The use of laparoscopy for colorectal surgery remains controversial (1). Laparoscopic colorectal surgery is notably different from all other laparoscopic procedures for several reasons: first, all of these other procedures are performed in a relatively fixed intra-abdominal location. As such, there is virtually no need for intraoperative repositioning of instruments, ports, and personnel. Second, the other operations include either no vascular division (herniopthy or fundoplication) or division of a small single vessel (cholecystectomy). Thus, vascular division can be rapidly, safely, and inexpensively undertaken. Conversely, the colonic mesentry includes numerous large vessels. Thus vascular control requires considerably more time and, quite often, much more cost than do other procedures. Third, in none of these procedures is an anastomosis fashioned. The anastomosis is the most critical portion of any colorectal operation. Fourth, the other procedures require either the removal of a small organ or no specimen retrieval at all. Removal of a properly resected segment of colon with its attached mesentery requires either a small incision or large port.

Potential advantages associated with laparoscopic colorectal surgery as compared to laparotomy are less intraoperative trauma, less postoperative pain, shorter hospitalization, and reduced disability. (2-6). Additional attributes are improved cosmesis and a reduction in postoperative adhesions (7-11). However, further investigation with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings.

The laparoscopic approach can be used for resection of diverticular disease, either as two-staged Hartmann’s procedure or a one-staged resection and primary anastomosis. The preoperative management of these patients should be exactly as that for laparotomy. For an elective resection, the patient preoperatively receives a mechanical bowel preparation and is premedicated with an adequate bowel preparation and is premedicated with an adequate bowel preparation.

Preoperative preparation

The laparoscopic approach can be used for resection of diverticular disease, either as two-staged Hartmann’s procedure or a one-staged resection and primary anastomosis. The preoperative management of these patients should be exactly as that for laparotomy. For an elective resection, the patient preoperatively receives a mechanical bowel preparation and is premedicated with an adequate bowel preparation.

The laparoscopic approach can be used for resection of diverticular disease, either as two-staged Hartmann’s procedure or a one-staged resection and primary anastomosis. The preoperative management of these patients should be exactly as that for laparotomy. For an elective resection, the patient preoperatively receives a mechanical bowel preparation and is premedicated with an adequate bowel preparation.

As such, there is virtually no need for intraoperative repositioning of instruments, ports, and personnel. Second, the other operations include either no vascular division (herniopthy or fundoplication) or division of a small single vessel (cholecystectomy). Thus, vascular division can be rapidly, safely, and inexpensively undertaken. Conversely, the colonic mesentry includes numerous large vessels. Thus vascular control requires considerably more time and, quite often, much more cost than do other procedures. Third, in none of these procedures is an anastomosis fashioned. The anastomosis is the most critical portion of any colorectal operation. Fourth, the other procedures require either the removal of a small organ or no specimen retrieval at all. Removal of a properly resected segment of colon with its attached mesentery requires either a small incision or large port.

Potential advantages associated with laparoscopic colorectal surgery as compared to laparotomy are less intraoperative trauma, less postoperative pain, shorter hospitalization, and reduced disability. (2-6). Additional attributes are improved cosmesis and a reduction in postoperative adhesions (7-11). However, further investigation with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings. Despite the many benefits, there are also some technical disadvantages to the use of laparoscopy. Especially in the hand of the novice, laparoscopic surgery is usually associated with a longer duration of operation, double the cost of equipment, and increased morbidity. Thus, although it is associated with longer follow-up is necessary to definitively prove these findings.
ADVANTAGES OF LAPAROSCOPIC PROCEDURES FOR BENIGN INFLAMMATORY CONDITIONS

Eric G Weiss
Associate Residency Program Director, Director of Surgical Endoscopy, Department of Colorectal Surgery, Cleveland Clinic Florida, USA

The use of laparoscopy for colorectal surgery remains controversial (1). Laparoscopic colorectal surgery is notably different from all other laparoscopic procedures for several reasons: first, all of these other procedures are performed in a relatively fixed intra-abdominal location. As such, there is virtually no need for intraoperative repositioning of instruments, ports, and personnel. Second, the other operations include either no vascular division (hemorrhoidectomy or fundoplication) or division of a small single vessel (cholecystectomy). Thus, vascular division can be rapidly, safely, and inexpensively undertaken. Conversely, the colonic mesentery includes numerous large vessels. Thus vascular control requires considerably more time and, quite often, much more cost than do other procedures. Third, in none of these procedures is an anastomosis fashioned. The anastomosis is the most critical portion of any colorectal operation. Fourth, the other procedures require either the removal of a small organ or no specimen retrieval at all. Removal of a properly resected segment of colon with its attached mesentery requires either a small incision or large port. Potential advantages associated with laparoscopic colorectal surgery as compared to laparotomy are less intraoperative trauma, less postoperative pain, shorter hospitalization, and reduced disability. (2-6). Additional attributes are improved cosmesis and a reduction postoperative pain, shorter hospitalization, and reduced disability. Potential advantages associated with laparoscopic colorectal surgery as compared to laparotomy are less intraoperative trauma, less postoperative pain, shorter hospitalization, and reduced disability. (2-6). Additional attributes are improved cosmesis and a reduction in the overall cost of the procedure (12,13).

There are several publications that have shown potential advantages for laparoscopy, the absence of any large, scientifically valid, externally monitored peer reviewed prospective randomized studies makes it impossible to reach meaningful conclusions. The debate regarding the advisability of laparoscopy for colorectal carcinoma continues. However fewer surgeons now take issue with either laparoscopic palliative resection of malignancies or treatment of benign disorders, as a variety of benign conditions have been safely and effectively treated by laparoscopic and laparoscopic-assisted approaches.

LAPAROSCOPIC RESECTION FOR SIGMOID DIVERTICULAR DISEASE

Preoperative preparation

The laparoscopic approach can be used for resection of diverticular disease, either as two-staged Hartmann's procedure or a one-staged resection and primary anastomosis. The preoperative management of these patients should be exactly as that for laparotomy. For an elective resection, the patient preoperatively receives a mechanical cathartic and both parenteral and oral antibiotic bowel preparations. Even if an anastomosis is planned, the patients should be preoperatively informed about the potential for either a primary anastomosis with a proximal diverting stoma or a resection with stoma and Hartmann's procedure. Sometimes this decision cannot be made until during the time of surgery and is contingent upon the extent of the septic process. This counseling is undertaken regardless of whether the resection of diverticular disease is planned by laparoscopy or laparotomy. All patients are preoperatively visited by an enterostomal therapist and are marked in both the right and the left iliac fossae to prepare for the eventuality of one of these procedures. Another preoperative precaution is the use of bilateral ureteral catheters. Since a phlegmon secondary to diverticular disease can include significant retraction of the ureter into the mass, this maneuver facilitates expeditious and safe identification of the ureter and subsequent vascular control. Once again patients should not be treated differently regardless of whether the resection of diverticular disease is planned by laparoscopy or laparotomy. In both instances, patients undergo intraoperative placement of bilateral ureteral catheters. The catheters are placed after the induction of general endotracheal anesthesia and prior to the incision. They are then removed after the dressing is applied and prior to extubation by the anesthesiologist.

A recent review of our experience with ureteric catheters evaluated the results of ureteric catherization relative to safety and operative time in 67 patients with bilateral ureteric catheters versus 95 patients without them who underwent laparoscopic segmental or right colectomy. Although ureteric catheters added a mean of 11.3 minutes to the surgical procedure, the overall anesthetic time for right hemicolectomy was no longer than that for left hemicolectomy, and only slightly longer than without the use of catheters. The morbidity rate was also quite acceptable. Thus, ureteric catheters may be useful in selective cases of laparoscopic left and right colorectal resections.

Preoperatively, the patients should also be consented for intraoperative transanal endoscopy. This procedure is sometimes useful to definitively identify the rectosigmoid junction to ensure complete removal of the distal sigmoid and anastomosis to the rectum. Lastly, all patients in whom a laparoscopic resection is planned should be informed about and consented for the possibility of a laparotomy. Various authors have estimated the incidence of “conversion” to laparotomy from 5% to over 40%.

Certain other preoperative adjunct studies are quite valuable. Colonoscopy or flexible sigmoidoscopy and air contrast barium enema should be undertaken in elective cases to exclude intraluminal neoplasia. In acute cases, a water-soluble contrast enema will have generally been performed to ensure the diagnosis (14). Although the study does not allow the same mucosal delineation and definitive exclusion of intraluminal neoplasia it should be capable of excluding any large carcino mas. Contingent upon the patient's symptoms, a CAT scan will also be obtained. This study can give some very useful information about any large phlegmonous mass, which would again mitigate toward intraoperative ureteric catheters. In acute cases, an abscess found by CAT scan would generally lead to percutaneous drainage followed by defecovaginoscopy. This sequence permits converting a Hartmann's procedure performed for acute separation, to a semi-elective procedure incorporating a bowel preparation and primary anastomosis.

Operative technique

Thromboembolic deterrent stockings are applied and low-molecular-weight Heparin are administered “on call” to the operating room. The patient is placed in the supine modified lithotomy position in Allen strictures (Allen Medical, Bedford, Heights, OH) and both arms are tucked at the patient's side in order to facilitate movement of personnel and instruments during the operation. Care should be taken to secure the patient to the table as a considerable amount of Trendelenburg and right side tilt will be used during operation. Furthermore, steep anti-Trendelenburg may become necessary during splenic flexure mobilization. The hips should be flexed no more than 15° and the knees to a similar maximum degree, again, to permit maximum mobility of the instruments, particularly in the iliac fossa ports. A minimum of two monitors is necessary in order to facilitate visualization for all of the operative personnel. It is crucial that the surgeon endeavor to work in a parallel arrangement with the monitor at all times.

The surgeon and the assistant stand to the right side of the patient. If necessary, during splenic flexure mobilization the surgeon stands between the patient's legs to allow a different parallel approach. Three trocars are usually sufficient to complete a sigmoid resection in the majority of cases: a periumbilical one for the camera, and two right-sided ports for instrumentation at the lateral border of the right rectus muscle. An additional fourth port may be placed in either the left paraumbilical or suprapubic area for specimen retrieval and anvil placement, or in the right upper quadrant to facilitate splenic flexure mobilization. This latter position is especially useful in obese patients.

Three techniques have been described for laparoscopic sigmoidectomy: total, assisted and dissection-facilitated laparoscopic resection (DLR). The laparoscopic-assisted technique offers the most benefit for minimally invasive surgery, including reduced pain, incidence of adhesions, and length of ileus and hospitalization, as well as some advantages over the total laparoscopic procedure (15-18). The small incision (2-4 cm) used for specimen retrieval can also be used for anvil introduction into the proximal bowel. This procedure minimizes the risk of peritoneal spillage and postoperative infection (6). By dissection-facilitated laparoscopic resection (DLR) the surgeon attempts laparoscopic mobilization of the sigmoid, descending colon, and splenic flexure. A Pfannenstiel incision, approximately 7 cm in length, is performed. Through this incision, remaining mobilization of the sigmoid and proximal rectum, and identification of the ureter are undertaken. After extracorporeal resection of the sigmoid, the anastomosis can be performed either manually or using a double-tapled technique. Although the DLR has the potential advantages of being more rapid and less expensive than the laparoscopic assisted procedure, it may also fail to confer the same benefits. Specifically, since a great deal of the operation is performed by a hand inserted through a 7-10 cm incision in the abdomen, benefits in terms of gut motility and reduction of adhesion formation may not be appreciated. Nonetheless, this type of approach may be suitable as a "bridge" during the "learning curve" for the less experienced laparoscopic surgeon until the surgeon is comfortable relinquishing tactile sensation and manual control of the dissection process; this operation can function as a safety net prior to adoption of a true laparoscopic technique. The same claims can be made for manual assisted laparoscopy (19,20).

In the laparoscopic-assisted procedure vascular division is performed...
after complete mobilization of the left colon along the Toldt's fascia including mandatory identification of the left ureter. Mobilization of the splenic flexure should be undertaken by gently retracting the transverse colon towards the pelvis. During this portion of the operation, reverse Trendelenburg position may be helpful to add the momentum to pull the transverse colon towards the pelvis. The transverse colon can be mobilized in one of two methods. Either the avascular plane along the omentocolic junction can be divided, or, alternatively, the omentum itself can be transected. If one chooses the former course, care must be taken not to injure the colon with the diathermy, monopolar, or ultrasonic dissection tools. If the latter method is elected, care must be taken not to injure the gastrointestinal vessels but to divide the omental branches caudal to this point. A safe assumption to allow for a tension-free anastomosis is to mobilize the transverse colon until the right side of the middle colic vessels has been reached. By this manner, even if the entire sigmoid and descending colon need to be inspected, the splenic flexure will almost always reach the sacral promontory in a tension-free manner to allow for anastomosis. As has been previously mentioned in this chapter in obese patients, an optional fourth right upper-quadrant port may be desirable to facilitate transverse colon retraction. Alternatively, a left paraumbilical port may be used to retract the descending colon. This port can then subsequently be exchanged using the seldinger technique for a 33mm port (Ethicon Endosurgery Inc, Cincinnati, Ohio) through which the specimen can be drawn and into which the anvil can subsequently be placed into the proximal colon. Prior to any vascular division the entire left colon from the proximal rectum to the mid-transverse colon should be affected including division of the inferior mesenteric artery and separately the inferior mesenteric vein. Because of the phlegmonous nature of diverticular disease, the left ureter should be exposed along its course and the entire sigmoid phleghmon mobilized into the field. Identification and preparation for ligation and division of the inferior mesenteric vessels is best accomplished by subsequently scoring the peritoneum and the right side of the sigmoid and descending mesocolon. Hypogastric nerves can generally be identified and reflected posteriorly, as a window is developed anterior to the aorta. This avascular window can be developed from the inferior aspect of the inferior mesenteric artery to the anus in a caudal direction and between the superior aspect of the inferior mesenteric artery and the inferior aspect of the inferior mesenteric vein in a caudal direction. Ligation is undertaken with a 33mm linear vascular stapler. Either clips or the ultrasonic scalpel (Ethicon Endosurgery Inc, Cincinnati, Ohio) may be used for any smaller branches. The ultrasonic scalpel reduces blood loss, time needed for smoke evacuation, and time and cost needed for repeatedly replacing the diathermy scissors with an endoscopic clip applicator. The rectosigmoid junction is then divided at the level of the promontory with a linear stapler introduced through the right iliac fossa port. Sigmoidoscopy is performed prior to stapler application to verify that the entire sigmoid colon is resected so that a colorectostomy rather than a colosigmoidostomy will be affected. Failure to resect the distal sigmoid significantly increases the risk of recurrent diverticulitis (21). A metallic clip at the intended proximal margin of resection will facilitate extracorporeal identification of the level previously intracorporeally selected for a tension-free anastomosis. After distal division of the rectum the distal stapled end of the sigmoid colon is gently grasped and delivered through the abdominal wall at the 33-mm port. As the end is withdrawn, the wound can be protected by a plastic drape inserted along the shaft of the Babcock forceps. If a 33 mm port was not utilized, a 3 - 5 cm incision can be donned in the left iliac fossa. Once again the plastic drape can be inserted over the Babcock clamp prior to withdrawal of the specimen through the 3-5cm incision. In this fashion potential lumen contamination is reduced and the specimen is more easily delivered because of reduction of the friction afforded by the lubricated plastic surface. The left colon is then transected and a proximal purse-string suture is placed at the previously selected level demarcated by the clips. In some instances palpation of the area demarcated by clips may reveal more significant muscular hypertrophy, lack of compliance, or diverticular disease than had been laparoscopically appreciated. Obviously, if one or several of the situations are encountered then a more proximal resection needs to be undertaken. If the more proximal resection band-aid's subsequent intracorporeal mesenteric mobilization then such mobilization must be undertaken to ensure a tension-free anastomosis. The anvil is inserted and the colon is returned into the abdominal cavity. The maneuvers are best facilitated by introduction of the camera through the right iliac fossa port. From this postion, care can be taken to ensure appropriate orientation of the bowel and its mesentery, exclusion of extraneous structures, and inclusion of structures intended for the anastomosis. After reinsufflation of the abdominal cavity, the circular stapler is placed into the rectal stump. As the bowel is reinserted back into the abdominal cavity, the anvil is inserted through a 3cm midline incision. The bowel is then carefully transanal inserted with air insufflation, and inspection of the tissue. Specifically a non-crushing bowel clamp is gently placed on the colon 10-15cm proximal to the anastomosis. The patient is placed in the flat position. The colonoscope is carefully transanally introduced while air is instilled. The anastomosis is colonscopically inspected to verify that it is circumferentially intact, widely patent, and hemostatic. From the laparoscopic aspect verification is undertaken that the anastomosis is air tight as attested to by the lack of bubbles. If an anastomotic leak is detected, it can be corrected in one of several ways. Firstly it has been shown, at least in the animal model, that hema staples can be used to safely reinforce the leaking laparoscopic anastomosis (22). Secondly, intracorporeal suturing with either intracorporeal or extracorporeal knot tying can be used to fortify the anastomosis. Thirdly a small incision can be made or the prior incision can be reopened to allow manual inspection and suturing. Ultimately the anastomosis must be satisfactorily reinforced, as the patient cannot leave the operating room without an airtight anastomosis. Proximal fecal diversion should not be a substitute for repair of an anastomotic deficiency. After the anastomosis has been verified as tension-free, circumferentially intact, patent, and hemostatic, the entire abdomen should be copiously irrigated and verified for meticulous hemostasis. After defusilation, all port sites should be closed as asymptomatic hemias have developed in 10mm port sites. If a Hartmann's procedure is planned, then all of the steps previously outlined are also undertaken. However, instead of returning the bowel to the peritoneal cavity for anastomosis, the proximal segment is extracorporealized and a stoma created. In these instances, the optional fourth port would be placed through the previously identified left iliac fossa colostomy site. The site would have been chosen prior to the completion of the intracorporeal stapler. Following transection of the distal aspect of the stapled-shut sigmoid, the 10mm port is withdrawn from the colostomy site, and a 2cm skin of skin is excised. If a Hartmann's procedure is planned great effort should be taken not to enter the presacral space in order to facilitate subsequent dissection. Placing non-absorbable sutures at the ends of the linear staple line can also facilitate subsequent identification of the rectal stump. The Babcock forceps would then be placed first caudally and then in the cephalad direction. Using small right angle retractors the mesorectal sheath and rectus muscle would be divided along the insulated shaft of the Babcock clamp. The procedure would be laparoscopically visualized to prevent any intracorporeal injury during this process. Ultimately, the posterior sheath and peritoneum would also be incised in a cephalad to caudal direction. The entire specimen would then be withdrawn through this site and the bowel occluded. After irrigation, verification of meticulous hemostasis, defusilation and closure of the other ports, the stoma would be permanently matured. If the patient is deemed physically suitable and satisfactorily recovered from the initial Hartmann's procedure, reversal can be considered commencing approximately three months after the first procedure. Preoperative evaluation should include a thorough investigation by an internist and or other medical specialist to ensure appropriate cardiopulmonary and other systemic functions. If the patient did not preoperatively undergo such studies then colonoscopy should be performed through the colostomy and the rectum to exclude synchronous neoplasms such as adenomas. If different surgeons performed the first operation, a water soluble contrast enema may be desirable to serve as a "road map" to ensure that the distal resection proceeded to the level of the sacral promontory and did not leave behind the distal sigmoid colon. Similarly this type of study is useful to document whether or not the splenic flexure is previously mobilized and also to judge the adequacy of proximal resection of diverticular disease. No effort is made to perform a total colectomy for the mere presence of panocolonic diverticulosis. The important factor in the decision making process is the presence of any muscular hypertrophy or luminal narrowing, not the mere presence of diverticulosis. A manometry to document adequate resting and squeeze pressure particularly in the elderly and patients who have remained functional for a considerable length of time. Preoperative preparation is identical. As for the initial colectomy itself, it will not be repeated at this juncture. Operative positioning is also identical. Uterine catheters are utilized in all of these cases due to the anticipated significant pelvic inflammation. However, the same precaution is also utilized for Hartmann's reversals planned by laparotomy. The incidence of conversion to laparotomy for Hartmann's reversal is probably higher than for other laparoscopic indications (23). The procedure commences by mobilization of the colostomy. After full mobilization, any residual proximal diverticular disease is resected. Care should be undertaken to ensure absence of muscular hypertrophy or luminal narrowing in an adequately capacious and compliant descending colon. After a purse-string suture is applied, the anvil of, preferably, a 33mm stapling device is secured within the lumen, and the bowel is then placed in the abdominal cavity. The fascial edges under the colostomy site are then grasped with Kocher clamps and enterolysis is performed. Under direct vision, a 1cm incision is made in the supraumbilical region and a 10mm port is placed under direct vision. A 33mm port is then secured to the colostomy site using fascial sutures. After abdominal insufflation, additional enterolysis can be undertaken if necessary. After all adhesions are freed and all loops of small bowel are freed from the pelvis the patient is placed in steep Trendelenburg and right side down position. The remainder of the operation is undertaken as already described previously in this manuscript.
after complete mobilization of the left colon along the Toldt's fascia including mandatory identification of the left ureter. Mobilization of the splenic flexure should be undertaken by gently retracting the transverse colon towards the pelvis. During this portion of the operation, reverse Trendelenburg position may be helpful to add the momentum to pull the transverse colon towards the pelvis. The transverse colon can be mobilized in one of two methods. Either the avascular plane along the omentocolic junction can be divided, or, alternatively, the omentum itself can be transected. If one chooses the former course, care must be taken not to injure the colon with the diathermy, monopolar, or ultrasonic dissection tools. If the latter method is elected, care must be taken not to injure the gastroepiploic vessels but to divide the omental branches caudal to this point. A safe assumption to allow for a tension-free anastomosis is to mobilize the transverse colon until the right side of the middle colic vessels has been reached. By this manner, even if the entire sigmoid and descending colon need to be inspected, the splenic flexure will almost always reach the sacral promontory in a tension-free manner to allow for anastomosis. As has been previously mentioned in this chapter in obese patients, an optional fourth right upper quadrant port may be desirable to facilitate transverse colon retraction. Alternatively, a left paramedian port may be used to retract the descending colon. This port can then subsequently be exchanged using the seldinger technique for a 33mm port (Ethicon Endosurgery Inc, Cincinnati, Ohio) through which the specimen can be drawn and into which the anvil can subsequently be placed into the proximal colon. Prior to any vascular division the entire left colon from the proximal rectum to the mid-transverse colon should be affected including division of the inferior mesenteric artery and subsequently the inferior mesenteric vein. Because of the phlegmonous nature of diverticular disease, the left ureter should be exposed along its course and the entire sigmoid phlegmon mobilized into the field. Identification and preparation for ligation and division of the inferior mesenteric vessels is best accomplished by subsequently scoring the peritoneum and the right side of the sigmoid and descending mesocolon. Hypogastric nerves can generally be identified and reflected posteriorly, as a window is developed anterior to the aorta. This avascular window can be developed from the inferior aspect of the inferior mesenteric artery to the anus in a caudal direction and between the superior aspect of the inferior mesenteric artery and the inferior aspect of the inferior mesenteric vein in a caudal direction. Ligation is undertaken with a 33mm linear vascular stapler. Either clips or the ultrasonic scalpel (Ethicon Endosurgery Inc, Cincinnati, Ohio) may be used for any smaller branches. The ultrasonic scalpel reduces blood loss, time needed for smoke evacuation, and time and cost needed for repeatedly replacing the diathermy scissors with an endoscopic clip applicator. The rectosigmoid junction is then divided at the level of the promontory with a linear stapler introduced through the right iliac fossa port. Sigmoidoscopy is performed prior to stapler application to verify that the entire sigmoid colon is resected so that a coloproctostomy rather than a colocolostomy will be affected. Failure to resect the distal sigmoid significantly increases the risk of recurrent diverticulitis (21). A metallic clip at the intended proximal margin of resection will facilitate extracorporeal identification of the level previously intracorporeally selected for a tension-free anastomosis. After distal division of the rectum the stapled distal end of the sigmoid colon is gently grasped and delivered through the abdominal wall at the 33-mm port. As the end is withdrawn, the wound can be protected by a plastic drape inserted along the shaft of the Babcock forceps. If a 33 mm port was not utilized, a 3 - 5 cm incision can be donned in the left iliac fossa. Once again the plastic drape can be inserted over the Babcock clamp prior to withdrawal of the specimen through the 3-5cm incision. In this fashion potential lumens contamination is reduced and the specimen is more easily delivered because of reduction of the friction afforded by the lubricated plastic surface. The left colon is then transected and a proximal purse-string suture is placed at the previously selected level demarcated by the clips. In some instances palpation of the area demarcated by clips may reveal more significant muscular hypertrophy, lack of compliance, or diverticular disease than had been laparoscopically appreciated. Obviously, if one or several of the situations are encountered then a more proximal resection needs to be undertaken. If the more proximal resection band-aid's subsequent intracorporeal mesenteric mobilization then such mobilization must be undertaken to ensure a tension-free anastomosis. The anvil is inserted and the colon is returned into the abdominal cavity. The maneuvers are best facilitated by introduction of the camera through the right iliac fossa port. From this position, care can be taken to ensure appropriate orientation of the bowel and its mesentery, exclusion of extraneous structures, and inclusion of structures intended for the anastomosis. After the stapler is fired the integrity of the resulting anastomosis is verified by laparoscopic and colonscopic inspection, air insufflation, and inspection of the tissue. Specifically a non- crushing bowel clamp is gently placed on the colon 10-15cm proximal to the anastomosis. The patient is placed in the flat position. The colonscope is carefully transanally introduced while air is instilled. The anastomosis is colonscopically inspected to verify that it is circumferentially intact, widely patent, and hemostatic. From the laparoscopic aspect verification is undertaken that the anastomosis is air tight as attested to by the lack of bubbles. If an anastomotic leak is detected, it can be corrected in one of several ways. Firstly it has been shown, at least in the animal model, that hema staples can be used to safely reinforce the leaking laparoscopic anastomosis (22). Secondly, intracorporeal suturing with either intracorporeal or extracorporeal knot tying can be used to fortify the anastomosis. Thirdly a small incision can be made or the prior incision can be reopened to allow mental inspection and suturing. Ultimately the anastomosis must be satisfactorily reinforced, as the patient cannot leave the operating room without an airtight anastomosis. Proximal fecal diversion should not be a substitute for repair of an anastomotic deficiency. After the anastomosis has been verified as tension-free, circumferentially intact, patent, and hemostatic, the entire abdomen should be copiously irrigated and verified for meticulous hemostasis. After deflation all port sites should be closed as symptomatic hemias have developed in 10mm port sites. If a Hartmann's procedure is planned, then all of the steps previously outlined are also undertaken. However, instead of returning the bowel to the peritoneal cavity for anastomosis, the proximal segment is extracorporeally reconstituted and a stoma created. In these instances, the optional fourth port would be placed through the previously identified left iliac fossa colostomy sight. The site would have been chosen prior to the Hartmann's procedure. Following mobilization of the distal aspect of the stapled-shut sigmoid, the 10mm port is withdrawn from the colostomy site and a 2cm disk of skin is excised. If a Hartmann's procedure is planned great effort should be taken not to enter the presacral space in order to facilitate subsequent dissection. Placing non-absorbable sutures at the ends of the linear staple line can also facilitate subsequent identification of the rectal stump. The Babcock forceps would then be placed first caudally and then in the cephalad direction. Using small right angle retractors the mesorectal sheath and rectus muscle would be divided along the insulated shaft of the Babcock clamp. The procedure would be laparoscopically visualized to prevent any intracorporeal injury during this process. Ultimately, the posterior sheath and peritoneum would also be incised in a cephalad to caudal direction. The entire specimen would then be withdrawn through this site and the bowel occluded. After irrigation, verification of meticulous hemostasis, deflation and closure of the other ports, the stoma would be permanently matured. If the patient is deemed physically suitable and satisfactorily recovered from the initial Hartmann's procedure, reversal can be considered commencing approximately three months after the first procedure. Preoperative evaluation should include a thorough investigation by an internist and or other medical specialist to ensure appropriate cardiopulmonary and other systemic functions. If the patient did not preoperatively undergo such studies then colonoscopy should be performed through the colostomy and the rectum to exclude synchronous neoplasms such as adenomas. If different surgeons performed the first operation, a water soluble contrast enema may be desirable to serve as a “road map” to ensure that the distal resection proceeded to the level of the sacral promontory and did not leave behind the distal sigmoid colom. Similarly this type of study is useful to document whether or not the splenic flexure is previously mobilized and also to judge the adequacy of proximal resection of diverticulitis disease. No effort is made to perform a total colectomy for the mere presence of pancolonic diverticulitis. The important factor in the decision making process is the presence of any muscular hypertrophy or luminal narrowing, not the mere presence of diverticulitis. A manometry to document adequate resting and squeeze pressure particularly in the elderly and patients who have remained functional for a considerable length of time. Preoperative preparation is identical. As for the initial colectomy itself, it will not be repeated at this juncture. Operative positioning is also identical. Uretic catheters are utilized in all of these cases due to the anticipated significant pelvic inflammation. However, the same precaution is also utilized for Hartmann's reannals planned by laparotomy. The incidence of conversion to laparotomy for Hartmann's reversal is probably higher than for other laparoscopic indications (23). The procedure commences by mobilization of the colostomy. After full mobilization, any residual proximal diverticulitis disease is resected. Care should be undertaken to ensure absence of muscular hypertrophy or luminal narrowing in an adequately capacious and compliant descending colon. After a purse-string suture is applied, the anvil of, preferably, a 33mm stapling device is secured within the lumen, and the bowel is then placed in the abdominal cavity. The fascial edges under the colostomy site are then grasped with Kocher clamps and enterolysis is performed. Under direct vision, a 1cm incision is made in the supraumbilical region and a 10 mm port is placed under direct vision. A 33mm port is then secured to the colostomy sight using fascial sutures. After abdominal insufflation, additional enterolysis can be undertaken if necessary. After all adhesions are freed and all loops of small bowel are freed from the pelvis the patient is placed in steep Trendelenburg and right side down position. The remainder of the operation is undertaken as already described previously in this manuscript.
Results

Bruce et al. (24) performed a retrospective review of 25 patients who underwent laparoscopic sigmoid colectomy for diverticulitis compared to 17 patients who underwent the same procedure by laparotomy. Prior laparotomy had been undertaken in twice as many patients in the laparoscopic group (56%) as in the laparotomy group (29%). Therefore, this study is stratified for an outcome in favor of laparotomy on this basis alone. The splenic flexure was mobilized in 24% of the patients in each group and a left colectomy was undertaken in one patient in the laparoscopic and three patients in the laparotomy group.

The most significant finding in favor of laparotomy was that the laparoscopic procedure took a mean of 397 minutes as compared to only 215 minutes in the laparotomy group. Despite this inordinate length of time under general anesthesia, a regular diet was commenced at a mean of 3.2 days in the laparoscopic group versus 5.7 days in the laparotomy group (p<0.001). Perhaps as a result of the timing of the introduction of diet, the hospital stay was increased from a mean of 4.2 days in the laparoscopic group to 6.8 days in the laparotomy group. Overall charges were significantly higher in the laparoscopic group at $10,230 as compared to $7,068 in the laparotomy group. Perioperative complications were noted in 16% of the laparoscopic group (2 major and 2 minor complications) and 23% of the laparotomy group (1 major and 3 minor complications). However, during the 30 days following surgery, more postoperative complications followed laparotomy.

Due to the small number of patients in the study this trend failed to reach statistical significance.

Liberman et al. (25) compared 14 patients who underwent laparoscopic diverticulitis to 14 patients who underwent the same procedure by laparotomy. The operative time of 192 minutes in the former group, was not significantly different than the 182 minutes in the latter group. However, estimated blood loss was significantly less in the laparoscopic group at 171ml as compared to 321ml in the laparotomy group (p<0.04). The postoperative stay was significantly reduced from 9.2 days in the laparotomy group to 6.3 days in the laparoscopic group (p<0.001) and the time of early oral fluid tolerance was reduced to 2.9 days the laparoscopic group from 6.1 days in the laparotomy group (p<0.01). Though operative room charges were significantly increased from $8,207 in the laparotomy group to $10,589 in the laparoscopic group (p<0.05), the overall hospital charge was not different at $11500 for the laparoscopic group and $13,400 for the laparotomy group. The morbitity rate was 14% in each group; there was no mortality in the laparoscopy group and $13,400 for the laparotomy group.

Role of Laparoscopy for Crohn’s disease

A variety of laparoscopic procedures may be applied to the treatment of Crohn’s disease. Including ileocolic resection, segmental bowel resection, total proctocolectomy, strictureplasty, stoma creation, and stoma reversal. The most common of these indications is ileocolic disease. It is prudent when considering a laparoscopic approach to ileocolic Crohn’s disease that appropriate selection criteria are used so that a safe and successful procedure may be performed. Accordingly, the following selection criteria are used:

1. Patients should have localized disease in a single segment of intestine as far as can be determined preoperatively. This criterion requires patients to undergo several diagnostic evaluations prior to surgical intervention. Colonoscopy with biopsies is necessary to determine whether the disease is truly limited to the loop of bowel. Therefore, intraoperative cholangiography or enotranscy in necessary to help exclude synchronous jejunal or ileal disease as well as to demonstrate any associated fistula. A CAT scan may be helpful to assess any phlegmon or abscess.

2. It is best that patients have had no previous surgery or have had surgery at a site other than the right iliac fossa. Although laparoscopy is easiest in patients who have had no prior surgery, we offer it to patients who have had one, two, or even three prior ileocolic resections.

3. The patient should not have any evidence of carcinoma. Since there is no proof that laparoscopy is as beneficial as laparotomy for cure of carcinoma, patients in whom a carcinoma has been preoperatively identified should plan to have a laparotomy.

There are some factors that increase the risk of complications during laparoscopic surgery. The mesentery in Crohn’s disease can be very friable due to the inflammatory process and possibly the use of steroids. This type of mesentery may freely bleed despite even minimal and gentle handling. Even during laparotomy, vascular control can be difficult and hemorrhage is not uncommon. In the laparoscopic setting, such vascular control may be hazardous, time consuming, and expensive, especially if an intracorporeal clip, pretied vascular loop or vascular stapler, respectively, are needed. Due to the thickened and shortened mesentery, extraction of the specimen through a small incision or a larger trocar may be impossible. This maneuver may result in mesenteric trauma, resulting in hematoma, hemorrhage, or venous thrombosis from the congestion of a thickened phlegmonous mesentery being strangled by a small fascial opening. Thus one should not struggle to deliver a thickened friable mesentery through a small incision. If necessary, portal vein and even the skin incision should be lengthened to allow trauma-free specimen delivery. O ne must remember that phlegmon and inflamed mesentery are deformable and can be delivered through incisions smaller than the actual diameter of the inflamed areas. Nonetheless conversion to an incision greater than 5cm may be necessary. However, a recent study of these patients in our institution has revealed that the same benefit with low morbidity can be expected if conversion to an incision larger than 5cm is necessary due to a large mass rather than due to inadvertent pursuit of the laparoscopic procedure to the point of causation of intraoperative trauma such as hemorrhage or enteroatry.

Surgical technique

Ileocele Resection

Preperative preparation

Much of the preoperative preparation is similar to that already outlined for diverticular disease. The patient should undergo a full physical examination, preferably by an internist or family practitioner to include appropriate laboratory testing because of chronic steroid use; serum electrolytes should be analyzed and appropriately corrected. Because of the chronicity of disease, anemia may be encountered and again should be corrected as appropriate. Leukocytosis may be noted due to either the demargination effect from steroids or from intra-abdominal sepsis. Significant nutritional deplation may require preoperative enteral or parental nutrition. The same admonitions about bilateral ureteric catheters as for diverticulists also apply for Crohn’s disease. Again, whether the procedure is planned by laparoscopy or laparotomy because of the thickened and phlegmonous mesentery often adherent to the right iliac fossa and right ureter, these catheters can be of significant benefit to facilitate safe identification of ureters and subsequent safe vascular ligation. As for diverticulists, the patients should be apprised of the fact that a laparotomy may be necessary as may a stoma. Preoperative enterostomal therapy counseling and selection of a right iliac fossa ileostomy site should be undertaken. Intraoperative colonoscopy may also be necessary to verify a disease-free colonic margin selected for resection.

Operative technique

After identification of the terminal ileum, the entire length of the small bowel is carefully inspected in order to identify any synchronous pnoximal strictures. This inspection is best accomplished using the two-handed Babcock clamp technique. Since in many cases, multiple synchronous areas of small bowel may be diseased, the need to evaluate the entire small intestine is fundamental. The loss of tactile sensation also limits the evaluation of thickened areas or small strictures. Moreover, the potential for inadvertent enteroatry increases with the amount of manipulation of the small bowel.

Once again the patient is placed in the supine modified lithotomy position in Allen straps, (Allen Medical Corporation, Bedford...
Results

Bruce et al. (24) performed a retrospective review of 25 patients who underwent laparoscopic sigmoid colectomy for diverticulitis compared to 17 patients who underwent the same procedure by laparotomy. Prior laparotomy had been undertaken in twice as many patients in the laparoscopic group (56%) as in the laparotomy group (29%). Therefore, this study is stratified for an outcome in favor of laparotomy on this basis alone. The splenic flexure was mobilized in 24% of the patients in each group and a left colicectomy was undertaken in one patient in the laparoscopic and three patients in the laparotomy group. The most significant finding in favor of laparotomy was that the laparoscopic procedure took a mean of 397 minutes as compared to only 215 minutes in the laparotomy group. Despite this inordinate length of time under general anesthesia, a regular diet was commenced at a mean of 3.2 days in the laparoscopic group versus 5.7 days in the laparotomy group (p<0.001). Perhaps as a result of the timing of the introduction of diet, the hospital stay was increased from a mean of 4.2 days in the laparoscopic group to 6.8 days in the laparotomy group. Overall charges were significantly higher in the laparoscopic group at $10,230 as compared to $7,068 in the laparotomy group. Perioperative complications were noted in 16% of the laparoscopic group (2 major and 2 minor complications) and 23% of the laparotomy group (1 major and 3 minor complications). However, during the 30 days following surgery, more perioperative complications followed laparotomy. Due to the small number of patients in the study this trend failed to reach statistical significance.

Liberman et al. (25) compared 14 patients who underwent laparoscopic for diverticulitis to 14 patients who underwent the same procedure by laparotomy. The operative time of 192 minutes in the former group, was not significantly different than the 182 minutes in the latter group. However, estimated blood loss was significantly less in the laparoscopic group at 1.71ml as compared to 321ml in the laparotomy group (p<0.04). The postoperative stay was significantly reduced from 9.2 days in the laparotomy group to 6.3 days in the laparoscopic group (p<0.001) and the time of early oral fluid tolerance was reduced to 2.9 days the laparoscopic group from 6.1 days in the laparotomy group (p<0.01). Though operative room charges were significantly increased from $8,207 in the laparotomy group to $10,589 in the laparoscopy group (p<0.05). In Hinchey IIA and IIB patients, the median length of hospitalization was almost 50% shorter after the laparoscopic approach (6 days vs. 10 days, p<0.05). They concluded that laparoscopic resection of diverticulitis can be performed with reduced morbidity and with a reduced length of hospitalization in patients with stage I or II disease. Patients with stage I disease and, after initial experience, those with stage II disease, can benefit from both reduced morbidity and a reduced length of hospitalization associated with laparoscopic treatment.

Boullot et al. (27) performed a retrospective review of 50 patients who underwent laparoscopic sigmoid colectomy for diverticular disease. The mean time was 195 minutes and there were no operative or postoperative mortalities. The postoperative morbidity was 14%. The median postoperative stay for the 50 patients was 10 days beyond which patients were reluctant to discharge the patients early in their initial experience. O’Sullivan (28) reported the use of laparoscopic peritoneal lavage in conjunction with parenteral fluids and antibiotic therapy in the management of eight patients with generalized peritonitis secondary to perforated diverticular disease. All patients had purulent peritonitis, without fecal contamination. They were treated with laparoscopic peritoneal lavage and intravenous fluids and antibiotics, with complete recovery and resumption of normal diet within 5-8 days. No patients required subsequent surgical intervention during the 12-48 month follow-up. A number of other authors (27,29-32) have published their results with laparoscopic resection of diverticular disease; the mean conversion rate was 14.9%, the mean dietary intake was 2.8 days, the mean hospitalization days was 5.8. The mean morbidity was 13% and the mean operative time was 210 minutes. (table 1). This interesting approach represents a truly minimally invasive option and warrants critical appraisal.

Clearly, laparoscopy for diverticular disease confers many advantages, including decreased morbidity, and length of hospitalization. Additional potential benefits include decreased pain and decreased readmission for bowel obstruction. Although none of these improvements have been noted in prospectively randomized trials, they have been repeatedly noted in prospective and retrospective data analyses as well as in cohort comparisons to laparotomy. Based upon these data, laparoscopy is our preferred approach to the treatment of sigmoid diverticulitis.

Role of Laparoscopy for Crohn’s disease

A variety of laparoscopic procedures may be applied to the treatment of Crohn's disease. Including ileocolic resection, segmental bowel resection, total proctocolectomy, strictureplasty, stoma creation, and stoma reversal. The most common of these indication is ileocolic disease. It is prudent when considering a laparoscopic approach to ileocolic Crohn’s disease that appropriate selection criteria are used so that a safe and successful procedure may be performed. Accordingly, the following selection criteria are used.

1. Patients should have localized disease in a single segment of intestine as far as can be determined preoperatively. This criterion requires patients to undergo several diagnostic evaluations prior to surgical intervention. Colonoscopy with biopsies is necessary to define the extent of disease and the location of the inflammatory process. Aspiration or enteroctomy are necessary to help exclude synchronous neoplastic disease as well as to demonstrate any associated fistula. A CAT scan may be helpful to assess any phlegmon or abscess.

2. It is best that patients have had no previous surgery or have had surgery at a site other than the right iliac fossa. Although laparoscopy is easiest in patients who have had no prior surgery, we offer it to patients who have had one, two, or even three prior ileocolic resections.

3. The patient should not have any evidence of carcinoma. Since there is no proof that laparoscopy is as beneficial as laparotomy for cure of carcinoma, patients in whom a carcinoma has been preoperatively identified should plan to have a laparotomy.

There are some factors that increase the risk of complication during laparoscopic surgery. The mesentry of Crohn’s disease can be very friable due to the inflammatory process and possibly the use of steroids. This type of mesentery may freely bleed despite minimal gentle handling. Even during laparotomy, vascular control can be hazardous, time consuming, and expensive, especially if an intracorporeal clip, preformed vascular loop or vascular stapler, respectively, are needed. Due to the thickened and shortened mesentery, extraction of the specimen through a small incision or a larger trocar may be impossible. This maneuver may result in mesenteric trauma, resulting in hematoma, hemorhage, or venous thrombosis from the congestion of a friable or thrombosed mesentry being strangled by a small fascial opening. Thus one should not struggle to deliver a thickened friable mesentry through a small incision. If necessary, peritoneal fascia and even the skin incision should be lengthened to allow trauma-free specimen delivery. One must remember that phlegmon and inflamed mesentery are deformable and can be delivered through incisions smaller than the actual diameter of the inflamed areas. Nonetheless conversion to an incision larger than 5cm may be necessary. However, a recent study of these patients in our institution has revealed that the same benefit with low morbidity can be expected if conversion to an incision larger than 5cm is necessary due to a large mass rather than due to injudicious pursuit of the laparoscopic procedure to the point of causation of intraoperative trauma such as hemorrhage or enteroatmy.

Surgical technique

Ileocolic Resection

Preoperative preparation

Much of the preoperative preparation is similar to that already outlined for diverticular disease. The patient should undergo a full physical examination, preferably by an internist or family practitioner to include appropriate laboratory testing because of chronic steroid use; serum electrolytes should be analyzed and appropriately rectified. Because of the chronicity of disease, anemia may be encountered and again should be corrected as appropriate. Leukocytosis may be noted due to either the demargination effect from steroids or from intra-abdominal sepsis. Significant nutritional depletion may require preparative enteral or parental nutrition. The same admonitions about bilateral ureteric catheters as for diverticulitis also apply for Crohn's disease. Again, whether the procedure is planned by laparoscopy or laparotomy because of the high risk of phlegmonous mesentery often adherent to the right iliac fossa and right ureter, these catheters can be of significant benefit to facilitate safe identification of ureters and subsequent safe vascular ligation. As for diverticulitis, the patients should be apprised of the fact that a laparotomy may be necessary as may a stoma. Preoperative enterostomal therapy counseling and selection of a right iliac fossa ileostomy site should be undertaken. Intraoperative colonoscopy may also be necessary to verify a disease-free colonic margin selected for resection.

Operative technique

After identification of the terminal ileum, the entire length of the small bowel is carefully inspected in order to identify any synchronous proximal strictures. This inspection is best accomplished using the two-handed Babcock clamp technique. Since in many cases, multiple synchronous areas of small bowel may be diseased, the need to evaluate the entire small intestine is fundamental. The loss of tactile sensation also limits the evaluation of thickened areas or small strictures. Moreover, the potential for inadvertent enterotomy increases with the amount of manipulation of the small bowel.

Once again the patient is placed in the supine modified lithotomy position in Allen straps, (Allen Medical Corporation, Bedford
The duodenum should be identified and reflected. As for diverticulitis, the omentum should be identified, the ureteric catheter, before any vessel ligation undertaken either with electrocautery scissors or an ultrasonic. Attention is next focused on the ileocolic segment; the right colon in our practice in approximately 4% of patients despite mandatory Trendelenberg and left side tilted down position is utilized. Careful placement in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. If patients are obese or if multiple adhesions exist, an optional fourth 10mm port may sometimes be placed in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. In order to facilitate the dissection of the right iliac fossa, steep of the left rectus muscle.

Heights, OH). The arms are both adducted to the sides. Care is taken to carefully pad potential areas of bodily injury. The hips and knees should be flexed no more than 15° to prevent any limit in the arc of motion of instruments, particularly in the iliac fossa ports. A Mushroom tipped catheter is placed into the rectum through which approximately 1 liter of normal saline is irrigated until the rectal effluent was clear. Betadine was then introduced to the catheter and the catheter was left taped inside of the plastic bag. A nasogastric tube and bladder catheter were inserted to decompress the stomach and bladder, respectively, prior to introduction of the first trocar. The abdomen and lower chest are prepared and draped in the usual sterile manner, allowing enough exposure in case a laparotomy is necessary. If the patient has had prior surgery, consideration can be given to either the open (Hasson) technique of trocar insertion or placing the Veress needle out of sight remote to all prior scars. If the patient has had no prior surgery then our preference is to place a 1cm stab wound under direct vision in the periumbilical region with a Veres needle. Regardless of the method of introduction of the first port, after pneumoperitoneum of 15mmHg is achieved, the abdomen is explored with a 0° camera. Two additional ports are generally placed, one in the left iliac fossa and one in the left parambilical region, lateral to the lateral edge of the left rectus muscle. These sites are chosen for maximal flexibility and minimum chance of injury to the epigastric vessels. If patients are obese or if multiple adhesions exist, an optional fourth 10mm port may sometimes be placed in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. In order to facilitate the dissection of the right iliac fossa, steep of the left rectus muscle.

A Mushroom tipped catheter is placed into the rectum through which approximately 1 liter of normal saline is irrigated until the rectal effluent was clear. Betadine was then introduced to the catheter and the catheter was left taped inside of the plastic bag. A nasogastric tube and bladder catheter were inserted to decompress the stomach and bladder, respectively, prior to introduction of the first trocar. The abdomen and lower chest are prepared and draped in the usual sterile manner, allowing enough exposure in case a laparotomy is necessary. If the patient has had prior surgery, consideration can be given to either the open (Hasson) technique of trocar insertion or placing the Veress needle out of sight remote to all prior scars. If the patient has had no prior surgery then our preference is to place a 1cm stab wound under direct vision in the periumbilical region with a Veres needle. Regardless of the method of introduction of the first port, after pneumoperitoneum of 15mmHg is achieved, the abdomen is explored with a 0° camera. Two additional ports are generally placed, one in the left iliac fossa and one in the left parambilical region, lateral to the lateral edge of the left rectus muscle. These sites are chosen for maximal flexibility and minimum chance of injury to the epigastric vessels. If patients are obese or if multiple adhesions exist, an optional fourth 10mm port may sometimes be placed in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. In order to facilitate the dissection of the right iliac fossa, steep of the left rectus muscle.

In our practice in approximately 4% of patients despite mandatory Trendelenberg and left side tilted down position is utilized. Careful placement in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. If patients are obese or if multiple adhesions exist, an optional fourth 10mm port may sometimes be placed in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. In order to facilitate the dissection of the right iliac fossa, steep of the left rectus muscle.

Attention is next focused on the ileocolic segment; the right colon in our practice in approximately 4% of patients despite mandatory Trendelenberg and left side tilted down position is utilized. Careful placement in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. If patients are obese or if multiple adhesions exist, an optional fourth 10mm port may sometimes be placed in the left upper quadrant again lateral to the lateral edge of the left rectus muscle. In order to facilitate the dissection of the right iliac fossa, steep of the left rectus muscle.

Vascular dissection can be safely and quickly performed during the extracorporeal phase, with less expense and possible more safely than during the intracorporeal phase. In addition, proximal vascular structures must be direct vision as a complimentary extracorporeal procedure. Once the bowel is resected and the anastomosis completed, the bowel is returned to the abdomen and the incisions are closed. It is important to close the fascia at all 10mm port sites as port site hernias have occurred (33). If a 33mm port was utilized, it can be replaced. It may be necessary to place several peritoneal and fascial sutures in order to prevent any leakage at the pneumoperitoneum during the reinfusion process. Alternatively, whether or not a 33mm port was utilized, the left sided specimen delivery incision can be primarily closed at this juncture.

Results of laparoscopically assisted resection for Crohn’s disease

The surgical results of laparoscopic ileocolic resection are summarized in table 2. The average morbidity rate is 11%. The average hospital stay is 7 days and the mean conversion rate 12.4%. Bauer (34) compared laparoscopy and laparotomy, reporting that the stented blood loss is less and the commencement of oral intake is earlier in the laparoscopic group. The most common cause for conversion to laparotomy is an unsuspected finding of a large inflammatory mass with an associated fistula (22). Hildebrandt (35) reported that the main benefit of this technique was early mobilization due to reduced pain. Bauer (36) concluded in a study of 18 patients following ileocolic resection that the preoperative evaluation and selection is paramount in predicting the outcome of patients with terminal ileal Crohn’s disease who underwent laparoscopic resection. During laparoscopic bowel evaluation, synchronous jejunal strictures, unrecognized by preoperative small bowel radiographic investigation, may be identified and treated. (22) Although the presence of a fistula makes the laparoscopic approach more difficult it is both feasible and advantageous to the patients (37).

During initial experience with laparoscopic colorectal surgery, lower gastrointestinal fistulas were considered a contraindication. The 30% overall conversion rate is higher than that published for ‘simple’ colorectal pathology, attesting to the challenging nature of these conditions (38). However, as experience has increased and instrumentation improved, this procedure is now used more often for patients with these indications (39).

Alabaz (40) compared the safety, outcome, and length of disability of patients who underwent laparoscopic-assisted or conventional ileocolic resection during the same time period; patients were stratified by severity of disease and many other parameters. Laparotomy was associated with a higher incidence of symptomatic small bowel obstruction, which necessitated readmission to the hospital. Although the incidence of relaparotomies were similar between the two groups (8% for the laparotomy group versus 4% for the laparoscopic group; P=NS), the incidence of symptomatic bowel obstruction was significantly increased in the laparotomy group (31% versus 8%; P<0.05). Moreover, the return to work and to normal activities was significantly shorter in the laparoscopic group (3.7 ±2 weeks in the laparoscopic group versus 8.0 ±2 weeks in the laparotomy group; P<0.001) than in the laparotomy group.

Traditionally, postoperative adhesion formation and bowel obstruction have plagued colonic resections. The problem is particularly vexing if a mucosectomy is planned, as the same surgeon may need to again delve into an adhesion-ridden abdomen. Not only is the length of time required to reenter the abdomen significantly longer (41) but the incidence of significant injury such as enterotomy or myotomy is as high as 20% (42). Traditionally very little could be done to prevent this problem. However, Becker et al. recently demonstrated that the combination of Sodium hyaluronate and carboxymethylcellulose (SeprafilmTM, Genzyme Corp, Cambridge Massachussetts) may significantly reduce the incidence, severity, and grade of adhesions at the site of application (43). Subsequent studies have confirmed the efficacy of Seprafilm placement even in patients with chronic adhesive disease (44). Other studies have clearly demonstrated the safety of the product even in the vicinity of deliberately injured bowel or intentionally leaked anastomosis (45). Most recently Salum et al. analysed 259 patients in whom Seprafilm was routinely placed at the conclusion of colorectal operation for diverticular disease. This group was compared to an age, gender, and height matched group. The 30% overall conversion rate is higher than that published for laparoscopic ileostomy or colostomy creation has been widely described in the literature (47-49). Oliveira et al. (50) assessed the outcome of patients who underwent elective laparoscopic stoma creation, including patients with fecal incontinence (n=11), Crohn’s disease (n = 6), unresectable rectal cancer (n = 4), pouch or rectovaginal fistula (n = 5), and others (n = 6). Conversion was necessary in five patients (15.6%) because of adhesions in three, and enterotomy in two patients. All converted cases had undergone previous surgery, and represent our early experience with laparoscopic stoma creation. Two (6%) patients developed postoperative stoma outlet obstruction after construction of a loop ileostomy. One of these patients required reoperation, where a rotational of the terminal ileum was found, while the other was successfully managed conservatively. Patients with previous surgery had a higher mean operative time (55 minutes versus 112 minutes; P=0.0002). However, the mean hospital stay was similar in patients with or without previous surgery (6.2 days versus 6.6 days; P= NS). Therefore, previous surgery itself should not be considered a contraindication for laparoscopic stoma creation. In fact, in this group it may be even more beneficial than for patients who have not undergone a prior laparotomy. Specifically, while a trephine stoma is possible in the latter group, it is much more difficult to safely accomplish in the former group. Laparoscopy allows both inspection of the extent of disease and extensive enterolysis without the need for laparotomy.

Total abdominal colectomy with ileostomy or ileorectal anastomosis and Hartmann’s revesal

Subtotal or segmental colectomy with an end ileostomy of colectomy with overviewing of the rectal stump are procedures that may be indicated when a primary anastomosis for patients with diffuse
posteriorly to confirm adequate mobilization of the hepatic flexure. Transected caudal to the gastroploic vessels. Regardless of the mobilization of the right colon should proceed to a level to the line of Toldt is exposed. Mobilization of the right colon is generally identified by “creeping fat”. They should be marked with clips to allow subsequent identification and strictureplasty.

generally identified by “creeping fat”. They should be marked with clips to allow subsequent identification and strictureplasty.

Vascular division can be safely and quickly performed during the extraperitoneal phase, with less expense and possible more safely than during the intraperitoneal phase. In addition, proximal strictures should be the direct vision as a complimentary extraperitoneal procedure. Once the bowel is resected and the anastomosis completed, the bowel is returned to the abdomen and the incisions are closed. It is important to close the fascia at all 10 mm port sites as port site hemias have occurred. If a 33mm port was utilized, it can be replaced. It may be necessary to place several peritoneal and fascial sutures in order to prevent any leakage at the pneumoperitoneum during the reinfusion process. Alternatively, whether or not a 33mm port was utilized, the left sided specimen delivery incision can be primarily closed at this juncture.

Results of laparoscopically assisted resection for Crohn’s disease

The surgical results of laparoscopic ileocolonic resection are summarized in Table 2. The average morbidity rate is 11%. The average hospital stay is 7 days and the mean conversion rate 12.4%. Bauer (34) compared laparoscopic and laparotomy, reporting that the stimated blood loss is less and the commencement of oral intake is earlier in the laparoscopic group. The most common cause for conversion to laparotomy is an unsuspected finding of a large inflammatory mass with an associated fistula (22). Hildebrandt (35) reported that the main benefit of this technique was early mobilization due to reduced pain. Bauer (36) concluded in a study of 18 patients following ileocolic resection that the preoperative evaluation and selection is paramount in predicting the outcome of patients with terminal ileal Crohn’s disease who underwent laparoscopic resection. During laparoscopic bowel evaluation, synchronous jejunal strictures, unrecognized by preoperative small bowel radiographic investigation, may be identified and treated. (22) Although the presence of a fistula makes the laparoscopic approach more difficult it is both feasible and advantageous to the patients (37).

During initial experience with laparoscopic colorectal surgery, lower gastrointestinal fistulas were considered a contraindication. The 30% overall conversion rate is higher than that published for ‘simple’ colorectal patholgy, attesting to the challenging nature of these conditions (38). However, as experience has increased and instrumentation improved, this procedure is now used more often for patients with these indications (39).

Alabaz (40) compared the safety, outcome, and length of disability of patients who underwent laparoscopic-assisted or conventional ileocolic resection during the same time period; patients were stratified by severity of disease and many others parameters. Laparotomy was associated with a higher incidence of symptomatic small bowel obstruction, which necessitated readmission to the hospital. Although the incidence of relaparotomies were similar between the two groups (8% for the laparotomy group versus 4% for the laparoscopic group; P=NS), the incidence of symptomatic bowel obstruction was significantly increased in the laparotomy group (31% versus 8%; P<0.05). Moreover, the return to work and to normal activities was significantly shorter in the laparoscopic group (3.7 ±2.2 weeks in the laparoscopic group versus 8.0 ±2.2 weeks in the laparotomy group; P=0.001) than in the laparotomy group.

Traditionally, postoperative adhesion formation and bowel obstruction have plagued colorectal resections. The problem is particularly vexing if a stricture is present. The procedure is planned, as the same surgeon may need to again delve into an adhesion-ridden abdomen. Not only is the length of time required to reenter the abdomen significantly longer (41) but the incidence of significant injury such as enterotomy or myotomy is as high as 20% (42). Traditionally very little could be done to prevent this problem. However, Becker et al. recently demonstrated that the combination of Sodium hyaluronate and carboxymethylcellulose (SeprafilmTM, Genzyme Corp, Cambridge Massachusettes) may significantly reduce the incidence, severity, and grade of adhesions at the site of application (43). Subsequent studies have confirmed the efficacy of Seprafilm placement even in patients with chronic adhesive disease (44). Other studies have clearly demonstrated the safety of the product even in the vicinity of deliberately injured bowel or intentionally leaked anastomosis (45). Most recently Salum et al. (50) reported that Seprafilm was used in patients in whom Seprafilm was placed at the conclusion of colorectal surgery. This group was compared to an age, gender, diagnosis, and procedure-matched cohort, also stratified by the number of prior laparotomies. At a follow up of up to over five years, there was a 50% reduction in the incidence of small bowel obstruction necessitating laparotomy. Because of these compelling data, it is our practice to place Seprafilm not only under the incision, but also over the Hartmann’s stump at the conclusion of every operation for diverticular disease.

Dunker (46) assessed body image, cosmetic results, and quality of life in patients with Crohn’s disease of the terminal ileum who had either laparoscopic-assisted or open ileocolic resection. He concluded that the cosmetic score was significantly higher in the laparoscopic than in the laparotomy group (p < 0.01) and that body image correlated strongly with cosmesis and with quality of life.

Anorectal Crohn’s disease

Only 1% to 5% of patients with Crohn’s disease present with isolated anorectal involvement, a subgroup of whom may benefit from either temporary or permanent faecal diversion. Laparoscopic loop ileostomy has been demonstrated to be a rapid and safe procedure. It can be accomplished with the use of three 10/12-mm trocars: one peri-umbilical for the camera and two for the instruments, as one incision will be for the stoma itself. Moreover, a complete intra-abdominal assessment can be achieved laparoscopically.

Laparoscopic ileostomy or colostomy creation has been widely described in the literature (47-49). Oliveira et al. (50) assessed the outcome of patients who underwent elective laparoscopic stoma creation, including patients with fecal incontinence (n =11). Crohn’s disease (n = 6), unrectsectable rectal cancer (n = 4), pouch or rectovaginal fistulas (n = 5), and others (n = 6). Conversion was necessary in five patients (15.6%) because of adhesions in three, and enterotomy in two patients. All converted cases had undergone previous surgery, and represent our early experience with laparoscopic stoma creation. Two (6%) patients developed postoperative stoma outlet obstruction after construction of a loop ileostomy. One of these patients required reoperation, where a stoma was created in the resected colon instead of the loop ileostomy. This patient was converted to a diverting loop ileostomy. The remaining patient had a higher mean operative time (55 minutes versus 112 minutes; P=0.0002). However, the mean hospital stay was similar in patients with or without previous surgery (6.2 days versus 6 days, P = NS). Therefore, previous surgery itself should not be considered a contraindication for laparoscopic stoma creation. In fact, in this group it may be even more beneficial than for patients who have not undergone a prior laparotomy. Specifically, while a trephine stoma is possible in the latter group, it is much more difficult to safely accomplish in the former group. Laparoscopy allows both inspection of the extent of disease and extensive enterolysis without the need for laparotomy.

Total abdominal colectomy with ileostomy or ileorectal anastomosis and Hartmann’s ‘reversal’

Subtotal or segmental colectomy with an end ileostomy of colostomy for diverticular disease.

Postoperative stoma outlet obstruction after construction of a loop ileostomy. One of these patients required reoperation, where a stoma was created in the resected colon instead of the loop ileostomy. This patient was converted to a diverting loop ileostomy. The remaining patient had a higher mean operative time (55 minutes versus 112 minutes; P=0.0002). However, the mean hospital stay was similar in patients with or without previous surgery (6.2 days versus 6 days, P = NS). Therefore, previous surgery itself should not be considered a contraindication for laparoscopic stoma creation. In fact, in this group it may be even more beneficial than for patients who have not undergone a prior laparotomy. Specifically, while a trephine stoma is possible in the latter group, it is much more difficult to safely accomplish in the former group. Laparoscopy allows both inspection of the extent of disease and extensive enterolysis without the need for laparotomy.

Total abdominal colectomy with ileostomy or ileorectal anastomosis and Hartmann’s ‘reversal’

Subtotal or segmental colectomy with an end ileostomy of colostomy for diverticular disease.
intra-abdominal sepsis, acute diverticulitis, toxic colitis or mechanical obstruction of the large bowel is associated with a high risk of dehiscence. Toxic colitis can be the initial symptom in one-third of patients with ulcerative colitis and is usually surgically managed. The use of the laparoscopic technique in these settings is debatable and should be avoided in the majority of cases as these patients tend to be severely ill, and a faster, more refined surgical approach may be desired. Two common conditions in which a total abdominal colectomy with ileostomy or with ileorectal anastomosis may be attempted are patients with either indeterminate colitis or pancreatitis.

The technique is similar to that for total proctocolectomy with an ileal pouch anal anastomosis for patients with mucosal ulcerative colitis, with the exception of performing a Pfannenstiel incision, as the rectum will not be mobilized.

The initial gain with total, subtotal, or segmental colectomy and a stoma (Hartmann's procedure) may be offset by the necessity of an additional operation which, despite having a low mortality (0-6%), carried a high morbidity (3-34%). Moreover, one-third of these patients will eventually find that their "temporary" stoma becomes permanent as patients and physicians are unwilling to accept the risk of a Hartmann's reversal. For this reason laparoscopic reversal of a segmental or subtotal colectomy with an end stoma and a rectal stoma, provided that it is safe, is an attractive option, particularly if morbidty can be reduced.

CONCLUSION

Laparoscopy is still controversial when applied for the attempted cure of colorectal carcinoma. While some advantages may be possible, certain disadvantages have also been postulated. Laparoscopic treatment of benign disease is far less controversial. Three of the best procedures and indications, respectively, are ileal pouch anal anastomosis for patients with mucosal ulcerative colitis, and laparoscopic secondary ileal pouch anal anastomosis for patients with ileoanal continuity, and ileorectal Crohn's disease, and laparoscopic secondary proctocolectomy or proctolostomy as Hartmann's reversal procedures. Significant benefits can be expected with these procedures relative to pain, ileus, length of hospital stay, cosmesis, ability, and possibly adhesion formation and subsequent bowel obstruction.

REFERENCES


intra-abdominal sepsis, acute diverticulitis, toxic colitis or mechanical obstruction of the large bowel is associated with a high risk of dehiscence. Toxic colitis can be the initial symptom in one-third of patients with ulcerative colitis and is usually surgically managed. The use of the laparoscopic technique in these settings is debatable and should be avoided in the majority of cases as these patients tend to be severely ill, and a faster, more refined surgical approach may be desired. Two common conditions in which a total abdominal colecetomy with ileostomy or with ileorectal anastomosis may be desired are patients with either indeterminate colitis or carcinoids. The technique is similar to that for total proctocolectomy with an ileal pouch anal anastomosis for patients with mucosal ulcerative colitis, with the exception of performing a Pfannenstiel incision, as the rectum will not be mobilized.

The initial gain with total, subtotal, or segmental colecetomy and a stoma (Hartmann's procedure) may be offset by the necessity of an additional operation which, despite having a low mortality (0-6%), carried a high morbidity (3-34%). Moreover, one-third of these patients will eventually find that their 'temporary' stoma becomes permanent as patients and physicians are unwilling to accept the risk of a Hartmann's reversal. For this reason laparoscopic reversal of a subtotal or total colonic stoma with an end stoma and a rectal stump, provided that it is safe, is an attractive option, particularly if morbidity can be reduced.

CONCLUSION

Laparoscopy is still controversial when applied for the attempted cure of colorectal carcinoma. While some advantages may be possible, certain disadvantages have also been postulated.

Laparoscopic treatment of benign disease is far less controversial. Three of the best procedures and indications are laparoscopic sigmoid colecetomy for diverticulitis, laparoscopic-assisted ileocolic resection for terminal ileal Crohn's disease, and laparoscopic stoma creation for perianal Crohn's disease, and other reasons. Other potentially advantageous operations and indications include laparoscopic-assisted total abdominal colecetomy for colonic Crohn's disease, laparoscopic total proctocolectomy for colonic and anorectal Crohn's disease, and laparoscopic secondary ileorectoplasty or coloproctoplasty as Hartmann's reversal procedures. Significant benefits can be expected with these procedures relative to pain, ileus, length of hospital stay, cosmesis, disability, and possibly adhesion formation and subsequent bowel obstruction.

REFERENCES