

Laparoscopic Resection of Curable Colon and Rectal Cancer

I. DIAGNOSTIC EVALUATION

When a colon or rectal cancer has been detected, preoperative staging, assessment of resectability, and assessment of the patient's operative risks are indicated. Usually with colonoscopy, the entire colon and rectum should be evaluated. Consideration of a minimally invasive surgical approach requires accurate localization of the tumor, from the serosal aspect of the bowel as a known cancer may not be apparent during laparoscopic visualization. Accurate localization is essential because the wrong segment of colon may be removed. For accuracy and for proper localization of a tumor in the rectum and cecum, Colonoscopy is the best, and may otherwise be inaccurate. Alternate methods for identifying the segment of colon involved include tattooing at the time of colonoscopy, barium enema, and CT colonography. In the setting of a large tumor CT scan may be helpful, but to localize for smaller tumors not reliable. If the tumor is not localized preoperatively, intra-operative colonoscopy may be helpful.

When open resection of colon cancer is performed the liver is not routinely evaluated preoperatively. Liver metastases of >1cm diameter are detected by CT scan with sensitivities and specificities of 90 and 95%. However, in many institutions this rarely results in a change in the operative strategy. Routine use is noted in centers where synchronous resection of the primary and metastatic tumors is performed. Instead, the liver is palpated intra-operatively or intra-operative US may be performed. A laparoscopic approach precludes the ability to palpate the liver, although the visualization provided may reveal surface lesions not detected by CT scan. If unable to palpate the liver intra-operatively, preoperative assessment of the liver by CT or US10 or intra-operative US should be performed.

In the case of rectal cancer, staging CT scan or transanal rectal US is routine and not influenced by the laparoscopic approach. Preoperative abdominal CT or hepatic US is required in planning surgical treatment for rectal cancer, as the findings may change the operative approach significantly.

II. PREPARATION FOR OPERATION

In North America, Preoperative mechanical bowel preparation is the common practice, to support its use, despite lack of clear evidence of benefit from meta-analysis and randomized controlled trials. Although some authors have recommended no preparation, during laparoscopic colon and rectal surgery an empty colon is generally considered to facilitate manipulation of the bowel. When considering a completely laparoscopic approach with intra-corporeal anastomosis, a longer period of preparation is used by some authors.

III. OPERATIVE ISSUES

Operative Techniques – Colon

Proximal and distal colonic resection margins (determined by the area supplied by the primary feeding arterial vessel(s)); lymphadenectomy with a minimum of lymph nodes harvested; and ligation of the named feeding vessel at its origin. The two adequately powered randomized trials of laparoscopic colectomy for curable colon cancer followed these oncologic principles and showed no significant difference in proximal and distal bowel margins, number of lymph nodes retrieved, and, in the Clinical Outcomes of Surgical Therapy Study Group (COST) trial, perpendicular length of the primary vascular pedicle.

These all factors determine which portions of the procedure may be performed intra-corporeally or extra-corporeally. In a patient with a normal body mass index (BMI) undergoing right colectomy it is often feasible to ligate the base of the ileocolic pedicle via a periumbilical incision. This might best be performed intra-corporeally in a heavier patient. For all other vessels, the origin of the vessel will generally need to be ligated intra-corporeally unless a larger incision such as used for hand-assisted procedures permits safe access to the base of the vessels. Inability to comply with oncologic principles should prompt conversion to an open operation.

Operative Techniques – Rectum

Operative guidelines for open rectal surgery have been established with levels of evidence and grades for techniques relevant only to the rectum. These include a distal margin of 1-2cm, lymphatics up to the origin of the superior rectal artery (or inferior mesenteric artery if indicated) and removal of the blood supply and appropriate mesorectal excision with radial clearance.

In a randomized trial Laparoscopic resection of rectal cancer has not been evaluated. Prospective and retrospective case series have suggested that in carefully selected patients the procedure is feasible. The confines of the pelvis confer on the laparoscopic approach adds additional challenges, particularly for distal rectal tumors. The ability to perform an oncologically adequate laparoscopic resection for rectal cancer will depend on tumor factors such as size, proximal or distal location, and patient factors including anatomy of the pelvis (narrow or wide), obesity, bulky uterus, and effect of prior radiation on tissue planes. Inability to adjust with oncologic principles should prompt conversion to an open operation.

Contiguous Organ Attachment

To manage locally advanced adherent colorectal tumors current guidelines for open colon and rectal cancer surgery recommend *en bloc* resection. Histologically negative margins achieved with *en bloc* resection are considered curative. Preoperative studies such as CT scan may suggest a bulky tumor invasive into an adjacent organ and guide the decision to perform an open resection. A known T4 colonic cancer may prompt an open approach. The ability to perform *en bloc* resection to which the tumor is adherent by laparoscopically is dependent on the structure, in addition to surgeon skill and experience. When the goal is curative resection, intra-operative discovery of a T4 lesion requires conversion, unless the surgeon is capable of properly resecting the lesion *en bloc*.

Tumor Perforation and the "No-Touch Technique"

Excessive force or use of instruments not suited to handling of the bowel may cause inadvertent perforation. Inadvertent perforation results in increased local recurrence of illness rates and a significant reduction in 5-year survival. Thus, although the "no-touch technique" (with early ligation of vessels) is not specifically recommended, avoidance of perforating the tumor with handling is suggested.

For open resection of curable colorectal carcinoma, with early ligation of the vascular supply, the value of the no-touch technique has not been proven. In laparoscopic resection, some surgeons employ a medial-to-lateral approach with early ligation of the mesenteric vessels. No oncologic benefit of this approach has been shown.

Prevention of Wound Implants

At the both extraction site incision and the port sites, Wound implants, or recurrence of cancer have been reported. The phenomenon has demanded extensive research.

Most measures suggested to prevent wound implants have been generated by *in vitro* and *in vivo* animal models, not clinical practice. The results of gasless laparoscopy are inconsistent, as some studies have shown a decrease in port site metastases, yet others have been unable to confirm this. Low insufflations pressure may result in reduced tumor growth. Carbon dioxide is the safest gas to work with in the clinical arena but may enhance tumor implantation and growth. Helium may reduce the rate of wound implants but is not used clinically. Wound excision has been shown to both decrease and to increase the rate of wound recurrence.

Certain experimental outcomes have resulted in simple modifications of the laparoscopic approach. Aerosolization of tumor implants occurs in experimental models employing large numbers of tumor cells, although others doubt its role in tumor implants. As it is easy to desufflate the pneumoperitoneum via the trocars rather than via the incision, some experts advocate this practice. Related to this is the description of gas leakage along loosely fixed trocars (the "chimney effect") which was related to increased tumor growth in one study. Thus use of trocars or fixation of trocar with modifications preventing slippage is widely used. Reductions in port site metastases have been shown in animal models following irrigation of the peritoneal cavity and/or port site incisions with solutions such as povidone-iodine, heparin, methotrexate, cyclophosphamide, tauroldine and 5-fluoro-uracil. Although these models employ supra-normal numbers of cancer cells, a consensus

panel of the European Association of Endoscopic Surgery reported that half the expert panel irrigated the port sites with either povidone-iodine, distilled water or tauroline and all the panel protected the extraction site and/or placed the specimen in a plastic bag prior to extraction.

The most significant impact on the incidence of port site metastasis has been that of experience and the development of laparoscopic techniques that permit an oncologic resection, identical to the open one, to be performed. Initial reports of port sites metastases ranging from 2%-21% have dropped to less than 1% in large case series and randomized trial. This is similar to the rate for open colorectal cancer resection. In the COST study and Lacy's study the rates were 0.5% and 0.9% respectively. The most important factor is surgical experience as considered in the prevention of incisional implants.

In summary, experimental animal models have shown a reduction in wound implants if the wound is protected or treated with a tumoricidal substance. There is no consensus on the nature of the irrigant, but diluted povidone-iodine and distilled water were the most commonly used among experts. In the operating room, in addition to wound protection, other commonly used techniques are fixation of trocars, evacuation of the pneumoperitoneum via the ports, and wound irrigation. Wound implants should be kept at a rate less than 1% by correct oncologic technique and experience.

IV. TRAINING AND EXPERIENCE

Laparoscopic colorectal resections are considered amongst the most complex of laparoscopic cases. Resection needs mobilization of a bulky structure, working in more than one quadrant of the abdomen, obtaining control of multiple large blood vessels, extraction of a large specimen, and creation of a safe anastomosis. For cancer, oncologic principles must be applied with the additional requirements of adequate distal and proximal margins, appropriate lymphadenectomy, proximal ligation of the vascular pedicle(s) and avoidance of handling and perforating of the tumor.

The level of experience for these procedures is likely variable and related to the specific procedure, the underlying pathology, and the skill and prior experience of the individual surgeon. Recognizing the need for experience by individual is advocated widely. Surgeons must be prepared to answer patients' questions regarding their experience.