

Minimally invasive surgery of the colon and rectum

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SUMMARY

Minimally invasive colectomy for surgical disease of the colon and rectum has been performed for 5 years. The purported advantages are less pain and quicker recovery. Utilization of minimally invasive colectomy for the treatment of colorectal carcinoma is controversial because of resection and staging adequacy, port recurrence, and patient survival. The safety and practicality of minimally invasive colectomy for malignancy will require evaluation in large clinical trials. Performance of minimally invasive colectomy for benign indications is an accepted practice.

REVIEW

Justification for minimally invasive colectomy. The purported advantages of minimally invasive colectomy (MIC) over open colectomy include improved intraoperative visualization of the pelvis¹², less stress on patient physiology,⁵⁹ less postoperative pain,^{5,63} improved cosmesis, shorter duration of ileus,^{13,58} briefer hospitalization,^{13,15,58} and lower cost^{16,40,58,64}. Proof for these advantages has been from uncontrolled studies. Scientific evidence of shorter ileus has not been conclusive.^{27,28,57} Improved cosmesis is an obvious advantage; proof of other advantages will require data from large clinical trials.

Treatment of colorectal cancer. Reports of MIC for cancer first appeared in 1991.^{17,30} Currently, a "large" single institution experience for this indication numbers under 100 patients.³⁵ As of yet there are no published multi-institutional prospective controlled studies comparing MIC versus open resection for colorectal

cancer, although such a trial is underway⁴³ and others will follow. It will take another 5-10 years for this information to be available; conclusions drawn now are subject to change.

Definitions. A loosely applied nomenclature has developed for the spectrum of minimally invasive colorectal procedures. A laparoscopic colectomy (LC) is an entire resection performed through trocar ports. If an incision is made to complete some portion of the resection, the procedure becomes a laparoscopically assisted colectomy (LAC). The reported incision length for LAC ranges from 2.5 to 10 cm.^{10,58} The definition of LAC is imprecise because it only specifies the presence of an incision, not the steps of the operation which were performed intracorporeally or extracorporeally. The imprecision of the definition may complicate comparison of one LAC to another or comparison of LAC with open colectomy. For convenience, LC and LAC will be referred to below as MIC. A recent extension of MIC is a system which allows insertion of the surgeon's hand into the abdomen to assist in the laparoscopic operation; this has been labeled "laparoscopic-assisted mini laparotomy."⁴⁷

Indications. MIC for colorectal cancer has been performed for cure and palliation of tumors located from the cecum to the anus.^{26,32,35,39,67} Recently there has been some concern over use of MIC for cure (see below), which has prompted some to recommend that curative MIC be performed only within controlled trials.^{7,66} The trend in the literature, however, has been to employ MIC for all stages of colorectal carcinoma, while adding the caveat that long term survival is unknown.

Contraindications. Relative contraindications to MIC for colorectal cancer include locally invasive disease,^{1,48} obesity,^{1,15,51} previous abdominal surgery,^{15,39} and malignant ascites.⁹ Most laparoscopists would not be dissuaded from MIC in a patient with previous abdominal surgery unless dense intraabdominal adhesions have been documented.

Technique: general. The objective in performing MIC for colorectal cancer is duplication of open oncologic resection. Theoretically this should allow the survival of the MIC patient to approach that of the open patient. Controversy arises in several areas regarding the duplication of the open operation.

Mobilization of the colon and rectum is performed intracorporeally for all cases of MIC. The location of the rest of the procedure depends on the tumor and the surgeon's preference. Low anterior resection (LAR) may be performed entirely within the abdomen, with the specimen removed transanally and the anastomosis created with an end-to-end stapler.^{1,18} Alternatively, a muscle splitting incision may be made to resect the specimen; the proximal colon then is placed back into the abdomen and a stapled anastomosis is created.⁷¹ The abdominal portion of an abdominoperineal resection (APR) may also be performed completely via the laparoscope. The specimen is removed during the perineal part of the procedure. There has been concern⁴⁵ that some lesions treatable by open LAR are excised with a laparoscopic APR because the current generation of laparoscopic stapler-cutters cannot be placed low in the pelvis; an articulating stapler-cutter should help this situation. Right hemicolectomy predominantly is laparoscopically assisted, with either intra- or extracorporeal ligation of the vascular pedicle followed by extracorporeal resection and anastomosis (hand sewn or stapled).²⁶

Technique: staging. Palpation of the liver and lymph nodes, which is performed during an open operation for colorectal malignancy, cannot be done during MIC. It is conceivable that this will result in understaged MIC patients. It remains to be seen if this difference between open and laparoscopic technique will produce a survival difference. The use of laparoscopic intraoperative ultrasound may provide a substitute for palpation during MIC.

Technique: tumor localization. Some early reports of MIC for cancer contained

cases in which the tumor could not be localized, which led either to conversion so palpation could be performed, or laparoscopic resection of a bowel segment which did not contain the tumor (necessitating a second resection).^{10,67} This problem may be avoided by tattooing the lesion colonoscopically prior to operation, or performing intraoperative colonoscopy.^{18,34,67}

Technique: lymphadenectomy. Another criticism of MIC is inadequate excision of lymph nodes. Primary (paracolic) and secondary (mesenteric) lymph nodes should be removed during a colectomy for cancer in order to stage the tumor. It is controversial whether lymphadenectomy increases survival.⁶⁹ Numerous uncontrolled studies have claimed that a properly performed MIC removes an equivalent number of lymph nodes compared to open colectomy.^{5,15,16,23} Such studies may be misleading because of a lack of discrimination between paracolic and mesenteric nodes and pathologist bias. The importance of lymphadenectomy with respect to staging and survival needs to be defined with controlled trials. Technically it may be easier to obtain lymph node clearance by intracorporeal ligation (rather than extracorporeal) of the vascular pedicle.¹

Technique: extent of resection. It was demonstrated more than 60 years ago that wedge resection of a colon tumor through small incision (Mikulicz procedure) resulted in a high rate of incisional recurrence.⁶¹ Resection with wide margins (following the vascular supply) subsequently was adopted and produced local control such that the technique endured to this day. There have been some reports of MIC in which less-than-customary margins were obtained, possibly in an attempt to facilitate the procedure.^{44,69} In defense of this, there is still some controversy over whether wide margin resection increases survival.⁵⁵ Wide margin resection should be carried out, however, if the surgeon wants to meet the primary objective of open operation duplication. A wide circumferential margin of resection also is important in preventing local recurrence of rectal cancer;⁵⁰ however, there is no data yet on this parameter for minimally invasive resection.²⁴

Technique: learning curve. Proficiency in MIC (defined as stable operative time) is obtained after 15-50 cases.^{60,70} Right hemicolectomy appears the least difficult technically; left sided colectomy is more difficult, especially with mobilization of the splenic flexure and/or mesorectum.²⁰ It is apparent that MIC requires more cases for proficiency compared to laparoscopic cholecystectomy. It is recommended that experience in the animal laboratory is obtained prior to performing MIC in humans.^{1,46} Team approach (more than 1 laparoscopist) in the operating room also is encouraged.²⁶

Conversion. Conversion most commonly is due to "difficult anatomy" or "difficult dissection" and probably represents difficulty from poorly positioned trocars, obstructed view, obesity, inflammation, operator inexperience, inadequate instrumentation, or any combination of these.^{15,26,32} Other causes for conversion include tumor fixation, bleeding, enterotomy, and trocar laceration of vessels or viscera.^{15,26,32} Conversion rates range up to 50%.^{5,15,44} It has been stressed that a primary consideration when contemplating conversion is duplication of the open operation. If a surgeon is presented with "difficult anatomy," there may be temptation to compromise the field dissection to facilitate the MIC. Such a case should be converted.

Complications. Some complications common to all laparoscopic surgery have occurred with MIC for colorectal cancer: trocar laceration of vessels and viscera,⁶⁵ enterotomy,^{15,26} and port site hernia.¹ Colectomy-specific complications have included anastomotic breakdown,¹⁵ stapler trauma to the bowel,^{16,26} intraabdominal abscess,^{15,32,71} ureteral injury,¹ and bleeding.^{15,32} In addition there has been pneumonia,⁷¹ deep venous thrombosis (DVT),¹ and the occasional mortality.⁵ There is some concern that long MIC operating time predisposes the patient to DVT.⁴⁵ The incidence of the above complications will be established

after large series of patients are published.

Recurrence. Port site and incisional recurrence after MIC for colorectal cancer was noted initially in 1993.¹⁹ Recurrence was noted for all tumor stages both in the trocar/incision site through which the specimen was extracted and also in trocar sites which never came in contact with the specimen.^{9,35,49,68} Port recurrence usually is noted within several months after operation. Implantation of intraabdominal malignancy at trocar sites is not unique to MIC, having been reported in gynecologic and general abdominal laparoscopy for years.⁸

Although reports of port recurrence after MIC are becoming more common, the incidence is unknown because of lack of the denominator.⁶⁶ The incidence in some small series of patients has been alarmingly high (e.g., 21%⁶). Incisional recurrence after open colectomy for colorectal cancer was 0.7 % in a series of 1603 patients, and was a marker of disseminated disease and limited survival.²⁹ Although it is too early to be sure, port recurrence in MIC may represent a local phenomenon and may not be an indicator of disseminated disease (but carcinomatosis has been reported³¹).

The mechanism of port recurrence is unknown. There is speculation that malignant cells are dispersed by the pneumoperitoneum. In a hamster model with intraperitoneal instillation of colon tumor cells, pneumoperitoneum tripled the port implantation rate compared to controls.³³ Treatment of localized port recurrence is wide local excision with or without radiation. Much of the criticism leveled at MIC for cancer is secondary to the issue of port recurrence.⁶⁶

Treatment of inflammatory bowel disease. MIC in both Crohn's and ulcerative colitis (UC) patients has been shown to be safe and feasible.^{1,36,38,54} Laparoscopic total abdominal colectomy with ileoanal pullthrough has been performed in UC patients, and laparoscopic ileocecectomy, segmental colectomy, and diverting colostomy has been done in Crohn's patients. It is unclear if the morbidity rate (secondary to bleeding, abscess, postoperative obstruction, and anastomotic breakdown) will be higher in IBD patients undergoing MIC compared to non-IBD patients. Occasional conversion secondary to inflammation or bleeding should be expected.

Treatment of rectal prolapse. The minimally invasive approaches to rectal prolapse which have been described include laparoscopic anterior resection,⁴ laparoscopic suture rectopexy,²² prosthetic fixation (laparoscopic Ripstein procedure),¹¹ and perineal proctosigmoidectomy (laparoscopically assisted Altemeier procedure)⁵³. The procedure choice in a given patient is complicated and requires evaluation for colon redundancy, sphincter competence, constipation, and patient condition.

Other conditions. MIC has been performed for benign polyposis,^{1,37} volvulus,^{1,62} diverticulitis,^{3,14,25} and endometriosis^{42,52} utilizing techniques describe above. MIC with coloanal pullthrough has been described in children with Hirschprung's disease.²¹ There have been case reports and small series of selected patients with penetrating trauma to the colon and rectum and with colonoscopic perforations which have been managed with a variety of laparoscopic techniques (e.g., colostomy, oversewing).^{41,56} Laparoscopic colostomy reversal has been described,² and is a good way for the beginning colorectal laparoscopist to gain experience.

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