Adoption of Laparoscopic Colorectal Surgery: It Was Quite a Journey

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Abstract

The adoption of laparoscopic colorectal surgery has been a slow but steady progress. The first adopters rapidly expanded the application of the technology to all colorectal pathology. Issues related to extraction and port site recurrence of cancer delayed widespread adoption until incontrovertible data from well-powered prospective randomized studies confirmed equipoise with open surgery. Since that time, the data has consistently demonstrated patient-care benefits related to reductions in both short- and long-term complications historically associated with open colectomy. The potential for further improvement related to single-port access, robotic assistance, and natural orifice access for both the surgery and/or extraction will await the test of time. However, it is clear now that laparoscopic colorectal surgery is the new standard of care and a key enabler of enhanced recovery programs.

Keywords

- ▶ laparoscopy
- ▶ adoption
- ▶ enhanced recovery

The Beginning: Fit and Start

The era of advanced laparoscopic surgery began with the structured and successful management of gallbladder disease and acute appendicitis. Based on these technical adaptations, pioneers in minimally invasive surgery rapidly moved to management of colorectal pathology. One of the earliest series was reported by Jacobs et al and demonstrated successful disease management of 20 patients with a variety of colorectal pathology.¹ The data demonstrated, in the pre-ERAS generation, that patients were able to tolerate a liquid diet on the first postoperative day and 70% were discharged within 96 hours of eating a regular diet. This was very different than the typical postcolectomy recovery of 2 to 3 days of NPO status and a length of stay of 7 to 10 days during the same era.² Jansen reported on 12 laparoscopic colectomies and confirmed the starting point of any new surgical technology describing the procedure as “safe and feasible,” with the caveat of a longer operative time and a substantial learning curve.³ Phillips et al contributed an additional 51 laparoscopic colectomies confirming the obvious benefits of the technique compared with open colectomy

with a 22% conversion rate with an average operative time of 2.3 hours and a length of stay of 4.6 days.⁴ The tipping point for laparoscopic colorectal surgery was arguably the multicenter retrospective study which independently reviewed outcomes and replicated the early benefits of the technique: (1) acceptable morbidity and mortality (24 and 0%, respectively); (2) adequate lymph node retrieval; and (3) a reduced length of stay compared with converted or open case.⁵ These early benefits accrued despite the obvious need for procedural improvement as evidenced by a 44% conversion rate, albeit with similar total costs.⁵

The early excitement related to adoption of laparoscopic colectomy was tempered by reports of trocar or extraction site tumor implantations which were considered unique compared with wound implantations with open colectomy for cancer.^{6–8} In fact, Cirocco et al reported the fourth case of colorectal port site recurrences and strongly recommended that laparoscopic colectomy for cancer be restricted to controlled clinical trials.⁸ Subsequent analysis of larger datasets for both open and laparoscopic colorectal cancer resections ultimately confirmed that the risk of port site/incisional implantation was approximately 1% and related both to

tumor biology and to some degree intraoperative skills rather than an inherent risk of laparoscopy.^{9–11} Despite the more rational assessment of the data, the concerns had already driven several groups to implement a structured comparison of laparoscopic versus open management of colorectal cancer. The conversion to laparoscopic surgery was a highly disruptive technology which required an incredible paradigm shift in operative skills needed for mastery. There were a few mechanisms available for the significant training required for safe and effective surgery by practicing surgeons let alone trainees. The completely novel surgical skills required were very threatening to high volume colon surgeons who typically performed few if any “easy” laparoscopic procedures or high volume laparoscopic surgeons who performed relatively few colectomies. Retrospectively, the profession can be comforted by the fact that minimally invasive techniques were maximally beneficial and safely and methodically adopted.

A Pause with a Cause

As the debate over oncologic equipoise awaited the completion of a variety of prospective randomized trials and large single-center assessments, the field continued to improvise with refinements in technique and outcome assessments. Debate raged between lateral to medial and medial to lateral proponents for dissection of the colon and mesocolon.^{12–17} The debate also included assessments of the relative benefits of intracorporeal anastomosis, smaller extraction sites, and even transanal extraction of the specimen to avoid any significant abdominal wounds.^{18–21}

Several authors assessed the concept of “learning curve” with this novel set of operative skills compared with the traditional open surgical training experienced by both the faculty and trainee surgeons in the 1990s. Groups advocated novel patient positioning compared with open surgery which allowed for “airplaning positional changes” or better use of gravity for management of the viscera.^{22–24} There was also early assessment of potentially enabling techniques, such as intraoperative colonoscopy and lighted ureteral catheters.^{25,26} Many of these potential enablers for laparoscopic colectomy were ultimately abandoned with improved laparoscopic instrumentation, energy devices, and clinical experience. While each group adopted specific nuances to their laparoscopic procedures, the range of cases was reported to be 11 to 60 before consistent operative times were achieved.^{27–31} These improvements also included clinically relevant short-term outcome measures, such as conversion rates, length of stay, morbidity, and mortality.^{32–34} Experienced groups were able to achieve similar operative times when compared with open surgery and conversion rates appeared to level off at approximately 10% with fairly liberal indications for laparoscopic colectomy. Even relatively early in the adoption of laparoscopic colectomy, several groups demonstrated consistent decreases in complications, length of stay, and, therefore, the cost of surgery with a laparoscopic versus open technique. Eventually, standardization of equipment and process led to consistent outcomes with laparoscopic colectomy.^{17,32–34} Ultimately, the body of literature

demonstrated that strict adherence to the basic surgical tenets of accurate tissue plane dissection, expeditious surgery, and wound minimization was a consistent advantage to our patients.

Hand-assisted laparoscopic surgery (HALS) was advocated as a means of increasing the adoption of laparoscopic colectomy and reducing the learning curve.^{35,36} HALS was also proposed as a means of returning tactile sensation which was perceived as the primary reason why standard laparoscopy was considered extremely challenging and time-consuming. There was also concern that the lack of tactile feedback was associated with increased intraoperative and postoperative complications. However, data on adoption of HALS demonstrated a similar learning curve as was previously discussed with laparoscopic techniques, with approximately 50 cases required for time stabilization with maintenance of clinical quality.³⁷ The same authors reported similar operative times (122 and 126 minutes), postoperative morbidity (30%), length of stay (5 days), or 30-day hospital readmission (16 and 11%) with HALS versus conventional laparoscopic right colectomy.³⁸ However, these results were not equivalent to other large published experiences of standard laparoscopy, and no follow-up of hand port incisional complications was provided. Kang et al reported a learning curve of 20 cases, again consistent with the earlier standard laparoscopic surgery.³⁹ Cima et al reviewed the initial 3-year period of adoption of HALS and reported an increased rate of left-sided and total colectomies (24–44%) but a clinically inconsequential reduction in operating time (258 vs. 242 minutes), and a 1 day longer length of stay when HALS was compared with laparoscopic colectomy.⁴⁰ Marcello et al performed a multicenter comparison of HALS versus laparoscopic sigmoid/left and total colectomy which demonstrated a mean reduction of 33 minutes in time for a sigmoid colectomy and approximately a 1 hour benefit for total colectomy.⁴¹ There was also a benefit in terms of conversion in favor of HALS (2 vs. 12.5%). More recent data comparing HALS to open colectomy have shown similar oncologic outcomes but less convincing short-term benefits, including length of stay which has been a consistent advantage of laparoscopic colectomy since its inception.^{42,43} In addition, data are noticeably absent with regard to the hernia rate associated with the hand port device. This issue is of particular concern given the report by Cobb et al who described a 10.6% hernia rate at 1 year.⁴⁴ Greater assessment of this potential long-term complication of HALS should be considered. As a result, while HALS is still advocated by some surgeons in certain circumstances, the body of data would support the use of standard laparoscopic techniques for the majority of elective segmental colectomies.

The Cancer Trials and the Tipping Point

Because of the concerns related to oncologic equivalence, especially related to trocar/extraction site recurrences, widespread adoption of laparoscopic colectomy was dramatically delayed compared with other advanced laparoscopic procedures. However, once the universally positive results appeared confirming excellent outcomes with laparoscopic

resection, the proscriptions related to limiting the procedure to clinical studies were removed for all surgeons.^{45–50} It was important to confirm that there were no significant differences in terms of overall survival, disease-free survival, and local and distant recurrence. Wound/port-site recurrence rates were also confirmed to be similar.

Following the widespread exposure of this literature to the colorectal surgical community, there was a significant increase in the adoption of laparoscopic colorectal resections for benign and malignant disease. An assessment of The Nationwide Inpatient Database demonstrated that the rate of laparoscopic colectomy was 2.2% (878/38,264) for 1996, 2.7% (1,175/42,166) for 2000, 5% (2,336/44,817) for 2004, 15% (7,548/42,903) for 2008, and 31.4% (14,610/31,888) for 2009.⁴⁷ The authors identified a noticeable change in the growth rate of laparoscopic partial colectomies after 2004, which coincided with the initial positive reports from trials involving colon cancer, and a probable tipping point after 2008.⁴⁷ Patel et al reviewed colectomy volumes in California in 2009 based on individual institutional colectomy volume status, and identified three tiers of institutional adoption based upon laparoscopic to total colectomy ratio: (1) low (0–17 cases/year) with a ratio of 0.32; (2) medium (18–50 cases/year) with a ratio of 0.50; and (3) high (> 50 cases/year) with a ratio of 0.92.⁵¹ Similarly, the SCOAP group found that the use of laparoscopic procedures increased from 23.3% in the 4th quarter of 2005 to 41.6% in the 4th quarter of 2010.⁵² Interestingly, hospitals where laparoscopy was most commonly used also had a substantial increase in the volume of all types of colon surgery (202 cases per hospital in 2010 from 112 cases per hospital in 2006, an 80.4% increase).

The Future

The journey of moving from open to laparoscopic colectomy was one of the major transformations in the delivery of surgical care. It required adoption of completely new ways of visualizing the operative field and guiding the surgical instrumentation for an excellent clinical outcome. During the transition, the profession took measured approaches to assessing new technology, adopted true enabling resources, and generally abandoned less efficient tools. The care plan for colectomy was also brought into question and resulted in a new approach to the perioperative care of both minimally invasive and open colectomy patients.

Further work is required to assess the true benefits of new concepts, such as single port versus multiport laparoscopy, robotic-assisted versus standard laparoscopy, and ultimately natural orifice access approaches. We need to be sure that we provide clear and important benefits in the context of increasing socioeconomic pressures on surgery. I am confident that we will continue to focus on our patients and the successful management of their clinical problems as we assess these new technologies in the face of current outcomes. As the old saying from George Santyana goes, “Those who cannot remember the past are condemned to repeat it.”

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