

Minimally Invasive Surgery for Colorectal Cancer—An Update

a report by

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Colorectal cancer is still the third most common malignancy in men and women and the second leading cause of cancer death worldwide. There are almost 150,000 cases diagnosed annually in the US, with approximately 57,000 deaths per year. The mainstay of colorectal cancer treatment is surgical resection of the tumor. Traditionally, a colon resection required a midline abdominal incision, a significant stay in the hospital, and a recovery period of up to three months.

Minimally invasive surgical techniques were described as early as 1901, when Kelling placed a cystoscope in a dog. In 1911, Jacobaeus laparoscoped a patient with ascites, and in the 1930s, carbon dioxide was used for insufflating the abdomen. It was not until the fiber optic revolution began in the late 1950s that routine surgical use became feasible. This culminated in the 1960s with the report of a laparoscopic tubal ligation. The modern era of laparoscopic surgery began in the 1980s, when high resolution charged coupling devices brought in the era of digital imaging, and in 1987, the first laparoscopic cholecystectomy was performed.

In 1991, five separate authors described a laparoscopic approach to colon resection; however, almost 15 years later, there is still some debate over whether a minimally invasive approach to colorectal cancer is appropriate. This article will review the principles of oncologic resection for colorectal cancer, the benefits and risks of laparoscopic surgery for colorectal cancer, and give an overview of some of the more significant trials published to date.

Principles of Oncologic Resection

Adjuvant chemotherapeutic regimens have improved survival in stage 3 cancers and may be of benefit in some patients with stage 2 cancers as well, but surgical resection is the definitive treatment for colorectal cancer. In general, the goals of an oncologic resection are: taking adequate margins, performing a lymphadenectomy, and performing a high ligation of the vascular pedicles. In addition, a total mesorectal excision is required for low rectal cancers.

For colon cancer, 5cm margins are usually adequate. For a right colectomy, I resect the distal 5cm of ileum as my proximal margin. I routinely take the ileocolic artery and right branch of the middle colic artery. For transverse colon cancers, I perform an extended right colectomy (from ileum to descending colon) and for left colon and sigmoid cancers I ligate the inferior mesenteric artery at the level of the aorta. In addition to cure, sphincter preservation is one of the goals in patients being treated for rectal cancer. For low rectal cancers, a mucosal margin of at least 2cm from the dentate line in conjunction with a total mesorectal excision is required.

Laparoscopic Colectomy—Pitfalls

As mentioned above, despite the fact that laparoscopic colectomy was described 15 years ago, it has still not become mainstream. The most common reason cited was the description of port site metastases reported after laparoscopic colectomies for stage 1 colon cancers. There was speculation that the incidence of port site metastases was higher after laparoscopic resections than open resections. However, in April 2001, the largest randomized trial to date comparing the surgical techniques showed no difference in the incidence of port site metastases. To date, no series or trial has shown an increased risk of port site metastases after laparoscopic resection for colorectal cancer.

Another reason for the slow acceptance of laparoscopic colectomy is the steep learning curve. The skill sets required for laparoscopic colon resections is far more advanced than those required for laparoscopic cholecystectomy. Current guidelines require a minimum of 20 cases performed for benign disease before attempting a laparoscopic resection for cancer.

As current surgical house staff enter the workforce, the skill sets will be present and the learning curve should shorten. In 1998, colorectal surgery residents in fellowships approved by the American Board of Colorectal Surgery performed a total of 253



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Figure 1: Incision for laproscopic left colectomy**Figure 2: Incision for laproscopic right colectomy**

laparoscopic cases. In 2005, this number approached 2,987 cases, with the average resident performing 45 laparoscopic cases.

difficulty visualizing the base of the transverse colon mesentery and working in that plane to achieve an adequate margin. It is also difficult to divide the rectum low in the pelvis. Until these technical hurdles are conquered, most surgeons will perform these cases as part of a protocol procedure.

Laparoscopic Colectomy—Benefits

One of the major advantages of a minimally invasive approach to colorectal cancer is reducing the length of stay in the hospital. According to Medicare data, in the academic year 1999–2000, after 161,000 major intestinal resections, the average length of stay was 11.3 days. This translates to roughly 1.8 million hospital bed days, with a cost of \$1.75 billion dollars per year. Laparoscopic colectomy has decreased length of stay in every large series published, with the potential to add significant cost savings to the healthcare system, even though the equipment is more expensive.

In addition to cost, all the benefits of a minimally invasive approach can be seen after laparoscopic colectomy. There is a shorter post-operative ileus, with a faster return to regular diet; a shorter length of stay, from anywhere from one to three days, depending on the study; decreased analgesic requirements, with an earlier return to activities of daily living; and a lower morbidity rate as well.

In the first prospective randomized trial comparing laparoscopic and open colectomy for cancer, the overall morbidity was 32% in the open group and 13% in the laparoscopic arm. An additional

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Some critics were concerned that laparoscopic colon resections do not adhere to oncologic principles; however, numerous trials compared margins, length of vascular pedicle, and number of lymph nodes harvested. There were no differences in any study comparing the open and laparoscopic approach.

The current areas of concern center on transverse colon cancers and very low rectal cancers. There is

study, published in 2004, also showed decreased morbidity with the laparoscopic approach. This data was duplicated again in the European prospective randomized trial midterm results published last year.

In addition, animal models have shown significantly less surgery related immunosuppression after a laparoscopic resection. A study published in 2002 showed lower

levels of vascular endothelial growth factor (VEGF), with the smaller incisions performed at laparoscopy. Finally, one significant benefit is cosmesis. The average incision length in my practice is 5cm after a laparoscopic colon resection. The smaller incisions heal faster, have fewer complications, and look better than their open counterparts (see *Figures 1–3*).

Current Data

Many case series and retrospective reviews have been published regarding laparoscopic colectomy for cancer. Most have dealt with right, left and sigmoid cancers, excluding transverse and rectal cancers for reasons mentioned above. To date, no trial has shown a survival disadvantage to a minimally invasive approach to colon cancer resections.

In 2002, Lumley published one of the early series looking at five-year survival rates after laparoscopic resections for colon cancer. His stage 1 cancers had 91% survival, stage 2 had 83% survival and stage 3 had 74% survival. The National Cancer Database (NCDB) recorded the following survival for colon cancers diagnosed in 1994–1995: stage 1 had 70% survival, stage 2 had 60% survival, and stage 3 had 40% survival. Two other studies published that year showed no differences in survival between the laparoscopic and open groups.

Figure 3: Incision for Open Left Colectomy



cancer-related survival to the open group. Based on this study, the American Society of Colon and Rectal Surgeons (ASCRS) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) approved a statement approving laparoscopic resection for colon cancer after performing 20 cases for benign disease.

Conclusion

Laparoscopic colon resections are oncologically sound, and have equivalent cancer-related survival and lower morbidity than the open surgical

There is a significant learning curve, and patients should only be referred to those surgeons experienced in minimally invasive approaches to colorectal cancer.

The first prospective randomized trial comparing laparoscopic and open surgery for colon cancer was published in the *Lancet* in 2002. This study showed no differences in overall survival, but significantly improved cancer-related survival in the laparoscopic arm.

In May 2004, the Clinical Outcomes of Surgical Therapy Trial (COST) was published in *The New England Journal of Medicine*. This was a multi-center prospective randomized trial, with 48 participating centers throughout North America. The study compared laparoscopic and open colectomies for right and left colon cancers, and enrolled 872 patients. Laparoscopic colectomy had an equivalent

technique. Based on the data, a laparoscopic colectomy for colon cancer should be the new standard of care. However, there is a significant learning curve, and patients should only be referred to those surgeons experienced in minimally invasive approaches to colorectal cancer.

There are on-going trials analyzing the benefits of a laparoscopic approach to rectal cancer, but most experienced minimally invasive colorectal surgeons are already performing rectal cancer resections. Finally, as technical improvements continue to develop, faster operating times and even shorter length of stays at hospital may be possible in the near future. ■