Laparoscopic Management of Colorectal Cancer

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Abstract
Laparoscopic treatment of colorectal cancer has emerged as a result of the technical advances that have been made since the introduction of laparoscopic cholecystectomy. The minimal-access approach to treatment of benign disease results in smaller incisions, reduced length of hospital stay, and a faster return to productive life.

Laparoscopic approaches to colon cancer must take into consideration the potential effects of the technique on tumor dissemination at the time of the surgical procedure, as well as rates of recurrence and overall survival. Several technical approaches to laparoscopic colon resection have now become possible, utilizing either total intra-abdominal maneuvers or laparoscopic-assisted techniques. Margins of resection and lymph node removal with the minimal-access techniques compare favorably with those of open colectomy. Several series now show that early results utilizing laparoscopic resection for colorectal cancer are favorable but that routine implementation of this procedure should await confirmatory outcomes generated by well-done prospective clinical trials. (CA Cancer J Clin 1999;49:221-228.)

Introduction
The revolution known in general surgery as the “Laparoscopic Era” began in the mid-1980s when the first laparoscopic cholecystectomy was successfully completed. This technique was facilitated by the development of the three-chip camera and the ability to display intra-abdominal anatomy on monitors in the operating room.

During the past 10 years, the development of new accessory equipment has led to successful laparoscopic bile duct exploration, gastroenterostomy, anti-reflux procedures, and splenectomy. These procedures were facilitated by the creation of a pneumoperitoneum using carbon dioxide, which expands the intra-abdominal space. This technique allows the surgeon to explore the intra-abdominal contents and perform surgical procedures in an inert environment where electrocautery can be safely applied.

In addition to use in many benign diseases, laparoscopic assessment techniques can be used for preoperative staging, confirmation of imaging studies with biopsy, and therapeutic or curative resection in patients with cancer.1

Laparoscopic Colon Procedures
Laparoscopic approaches to the colon were initially conceived in the late 1980s when laparoscopic appendectomy began to show promise. The laparoscopic approach to the appendix involved the mobilization of the right colon, especially in patients with retrocecal appendicitis.

Reports of colonic and rectal resection for both benign and malignant disease began to appear in the early 1990s.2-4 These procedures were described as either “laparoscopic-assisted” or totally performed in the peritoneal cavity using a
Laparoscope and intracorporeal stapling or suture (Table 1).

The laparoscopic-assisted approach, with the creation of an extracorporeal anastomosis, is most commonly used when right colectomy and ileo-transverse anastomosis are performed. Although adhesions from earlier abdominal surgeries can increase the difficulty of performing laparoscopic procedures, laparoscopic colectomy can be performed in patients who have previously undergone open procedures. Nevertheless, when laparoscopic procedures are used, the inability to palpate the colonic lesion, a routine aspect of open operations, can cause difficulty with respect to locating the primary colonic lesion or can increase the chance of missing synchronous tumors in the colon. To prevent these problems, preoperative colonoscopy with tattooing of the colonic wall or intraoperative colonoscopy is recommended.

### Laparoscopic Versus Open Procedures

Several series have reported that short-term outcomes with laparoscopic colon resection are similar to those achieved with open procedures in patients with benign colorectal disease. Likewise, the incidences of anastomotic leakage, intraabdominal abscess, and postoperative colonic stricture are similar in patients undergoing laparoscopic and open procedures.

As is the case with laparoscopic cholecystectomy, some patients may require conversion from a laparoscopic to an open procedure. This is usually secondary to identifying significant adhesions or additional unexpected pathology. The rate of conversion in laparoscopic colectomy has continued to decrease over the past several years as surgeons have become more facile with these techniques. Early studies reported a conversion rate of 30% to 40%, whereas more recent studies indicate that only 7% to 10% of patients need conversion to open procedures.

### Benefits of Laparoscopic Procedures

The expected benefits of any laparoscopic procedure are to reduce the need for a large abdominal incision, lessen postoperative pain, and decrease the time to return to work and normal activity (Table 2). Several studies have reported a reduced hospital stay following laparoscopic colonic resection; others, however, while noting a reduction in ileus and the need for postoperative narcotics, did not find differences in overall length of stay compared with open procedures.

Although several well-done studies from individual institutions have been reported, comprehensive assessment of laparoscopic techniques for patients with colorectal cancer will require results of randomized clinical trials, such as studies currently being conducted by the National Cancer Institute and the Clinical Outcomes of Surgical Therapy study group. It is hoped that these prospective randomized studies will help determine whether patients undergoing laparoscopic colectomy have recurrence rates similar to those of patients undergoing open colectomy.

**SURGICAL CHALLENGES**

A controversial issue with respect to performing minimal access procedures for cancer is the possibility that tumor cells may be implanted in the percutaneous (trocar) sites (Table 3). A large

| Table 2 | Advantages of Laparoscopic Colonic Resection for Cancer |
|---------|-------------------------------------------------------|
| 1. Limited abdominal wall trauma |
| 2. Reduced postoperative pain |
| 3. Possible more rapid return of bowel function |
| 4. Possible reduced length of hospital stay |
| 5. Possible hastened postoperative recovery |
| 6. Similar staging opportunities compared with open procedures |
| 7. Short-term outcomes similar to traditional procedures |
| 8. Possible protection of immune function |

| Table 3 | Possible Causes of Trocar Site Implantation Associated with Laparoscopic Colon Resection for Cancer |
|---------|------------------------------------------------------------------------------------------------|
| 1. Tumor spillage secondary to manipulation |
| 2. Disbursement of cells secondary to carbon dioxide pneumoperitoneum |
| 3. Mechanical disruption of peritoneum |
| 4. Entrapment of tumor cells secondary to trocar-site hematoma |
| 5. Tumor spillage secondary to specimen removal |

223 CA—A CANCER JOURNAL FOR CLINICIANS
number of animal studies have suggested that the pneumoperitoneum necessary for laparoscopic colorectal surgery may, in fact, enhance cell disbursement and the development of trocar site recurrence. Additional studies suggest that surgical technique, especially the handling of the bowel tumor, may be the initiating event in port site recurrence. If pneumoperitoneum is the culprit, the use of abdominal wall lift devices, which allow gasless laparoscopic techniques, may represent a solution. These gasless techniques have not become popular, however, and probably will not replace the use of carbon dioxide pneumoperitoneum in the foreseeable future.

Unfortunately, traditional celiotomy used by surgeons for many decades in the treatment of patients with colorectal cancer has not been standardized (Table 4). This prohibits accurate comparison of outcomes among surgeons. Certain principles, such as careful handling of the tissue, adequate surgical margins, wide resection of colonic mesentery to include nodal drainage regions, and appropriate anastomotic technique, are all important to the performance of safe and effective colonic resection for cancer. Generally, these principles can be similarly satisfied by laparoscopic colonic resection. Several investigators have reported, for instance, that lymph node retrieval (Table 5) and length of tumor margins are similar, regardless of whether open or laparoscopic maneuvers are used.

It is interesting to note that an average of 13 lymph nodes are obtained using either the laparoscopic or the traditional, open-colon procedures. The identification of nodal metastatic disease currently depends on histologic evaluation, which may miss small foci of tumor, causing patients to be understaged using the TNM classification. In the future, use of technology such as polymerase chain reaction may better identify metastatic disease in lymph nodes removed by open and laparoscopic techniques.

Although several recent reports indicate that node retrieval has been ample in laparoscopically resected patients, other investigators have observed that lymph node retrieval during laparoscopic colon resection is inadequate when compared with open traditional approaches. Additionally, although node dissection may be satisfactory with laparoscopic resection of the right colon, the retrieval of nodes in patients having left colon or rectal excisions has been sub-optimal.

**Future Role for Laparoscopic Techniques**

Any eventual role of laparoscopic resection for treatment of colorectal can-

| Table 4 | Principles of Colorectal Cancer Resection |
|---------|------------------------------------------|
| 1. Full intra-abdominal assessment |
| 2. Identification and confirmation of visceral metastases |
| 3. Full mesenteric and nodal dissection |
| 4. Adequate margins of resection (longitudinal and radial) |
| 5. Safe creation of anastomosis or stoma where applicable |
cancer will have to be confirmed by reports from well-done, prospective series. Fortunately, several of these are now in progress.

Recent reports from single-institution, prospective, randomized studies provide results of at least the short-term outcomes of patients undergoing laparoscopic procedures. Milsom et al, for instance, recently compared 42 patients with cancer who underwent laparoscopic resection with 38 patients who had conventional open procedures. These patients were followed for a median of 1.5 and 1.7 years, respectively. No port site recurrences were reported in the laparoscopic group, and cancer-related deaths were equal in both groups.

Despite the favorable short-term outcome, these authors correctly pointed out that results from a single institution study do not have the statistical power provided by a multi-institutional study. Statistical power is especially important with regard to port site recurrence, which has been estimated to occur in 1% to 1.5% of patients in some series. Large numbers of patients must be fully assessed to completely address the criticism that tumor implantation may be increased in patients undergoing laparoscopic colectomy.

| Published Report | Year | Number of Nodes (Average) |
|------------------|------|---------------------------|
|                  |      | Open | Laparoscopic |
| Bleday et al²     | 1993 | 9.5  | 10.5         |
| Peters et al¹⁹    | 1993 | 8.5  | 7.9          |
| Tate et al³       | 1993 | 10.0 | 13.0         |
| Musser et al²⁰    | 1994 | 7.9  | 10.6         |
| Hoffman et al⁹    | 1994 | 8.0  | 6.1          |
| Darzi et al¹⁷     | 1995 | 11.0 | 8.0          |
| Franklin et al⁷   | 1995 | 14.7 | 15.8         |
| Tucker et al⁴     | 1995 | 6.4  | 8.7          |
| Lacy et al¹⁸      | 1995 | 12.5 | 13.0         |
| Lord et al²¹      | 1996 | 8.9  | 7.8          |
| Franklin et al⁶   | 1996 | 13.0 | 15.3         |
| Milsom et al⁸     | 1998 | 25.0 | 19.0         |

Table 5: Comparison of Lymph Node Harvest in Open and Laparoscopic Colectomy
While it is clear that laparoscopic colorectal surgery can be performed safely, the question remains whether laparoscopic colorectal surgery can be performed safely for patients with large bowel cancer (Table 6). Franklin et al.\(^6\) addressed this issue with a non-randomized, prospective multicenter study of 194 patients undergoing laparoscopic or open colon resection. They reported that laparoscopic surgery allowed a similar resection with an equal number of mesenteric nodes removed, similar margins of resection, and comparable survival and disease-free intervals (Table 7). The mean follow-up for the laparoscopic group was 22 months. Recurrent disease was noted in 7% of patients after open resection and in 8% after laparoscopic resection.

A randomized study from Spain performed by Lacey and colleagues\(^18\) showed no differences in lymph node removal, pathological staging, or margins of resection when patients who underwent laparoscopic or open colectomy were compared. These authors noted fewer complications, in fact, in their laparoscopic patients. It is expected that similar studies will be published in the next several years that will confirm equivalent short-term outcomes for the two surgical techniques.

**Recommendations**

What should we recommend to our patients who have colorectal cancer and which surgical techniques should we use in caring for these patients? The ultimate answer depends on the training and experience of the individual surgeon in recom-

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**Table 6**

**Possible Disadvantages of Laparoscopic Colonic Resection for Cancer**

1. Reduced ability to explore peritoneum
2. Reduced ability to palpate and localize colonic lesion
3. Mechanical manipulation of tumor leading to cellular disbursement
4. Increased operating room time and cost
5. Possibility of port-site tumor seeding
6. Possible detrimental effects of conversion to open procedures
7. Questionable detrimental effect on recurrence rates and survival
mending an operation that is both safe and effective for a patient with a particular disease process.

A review of all available reports clearly shows that laparoscopic colon resection for benign and malignant disease is safe and comparable, in the short-term, to conventional, open procedures. Patients with small right-sided malignancies can be effectively treated with laparoscopic-assisted right colectomy and creation of an extracorporeal anastomosis. These patients will require close follow-up for possible port site recurrence. It is the obligation of surgeons performing these procedures to report unusual manifestations of tumor recurrence in their patient populations.

The resection of bulky or advanced colon cancer is still best performed using open, conventional techniques, as complete resection and full assessment of the intra-abdominal cavity can be performed. Preoperative laparoscopy for the assessment of metastases from colon and rectal cancer is not associated with the same overall benefit as is laparoscopy for pancreatic or esophageal cancer, as most patients with colonic malignancy require resection, even when disease has metastasized to the liver or other organs.

Patients who request laparoscopic resection of colorectal cancer or those deemed to have disease appropriate for the technique should be considered for surgical clinical trials under Institutional Review Board guidelines. These trials may finally determine whether “open” and “minimal-access” techniques are truly equal.

**Table 7**

| Study                  | Follow-up (Months) | Number of Patients | Converted (Number, %) | Recurrence (Number, %) |
|------------------------|--------------------|--------------------|-----------------------|------------------------|
| Fielding et al          | 33                 | 149                | 26 (7)                | 10 (7)                 |
| Lacy et al             | 11.5 - 21.4        | 31                 | 4 (13)                | 5 (16)                 |
| Milsom et al           | 18                 | 42                 | —                     | 3 (7)                  |
| Franklin et al         | 33                 | 191                | 8 (4)                 | 25 (13)                |

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