously.

At the completion of the LRYGB, a flexible endoscope is useful to examine the gastrojejunal anastomosis (Olympus GIF XQ40, Exerna CLV-160). The scope is inserted prior to completion of the closure of the gastrojejunostomy common opening when using the linear stapler anastomosis technique. This maneuver serves to stent the opening and to help gauge the diameter of the anastomosis. After the anastomosis is completed, intraluminal insufflation of the submerged anastomosis is used to inspect for air leaks. The endoscope is further useful in gauging the size and patency of the anastomosis and to examine for bleeding and viability of the gastric pouch.

## Voice Activation Technology

A major new innovation in operating room procedure has been the introduction of voice control technology (Intuitive Surgical and Stryker Endoscopy). This technology provides a centralized and simplified interface for a surgeon to medical devices through voice commands. The system requires a computer control unit associated with other accessory units which are networked with multiple devices. The surgeon, who wears a wireless headphone/microphone transmitter (ATW-T75 Transmitter) (Audio-Techniques/Stryker Endoscopy) is able to control and operate the devices throughout the procedure saving time and dependency on human intermediaries. This technology allows the surgeon to voice control the camera, light source, insufflator, video/image recorder, printer, telephone, operating table, and operating room lights.

Voice-activated control is especially appropriate to bariatric laparoscopic procedures because of the multiple adjustments and readjustments of multiple complicated medical devices during the course of the operation. Safety and quality of patient care appear to be enhanced by returning focus from the technology to the patient [15].

## Operating Room Layout

The organization and layout of the operating room are as crucial to efficient surgery as the equipment used. There must be an adequate space for transfer of morbidly obese patients to and from the operating table must be allowed for, including the number of personnel needed for the transfer. Vital equipment must be in easy reach without obstructing movement of the operating staff. Many teams use mobile towers to house equipment.

Over the last 5 years, operating rooms specialized for minimally invasive procedures have made significant strides. These operating rooms employ boom technology for efficient space utilization and integrate electrical, fiber optic, computer, communication, digital, video, voice activation, and piped gas technologies. These have been called "fully integrated" or "intelligent" operating rooms. Efficient design of these operating rooms will likely improve overall operating efficiency and safety [16]. The advantages in efficiency and safety appear to justify the cost as these complex procedures become increasingly frequent in many medical centers.

## Robotics

### *Robotic Assistance*

Because of the complex scope maneuvering in the upper and mid-abdomen, surgeons must allow for a learning curve. Preliminary studies have shown that the benefit of the robotic arm is improved efficiency of motion and improved ergonomics for the surgeon at the console [17–19].

The da Vinci Surgical System is an FDA-approved laparoscopic surgical robot that is used by many surgical specialties (Fig. 23). The system is capable of performing surgical cutting, dissecting, suturing, tissue retraction as well as providing visualization. It provides improved dexterity, greater surgical precision, improved minimal access, increased range of motion due to the articulation of the arm *wrist* joints, three-dimensional image drawing, and reproducibility. A number of clinical investigators have been involved with trial of this robot in laparoscopic bariatric surgery [20, 21]. These early studies note that laparoscopic bariatric surgery using the da Vinci robot is safe and feasible but will require further investigation. Currently there is no clear outcome advantage demonstrated with the use of the robot in bariatric surgery, though many groups throughout the country use it routinely and attest to its value in performing these complex operations.

Fig. 23. Robot docked during gastric bypass procedure.

## Appendix 1: Laparoscopic Roux-en-Y Gastric Bypass Reusable Instrumentation

| Routine set | | | |
|---|---|---|---|
| Item name | Item # | Company | # on set |
| Crocodile grasper (traumatic) (32 cm) | 90-7064 | Snowden-Pencer | 2 |
| Crocodile grasper (traumatic) (45 cm) | 90-7264 | Snowden-Pencer | 2 |
| Diamond jaw atraumatic dissector (32 cm) | 90-7041 | Snowden-Pencer | 3 |
| Diamond jaw atraumatic dissector (45 cm) | 90-7271 | Snowden-Pencer | 3 |
| Endo-right angle | 90-7031 | Snowden-Pencer | 1 |
| Right angle electrode | 89-7200 | Snowden-Pencer | 1 |
| Tapered curved dissector | 90-7033 | Snowden-Pencer | 1 |
| Hasson "S" retractor narrow | 88-9113 | Snowden-Pencer | 1 set |
| Hasson "S" retractor wide | 88-9114 | Snowden-Pencer | 1 set |
| Monopolar cord | 88-9199 | Snowden-Pencer | 1 |
| Instrument tray | 88-6275 | Snowden-Pencer | 1 |
| *Scopes* | | | |
| 30° 10 mm | 502-357-030 | Stryker | 1 |
| 45° 10 mm | 502-357-045 | Stryker | 1 |
| 30° 5 mm | 502-585-030 | Stryker | 1 |
| 45° 5 mm | 502-585-045 | Stryker | 1 |
| 45° 10 mm extra long | 502-657-045 | Stryker | 1 |
| *Scope warmer* | | | |
| Scope warmer canister | C3001 | Applied Medical | 1 |
| Base for scope warmer | C3002 | Applied Medical | 1 |
| Seals for scope warmer | C3101 | Applied Medical | 1 |
| *Table-mounted instrument holding device* | | | |
| Fast Clamp System | 89-8950 | Snowden-Pencer | 1 |
| *Liver retractors* | | | |
| 80-mm triangular liver retractor 5 mm | 89-6110 | Snowden-Pencer | 1 |
| "Big D" diamond flex liver retractor | 89-8216 | Snowden-Pencer | 1 |
| *Bowel instruments* | | | |
| DeBakey clamp, straight, 10 mm | 90-7052 | Snowden-Pencer | 1 |
| DeBakey clamp, curved, 10 mm | 90-7054 | Snowden-Pencer | 1 |
| *Specials* | | | |
| Diamond flex articulating atraumatic grasper 40° | 89-0509 | Snowden-Pencer | 1 |
| Bougie 34-French or olympus endoscope bowel grasper | 33331C | Storz | 1 |
| Diamond-jaw needle holder | 90-7016 | Snowden-Pencer | 1 |
| O'Brien LAP-BAND placer | | Automated Medical Products Corp. | 1 |
| StrykeProbe and tips, 5 mm (32 and 45 cm) | | Stryker Endoscopy | 1 |

## References


1. Ramanathan RC, Gourash W, Ikramuddin S, Schauer PR. Equipment and instrumentation for laparoscopic bariatric surgery. In: Deitel M, Cowan GSM, editors. Update: surgical for the morbidly obese. Toronto: FD-Communications; 2000. p. 277–90.
2. Carbonell AM, Joels CS, Sing RF, Heniford BT. Laparoscopic gastric bypass surgery: Equipment and necessary tools. J Laparoendosc Adv Surg Tech. 2003;13(4):241–5.
3. Schauer PR, Ikramuddin S, Gourash W. Laparoscopic Roux-en-Y gastric bypass: a case report at one-year follow-up. J Laparoendosc Adv Surg Tech. 1999;9:101–6.
4. Schauer PR, Ikramuddin S, Gourash W, Ramanathan R, Luketich JD. Outcomes of laparoscopic Roux-en-Y gastric bypass for morbid obesity. Ann Surg. 2000;232(4):515–29.
5. Coller JA, Murray JJ. Equipment. In: Ballantyne GH, Leahy PL, Modlin IL, editors. Laparoscopic surgery. Philadelphia: WB Saunders; 1994. p. 3–14.
6. Spencer MP, Madoff RD. Imaging. In: Ballantyne GH, Leahy PL, Modlin IL, editors. Laparoscopic surgery. Philadelphia: WB Saunders; 1994. p. 15–21.
7. Berci G, Paz-Partlow M. Videoendoscopic technology. In: Toouli J, Gossot D, Hunter JG, editors. Endosurgery. New York: Churchill Livingstone; 1996. p. 33–9.

8. Prescher T. Video imaging. In: Toouli J, Gossot D, Hunter JG, editors. Endosurgery. New York: Churchill Livingstone; 1996. p. 41–54.
9. Melzer A. Endoscopic instruments—conventional and intelligent. In: Toouli J, Gossot D, Hunter JG, editors. Endosurgery. New York: Churchill Livingstone; 1996. p. 69–95.
10. AORN Bariatric Surgery Guideline. AORN J. 2004;79(5):1026–52.
11. Schauer PR, Gourash W, Hamad G, Ikramuddin S. Operating set up and patient positioning for laparoscopic gastric bypass. SAGES Manual. Springer (in press).
12. Nguyen NT, Cronan M, Braley S, Rivers R, Wolfe BM. Duplex ultrasound assessment of femoral venous flow during laparoscopic and open gastric bypass. Surg Endosc. 2003;17:285–90.
13. Collier B, Goreja MA, Duke BE. Postoperative rhabdomyolysis with bariatric surgery. Obes Surg. 2003;13(6):941–3.
14. Mognol P, Vignes S, Chosidow D, Marmuse JP. Rhabdomyolysis after laparoscopic bariatric surgery. Obes Surg. 2004;14:91–4.
15. Luketich JD, Fernando HC, Buenaventura PO, Christie NA, Grondin SC, Schauer PR. Results of a randomized trial of HERNES-assisted versus non-HERMES-assisted laparoscopic antireflux surgery. Surg Endosc. 2002;16(9):1264–6.
16. Kenyon TAG, Urbach DR, Speer JB, Waterman-Hukari B, Foraker GF, Hansen PD, Swanstrom LL. Dedicated minimally invasive surgery suites increase operating room efficiency. Surg Endosc. 2001;15:1140–3.
17. Kavoussi LR, Moore RG, Adams JB, et al. Comparison of robotic versus human laparoscopic camera control. J Urol. 1995;154:2131–6.
18. Omote K, Feussner H, Ungeheuer A, Arbter K, Wei GQ, Siewert JR, Hirzinger G. Seof-guided robotic camera control for laparoscopic surgery compared with human camera control. Am J Surg. 1999;177:321–4.
19. Dunlap KD, Wanzer L. Is the robotic arm a cost effective tool? AORN J. 1998;68:265–72.
20. Nguyen NT, Hinojosa MW, Finley D, Stevens M, Paya M. Application of robotics in general surgery: initial experience. Am Surg. 2004;70(10):914–7.
21. Jacobsen G, Berger R, Horgan S. The role of robotic surgery in morbid obesity. J Laparoendosc Adv Surg Tech A. 2003;13(4):279–83.